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Index to Volume 25

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INDEX TO VOLUME 25

JULY to DECEMBER, 1913

NOTE.—Figures in page columns refer to the continuous paging of this volume, except in the department of the index devoted to "Contracts," in which the figure in the first column denotes the number of the issue in the volume (26 issues in all), and the second number denotes the page in that issue. As an example, "Addition to Factory, Vancouver.....6, 82," indicates page 82 of issue No. 6.

AUTHORS.

	PAGE
*Abbot, Col. Frederick V.	714
Abbott, W. H.	791
Andrews, H. C.	589
Andrews, Dr W. W.	154
Baar, Armand	567
Barlow, James E.	343
Binnie, Sir Alexander R.	292
Blanchard, Arthur H.	287
Bowman, William Law.	860
Brown, Prof. E.	904
Burns, David (obituary)	292
Busfield, J. L.	791
Casey, W. A.	292
Campbell, R. H.	331
Challis, J. B.	292
Chase, E. Sherman	421
*Christie, A. G. 165, *206, *229	
*Clark, Geo. T.	523
Clements, E. S.	160
*Conard, William R.	294
Cowan, H. W.	533
Cowan, H. W.	247
Crabtree, James	402
Crosby, W. W. 127,	177
*Darling, E. H.	411
DeVarona, I. M.	211
Dixon, F. M.	270
Eddy, H. T.	682
Ellis, J. Russell	358
*Elmont, V. J. *361, 682,	778
*Elmont, V. J.	873
Elmont, V. J.	906
*Findlay, D. C.	156
Fowler, Gilbert J.	556
Francis, Walter J.	685
*Fraser, Alan, B.A.Sc.	779
Fuller, Myron L.	375
*Gandolfo, J. H.	343
Gifford, Byron T.	441
Gillette, Halbert P.	630
Gillespie, Peter	180
Goodday, Leonard *297,	*429
Grant, Lawford	292
Greig, J. M. M. *261,	*575
Gregory, John	491
Gullan, Hector F.	398
Hauer, Daniel J.	672
Hausen, Paul	583
Hirst, A. R.	559
Hocken, Mayor H. C.	186
*Hogg, T. H.	695
Hogg, T. H.	905
Hubert, Professor H.	635
Hubbell, E. W.	303
Hudson, Joseph G. S.	295
Inglis, M. M.	139
Johnson, A. N.	707
Johnson, A. N.	908
Johnson, George A. 292,	313
*Keele, J.	844
Kirsehbraun, Lester	801
Kirwan, Gerald L.	137
Kribs, Gordon 133,	*823
Laing, A. T.	180
Law, Leroy M. 738,	838
Lawler, G. S.	170
Lee, Thomas B.	151
Lewis, John H.	439
*Loudon, T. R.	627
Lovelace, E. S. M.	631
Macallum, A. F. 407,	565
Macdonald, J. A.	874
*Macdonald, J. A.	896
Macdonald, J. A.	
.... 183, *284, 395, 497, *727,	*810
Malek, J. R.	709
Magrath, Charles A.	292
Marrs, C. H.	101
*Marshall, Robt. J.	545
*Mackenzie, H. R.	238
MacGregor, J. Grant	293
Macpherson, Fred. L. 197,	333
Macpherson, Fred. L.	857
McLean, W. A.	292
Meade, Richard K.	203
*Milner, B. B.	330
Mumford, E. Moore	556
*Murray, W. P.	268
Norris, George L.	849
Oliver, J. A.	267
Orten Boving, Jens	877
Page, Logan Waller	740
*Pannell, Ernest V.	831
Paton, M. J.	292
Phillips, E. P. A.	292
Porter, Horace C.	880
Potter, Alexander *171, *623,	808
*Pratley, P. L.	351
*Priestman, Gerald	720
Pullar, H. B. 264,	703
Rankin, A. M.	292
Ransom, William	899
Redway, W. E.	842
Rice, Geo. S.	248
Richardson, Clifford	872
Robins, S. J.	292
Rogers, Hon. Frank F.	705
Seurot, Paul	622
Shenton, H. C. H.	249
*Sinclair, Robert B.	538
Spackman, Henry S.	215
Spencer, Wm. B.	493
Stevens, Col. Edmund A.	568
Sterilization Company	808
Storrie, Wm.	292
Stuart, James L.	648
Swain, Dr. George Fillmore	119
Tillson, Geo. W.	217
Townsend, Col. C. McD.	299
Trautschold, Reginald *345, *389, *526, *585, *665, *736,	*814
*Trautschold, Reginald	866
Turner, C. A. P.	777
Turner, C. A. P.	906
Tyrrell, H. G.	371
Van Emon, B. C.	890
Van Ornum, S. J.	235
*Wentworth, C. A.	887
White, Linn	272
Woolson, Ira H.	112
*Worthington, A. N.	554
Wynne-Roberts, R. O. 152, 318, *363, 619,	644
Yorath, Christopher J.	377
Young, C. R.	776
Young, C. R.	905

EDITORIAL.

	PAGE
Aqueduct, Ottawa's Proposed	711
Canadian Engineers and Road Conventions	532
Canadian Society, Agitation for Provincial Divisions of the	651
Canadian Oil Resources	562
Centralized Road Board Advocated for Canada	502
Chemistry in Engineering	591
Circular Conduits, Water Pressures in Large	711
Clay in Concrete	437
Coal Resources of the World	438
Conduits, Water Pressures in Large Circular	711
Commission Without an Engineer, A	839
Commission Control of Ontario Water-Powers	562
Conventions, Canadian Engineers and Road	532
Concrete, Fire-Resisting	776
Concrete Construction	622
Concrete, Clay in	437
Construction Camps, Preservation of Health in	681
Corrosion of Water Pipes, The	903
Electrical Illumination, Advance in	213
English For Engineers	342
Engineer and Employer, Municipal	341
Engineer and the Language	118
Engineer as an Expert Witness, The	775
Engineer, A Commission Without An	839
Engineers as Citizens	807
Engineers and Literature	182
Engineering Work, Geology in	437
Exhibitions of British Goods in Canada	149
Fees, Ottawa's Water Project and Engineering	871
Fire-Resisting Concrete	776
Fire Regulations for Railways, Revised	214
Fixed Carbon Test, The	808
Geology in Engineering Work	437
Hamilton's Railway Problem	213
Health in Construction Camps, Preservation of	681
Highways Urged by Counties, Permanent	743
Highway Commission at Belleville, The	712
"In Honor of the Dean"	839
Inter-Attrition Theory of Road Wear, The	181
International Highways	621
International Geological Congress, The	278
Lake of the Woods Water Level	277
Lake Erie, To Raise the Level of	117
Language, Engineer and the	118
Literature, Engineers and	182
Mathematics as an Engineering Study	621
Municipal Engineers, Re Proposed Canadian Institution of	532
Municipal Engineer and Employer	341
Municipal Engineering and Public Health	373
Municipal Control of Public Utilities	744
Municipal Engineers, Organization Among	373
Municipal Engineers, An Institution for	149
Oil Resources, Canadian	562
Oil Wells, Water in	775
Ontario's Ten-Million-Dollar Roads	591

*Illustrated.

PAGE

Organization Among Municipal Engineers 373
Ottawa's Proposed Aqueduct..... 711
Ottawa's Water Project and Engineering Fees 871
Patents and the Engineer..... 278
Paving "Determinator," The..... 651
Pavement, Points in Choosing a.. 501
Permanent Highways Urged by Counties 743
Points in Choosing a Pavement.. 501
Pollution of International Waterways 903
Pollution of the Niagara and Detroit Rivers, The..... 277
Preservation of Health in Construction Camps 681
Provincial Divisions of the Canadian Society, Agitation..... 651
Proposed Canadian Institution of Municipal Engineers, The..... 532
Public Utilities, Municipal Control of 744
Public Health, Municipal Engineering and 373
Reports From Municipal Engineers 309
Road Wear, The Inter-Attrition Theory of 181
Road Improvement, The Views of the People on..... 681
Road Board Advocated for Canada, A Centralized 502
Roads, Ontario's Ten-Million-Dollar 591
Roads in Ontario, Provincial..... 277
Sewage Disposal, Stream Flow in. 561
Shipbuilding, Steel for Canadian. 502
Steel for Canadian Shipbuilding.. 502
Stream Flow in Sewage Disposal. 561
Strength of Concrete, Wet vs. Dry 309
Training, The Value of Engineering 531
Tunnel Under the English Channel, A 438
Value of Engineering Training, The 531
Views of the People on Road Improvement, The 681
Water in Oil Wells..... 775
Water Level, Lake of the Woods.. 277
Water Pipes, Corrosion of..... 904
Water Pressure in Large Circular Conduits 711
Water-Powers, Commission Control of Ontario 562
Water Project and Engineering Fees, Ottawa's 871
Waterways, Pollution of International 903
Water Waste in Cities..... 743

LEADING ARTICLES.

*Abutments, Some Notes on High Railway 779
*Abutment, The Design of a Reinforced Concrete 238
Action of Salts in Alkali and Sea Water on Cements..... 233
Action of Various Substances on Mortar 203
*Adoption of Fuel Oil, The..... 731
Air and Water Purification by Ozone 271
*Air Pump, The Rotary Type.... 817
Allowable Heights and Areas for Factory Buildings 112
American Good Roads Congress, Philadelphia, Programme of.... 537
American Road Builders' Association Convention 744
American Road Congress..... 489
American Manufacture of Diesel Engines 821
American Municipalities, League of 374
American Road Builders' Association, Convention of..... 907
American Road Congress in Detroit 225
Am. Soc. C. E., Previous Convention in Canada of..... 151
Analysis of Coals..... 611
*Aqueduct, The Winnipeg-Shoal Lake 605
Arch Bridge at Saskatoon..... 881
*Armstrong, Whitworth's New Canadian Plant 848
Asphalt Specifications, Toronto... 837
Asphaltic Concrete as a Paving Material 272
Autoclave Tests for Cement, The Efficiency of the..... 444
*Automatic Railways 814
Bacteria Bed, Functions of the Non-Bacterial Population of the 402
*Barge for Nelson, B.C., Canadian Pacific Railway 372
*Barges Propelled With Producer Gas Engines 381
*Belt Conveyers (Part II)..... 526
"Bending Moments in Flat Slabs," Discussion of..... 682
Bending Moments in Flat Slabs.. 485
Binnie Contract 873
Bituminous Concrete Pavements... 493
*Boucanne River Viaduct, The.... 350
*Breakwaters to Withstand Wave Action, Cross Sections of..... 714
Brick for Country Roads..... 733
Brick Road Construction, Essential Features in Good..... 600
*Brick Construction, Points in Brick and 545
*Bridge Construction at Newcastle, N.B. 887
Bridge at Saskatoon, Arch..... 881
*Bridge, The Saskatoon Traffic... 551
*Bridge, Statical Analysis of Reinforced Concrete Arch..... 746
*Bridge, Fort William, Kaministiquia River 516
Bridges, The Determination of Internal Temperature Range in Concrete Arch 329
*Bridge at Mud Lake, Ontario, Foundation Work on C.P.R..... 339
Bridges, Typical Specifications for Steel Highway 424
Bridge Floors Replaced With Concrete 141
*Bridge With Suspended Roadway in Reinforced Concrete, A 150-Foot Arch 361
*Bridge Over the St. Lawrence River at Lachine, The Canadian Pacific Railway 268
*Bridge at Lytton, B.C., New Highway 187
British Columbia Engineer, The.. 639
British Columbia, Progress in the Investigation of the Water-Powers of 435
British Road Board, The..... 490
*Bucket Elevators 585
*Bucket Ladder Excavators for Canal Construction 380
*Bucket Carriers, Handling Materials by 665
Business Methods in Construction Work 648
Canadian Canal Traffic in 1913... 910
Canada's Projects of Waterway Improvement 899
Canadian Society of Civil Engineers, Proposed Change in the By-laws of the..... 640
Canal Traffic in 1913, Canadian... 910
Carbon Test, Value of the Fixed. 703
Carbon Test, Fixed..... 780
Canadian Public Health Association Convention at Regina, September 18, 19 and 20..... 592
*Canadian Electric Steel Furnace, A 627
*Canadian Locomotive Company's New Plant, The..... 529
Calcutta Electric Supply Company, The Power Plant of the..... 433
*Canadian Pacific Railway Barge for Nelson, B.C..... 372
*Canal Construction, Bucket Ladder Excavators for..... 380
Canadian Institution of Municipal Engineers, A Plea for a..... 151
*Canadian Pacific Railway Bridge Over the St. Lawrence River at Lachine, The 268
*Canal, The New Welland Ship... 325
Carbon Limitation, Fixed..... 872
Castings, Semi-Steel 902
"Circular Pipes," Re "Stresses in" 904
Cement for Concrete, Amount of.. 205
Cement at Collieries Use of..... 491
Cement in Egypt..... 578
Cement Manufacture in Canada.. 702
Cement Production From Raw Materials 372
Cement, Some Tests of Caked.... 828
Cement, The Efficiency of the Autoclave Tests for..... 444
*Central Heating Systems, The Design of 165, 206, 229
Census in Massachusetts, Traffic... 578
Channel Tunnel Controversy, Some Phases of the..... 701
Chemical and Biological Effect of Water Filtration, The..... 533
City Forces, Piece-Work System Applied to 366
*Clays, Field Examination and Testing of 844
Clay Products, Structural Materials and 851
*Cleaning Producer Gas, A New Process of 864
Coal and of the Process of Combustion, The Oxidation of..... 880
Coal Testing Plant for the Saskatchewan Government 448
*Coal Gas Plants, The Design of Medium-Sized 824
Coal Production in British Columbia 308
Coal Fields, The Sydney..... 295
*Coleman Township Roads for Seasons 1909, 1910, 1911, 1912, Distribution of Expenditures on 434
*Co-Ordinates, Protracting Railway Traverses by the Method of 896
Consulting Engineer and the Municipal Engineer, The..... 249
Construction Work, Business Methods in 648
Concrete Road Construction..... 908
Concrete Roads, Cost of..... 901
Concrete, Salt in 870
"Concrete Roads," Discussion on. 707
Concrete Masonry in Highway Bridges, Specifications for..... 610
Concrete Arch Bridges, The Determination of Internal Temperature Range in..... 329
Concrete Roads in Wayne County, Mich. 553
*Concrete Dam Construction Near Trenton, Ontario..... 443
Concrete, Waterproofing of..... 393
Concrete as a Paving Material, Asphaltic 272
Concrete Roads 705
*Concrete Construction at Fort William, Ont., Speedy Reinforced 773
Congress, Road Resolutions Adopted by the 1913..... 189
Contracts, Public Construction.... 237
*Conveyers, Spiral or Screw..... 389
*Conveyers, Suction 866
Convention—American Road Builders' Association 744
Corrosion of Pipes by Raw and Treated Waters, The..... 799

*Illustrated.

	PAGE
Cost of Operating Electric Trucks	713
Cooling Gas Engines, New Method of	541
Corrosion of Water Mains, The	899
Cost of Concrete Road	901
Cost, Road Maintenance and	398
Costs in Road and Pavement Work, A Few Comparative	333
Cost of Generating Power With Diesel Oil Engines, The	133
C.P.R. Electrification	216
Cross Ties, Panama Railroad	735
*Cross-Sections of Breakwaters to Withstand Wave Action	711
*Cross Section of the Mount Royal Tunnel, The	148
Cuts in Newly-Paved Streets	343
*Dam of the Ottawa River Storage System, The Timiskaming	810
*Departure From Common Practice in Sewage Disposal	623
Destruction of Garbage by Incineration	589
Design of Sewerage Systems and Disposal Works, New Jersey Regulations for the	518
*Design and Graphic Method for Calculating a Steel Truss	297
*Design of Medium-Sized Coal Gas Plants, The	824
Design of Sewerage Systems, Important Factors in the	669
*Design of Central Heating Stations, The 165, 206,	229
*Design, Utility and Attractiveness in Economic Reservoir	171
*Design of a Reinforced Concrete Abutment, The	238
*Design for the Foundation of 150 Ton Shear Legs	429
*Design of Footings in Reinforced Concrete	551
Development of Sewage Disposal Practice, The	421
Diesel Oil Engines, The Cost of Generating Power With	133
Diesel Engines, American Manufacture of	821
Discussion of "Bending Moments in Flat Slabs"	682
Discussion on "Concrete Roads"	707
*Discussion on "Stresses in Circular Pipes"	873
*Dinner in Honor of Dean Galbraith, A	847
*Dominion Iron and Steel Company, Limited, The Wire and Nail Mills of the	416
*Dominion Iron and Steel Company, Limited, The Rod and Merchant Mills of the	251
Drainage as Affecting Highway Traffic	310
Drain Tile, Reinforced Cement	414
Drinking Water, The Elimination of Taste in Treated	114
Ductility, Paraffine Scale and	838
Ductility of Electric Furnace Steels, Effect of Heat Treatment on the Strength and	890
"Duke of Connaught" Tolls	550
Earthwork, Methods of Handling Light	368
Economies of Central Station Heating	441
Economic Possibilities of the Overshot Water Wheel, The	279
Effect of High Pressures	745
Effect of Drilled Holes on Strength of Structural Steel, The	809
Effect of Heat Treatment on the Strength and Ductility of Electric Furnace Steels	890
*Effect Upon Design in Reinforced Concrete of Alterations in the Modular Ratio, The	652
Electric Railway Convention in Atlantic City	517
Electric Trucks, Cost of Operating	713
Electric Furnaces, With Special Reference to an Induction Furnace, Notes on	750
Electric Iron Smelting	877
Electric Welding for Track Repairs	570
*Electric Steel Furnace, A Canadian	627
Electric Drive in Machine Shops	612
Electric Resistance of Magnetized Graphite	418
*Electric Locomotives for Mount Royal Tunnel	796
Electrical Energy for Smaller Towns, The Generation of	139
*Electrification of the Lötschberg Railway	641
Electrification of Mount Royal Tunnel	571
Electric Furnace Steels, Effect of Heat Treatment on the Strength and Ductility of	890
Elevator, Restoring the Transcona	730
Elevators, Bucket	585
Elevators; Their Uses and Abuses. Emergency Stop-Log Apparatus, An	890
Engineer and the Social Problems	855
Engineer and Public Health, The Municipal	119
Engineer, The British Columbia	690
Engineering as a Profession	639
Equipment, The Protection and Upkeep of Road	685
Essential Features in Good Brick Road Construction	672
Extinguishing of Fires in Oils and Volatile Liquids	600
Explosives, Bureau of Mines' Bulletin on	752
Explosions, Experimental Mine	179
Experimental Mine Explosions	449
Extent and Wear of Pavements in Canadian Cities, The	449
Factory Buildings, Allowable Heights and Areas for	503
Features of the Springfield (O.) Sewage Disposal Plant	112
*Field Examination and Testing of Clays	808
*Filtration Plant at Haileybury, Ontario, Pressure	844
Filter Specifications, Toronto	125
*Filtration at Saskatoon, Mechanical Gravity	782
Filtration Plant Extension, Concerning Toronto's	523
Filtration, The Chemical and Biological Effect of Water	247
Filtration Plant, Addition to the Toronto	533
Filtration Plant, The Site of the Montreal	184
Fineness of Cement and Rate of Hydration	222
Financing of Road Engineering, The	215
Financing of Municipal Works, The	521
Fires in Oils and Volatile Liquids, Extinguishing of	318
Fire Hazard in Turbo Generators, The	752
Fixed Carbon Test Empirical	170
Fixed Carbon Test, Value of the	738
Fixed Carbon Test	703
Fixed Carbon Depends on Crude	780
Fixed Carbon Limitation	801
Flat Slabs, Bending Moments in	872
"Flat Slabs." Re	485
"Flat Slabs." Discussion of "Bending Moments in"	906
"Flat Slabs." Further Discussion of "Bending Moments in"	682
Floods, The Control of River	776
Forest Development and Preservation	299
*Footings in Reinforced Concrete, Design of	334
Fort William, Industrial Development in	554
*Fort William, Ont., Speedy Reinforced Concrete Construction at	610
Freighters Failed to Weather Storm on the Great Lakes on November 9th, Some Points for Consideration in Discussing the Reasons Why Some of the Upper Lake	773
Further Discussion of "Bending Moments in Flat Slabs"	841
Fuel for Heavy-Oil Engines, Specifications for	776
Fuel for Locomotives, Peat Powder as	289
Fuels for Power Production, Liquid, Solid and Gaseous	344
Fuel for Heavy-Oil Engines	580
Fuel in the United Kingdom	266
*Fuel Oil, The Adoption of	493
Functions of the Non Bacterial Population of the Bacteria Bed	731
Furnace Slag, Paving Brick From	402
Furnace, Notes on Electric Furnaces, With Special Reference to an Induction	713
Garbage by Incineration, Destruction of	750
*Gas, A New Process of Cleaning Producer	589
*Gas Plants, The Design of Medium-Sized Coal	864
Gas Prospects in Western Canada, Oil and	824
Gas Engines, New Method of Cooling	563
Gas, Prevention of Waste of Flowing Oil and	541
*Generators, Waterwheel	337
*Government Elevators at Port Arthur	540
Graphite, Electric Resistance of Magnetized	558
Ground Waters for Public Supplies, Quantitative Estimation of	418
*Haileybury, Ontario, Pressure Filtration Plant at	375
*Hamilton, The Railway Situation in	125
*Handling of Materials, Mechanical	411
Handling of Idle Plant	345
Handling Light Earthwork, Methods of	713
Harbors, Sand Travel in	368
Heat Treatment on the Strength and Ductility of Electric Furnace Steels, Effect of	617
Heating, Economics of Central Station	890
Heavy-Oil Engines, Fuel for	441
High Pressures, Effect of	266
High-Pressure Spray Treatment of Road Surfaces	745
Highway Bridges, Specifications for Concrete Masonry in	280
Highway Accounting, With Special Reference to Maintenance	610
Highway Engineering in Contractors' Organization, Opportunities for	630
Highway Commission Report, 1912, Massachusetts	264
*Highway Bridge at Lytton, B.C., New	552
Highway Traffic, Drainage as Affecting	187
Hydro-Electric Installation, City of Tokyo	310
*Hydro-Electric Railway for Toronto and North-Eastern District, A Proposed Municipal	193
Hydration, Fineness of Cement and Rate of	767
*Ice Manufacture in Ottawa, Artificial	215
Important Factors in the Design of Sewerage Systems	137
	669

*Illustrated.

	PAGE
Improved Management of Water works	583
Induction Furnace, Notes on Electric Furnaces, With Special Reference to an	750
Incineration, Destruction of Garbage by	589
Increase of "Run" in Mechanical Filters	564
Increasing Complexity of Municipal Government, The	186
Industrial Development in Fort William	640
*Insulation of Joints in Pipe Lines	294
Irrigation in Oregon	439
Iron Smelting, Electric	877
Iron, The Preservation of	276
*Kaministiquia River Bridge, Fort William	516
Kaministiquia Power Company	252
*Laying Toronto's Second Intake Pipe	760
Landslides in Construction Work, Prevention of	248
League of American Municipalities	374
Legal Suggestions Respecting Road Contracts	860
*Leonard Locomotive and Car Shops of the National Transcontinental Railway at Quebec, P.Q., The	688
Liquid, Solid and Gaseous Fuels for Power Production	580
*Locomotives for Mount Royal Tunnel, Electric	796
Lock Work on the Panama Canal	618
*Long-Distance Measuring With a Stadia	183
*Lötschberg Railway, Electrification of the	641
London, Ont., Storm Sewers for	842
Lötschberg Tunnel, The	223
*Lytton, B.C., New Highway Bridge at	187
Manitoba's Log-Drag Competition	731
Macadam Roads, The Selection of Materials for	740
Macadamized Roads Constructed With Tarry, Bituminous or Asphaltic Binders	157
*Machinery and Appliances, Sewage Pumping	720
Macadam Roads and Pavements, Some Notes on	197
Macadam Road Construction, The Penetration Method in	177
Macadam Road Construction, Conclusions Regarding	108
Macadam Surfaces, Treatment of Worn-Out and Ravelled	568
Machine Shops, Electric Drive in	612
*Magnetic Meridian, Determination of the	395
Maintenance, Highway Accounting, With Special Reference to	630
Malleable Castings, Production of	813
*Materials by Bucket Carriers, Handling	665
Massachusetts Highway Commission Report, 1912	552
*Materials, Mechanical Handling of	345
McGregor Lake Scheme for Ottawa Water Supply, The Rejected	646
*Mechanical Handling of Materials	345
*Mechanical Gravity Filtration at Saskatoon	523
Mechanical Filters, Increase of "Run" in	564
Mechanical and Electrical Equipment of the Windsor Hotel, Montreal	223
Methods of Handling Light Earthwork	368
Mica Deposits in Canada	643
*Modular Ratio, The Effect Upon Design in Reinforced Concrete of Alterations in the	652
Monel Metal	328
Montreal Filtration Plant, The Site of the	222
Motor Traction, Railways and	753
Mortar, Action of Various Substances on	203
*Mount Royal Tunnel, Electric Locomotives for	796
*Mount Royal Tunnel, The Cross-Section of the	148
Mount Royal Tunnel, Electrification of	571
*Mud Lake, Ontario, Foundation Work on C.P.R. Bridge	339
Municipal Asphalt Plants Fail, Why Some	145
Municipal Control of Waterfront	267
Municipal Engineers, An Association for	247
Municipal Government, The Increasing Complexity of	186
Municipal Engineer and Public Health, The	690
Municipal Engineer, The Consulting Engineer and the	249
Municipal Water Softening	313
Municipal Works, The Financing of	318
*National Transcontinental Railway at Quebec, P.Q., The Leonard Locomotive and Car Shops of the	688
*Newcastle, N.B., Bridge Construction at	877
New Jersey Regulations for the Design of Sewerage Systems and Disposal Works	518
*New Industry for Canada	317
*New Process of Cleaning Producer Gas, A	864
*Notes on Provincial Land Surveying	727
Oil Fuel, Advantages of	244
Oil and Gas, Prevention of Waste of Flowing	337
Oil and Gas Prospects in Western Canada	563
Oil and Gas in Western Alberta	805
Oils and Volatile Liquids, Extinguishing of Fires of	752
*Ottawa River Storage System, The Timiskaming Dam of the	810
Opportunities for Highway Engineering in Contractors' Organization	264
Ottawa, Pavement Requirements in	874
*Ottawa River Storage Systems, The	284
*Ottawa Water Supply Project	595
Over-Oxidization of Steel	806
Oxy-Acetylene Torch	500
Oxidation of Coal and of the Process of Combustion, The	880
*Ozone to Water Purification, The Application of	142
Painting Structural Steel	829
Panama Railroad Cross-Ties	735
Panama Canal, Lock Work on the	618
Paraffine Scale and Ductility	838
Pavements—Report, Some European	764
Pavements, Bituminous Concrete	493
Pavements in Canadian Cities, The Extent and Wear of	503
Pavement Construction, Street and	407
Pavement Requirements in Ottawa	874
Pavement Work, A Few Comparative Costs in Road and	333
Pavements, Scientific Selection of	127
Pavement Sub Grade	235
*Pavement Test, A Remarkable	247
Paving Brick From Furnace Slag	713
Paving, Proper Inspection of Track	834
Peat Powder as Fuel for Locomotives	344
Penetration Method in Macadam Road Construction, The	177
Piece-Work System Applied to City Forces	366
Pile Foundations for Blast Furnaces, Reinforced	565
*Pipe, Laying Toronto's Second Intake	760
"Pipes," Re "Stresses in Circular"	904
*Pipes, Stresses in Circular	695
Pipes by Raw and Treated Waters, The Corrosion of	798
*"Pipes," Discussion on "Stresses in Circular"	873
Plant, Handling of Idle	713
*Plate Girder Bridge in Railway Construction	101
*Points in Brick and Brick Construction	545
Poles and Cross-Ties, 1912, in Canada, Production of	615
Pontoon Bridge, A Notable	553
*Pontoons for a Modern Floating Boathouse, Reinforced Concrete	156
*Port Arthur, Government Elevators at	558
Power Production, Liquid, Solid and Gaseous Fuels for	580
Prevention of Landslides in Construction Work	248
Prevention of Waste of Flowing Oil and Gas	337
Preparatory Treatment of Sewage —Observations and Experiments	769
Preservation of Iron, The	276
Present Methods of Testing Materials	635
Present Stage of Scientific Water Supply in America	565
Problems of the Future, Railway Transportation	293
*Producer Gas, A New Process of Cleaning	864
*Producer Gas Engines, Barges Propelled With	381
Production of Malleable Castings,	813
Production of Poles and Cross-Ties, 1912, in Canada	615
Profession, Engineering as a	685
Progress and Inspection of Surveys, Points in the	303
Proper Inspection of Track Paving	834
Proposed Change in the By-laws of the Canadian Society of Civil Engineers	640
*Proposed Municipal Hydro-Electric Railway for Toronto and North-Eastern District, A	767
Protection and Upkeep of Road Equipment, The	672
*Protracting Railway Traverses by the Method of Co-Ordinates	896
Public Construction Contracts	237
Public Health, The Municipal Engineer and	690
Pure Water in Saskatchewan by Provincial Bureau of Health, Maintenance of	225
Purification of Sewage Effluent	556
Quantitative Estimation of Ground Waters for Public Supplies	375
Radium Industry, Australia's	127
Rail Failure Statistics	487
Railway Transportation Problems of the Future	293
*Railway Special Work, Standardization of Street	674
Railways and Motor Traction	753
*Railway Plate Girder Bridges in Construction	101
Railway Tie Situation in Eastern Canada, The	160
Railway Economics	791
*Railways, Automatic	814
*Railway Abutments, Some Notes on High	779
*Railway for Toronto and North-Eastern District, A Proposed Municipal Hydro-Electric	767
Railway Cars of Steel	530
Railway Situation in Hamilton, The	411

*Illustrated.

	PAGE
Railways, Electrification of	236
*Railroad-Testing Plant, a Maintenance-of-Way Department	330
Rainfall, Winnipeg	487
*Rotary Type Air Pump, The	817
Reinforced Cement Drain Tile	414
Reinforced Concrete in Mines	270
*Reinforced Concrete Pontoons for a Modern Floating Boathouse	156
*Reinforced Concrete Arch Bridge, Statical Analysis of	746
*Reinforced Concrete Abutment, The Design of a	238
Reinforced Pile Foundations for Blast Furnaces	567
*Reinforced Concrete of Alterations in the Modular Ratio, The Effect Upon Design in	352
*Reservoir Design, Utility and Attractiveness in Economic	171
*Reservoir, Regina, The Tor Hill	363
Restoring the Transcona Elevator	730
Rejected McGregor Lake Scheme for Ottawa Water Supply, The	646
Resistance of Thick Cylinders to Rupture	580
Resistance of Steel to Wear	849
Resolutions Adopted by the 1913 Congress, Road	189
Rivers, Sanitary Survey of	709
Rivers, Sanitary Survey of	644
Rivers, Sanitary Survey of	619
Road Contracts, Legal Suggestions Respecting	860
Roads, Brick for Country	733
Roads, Concrete	705
Roads, Discussion on Concrete	707
Roads, The Selection of Materials for Macadam	740
Roads and Pavements, Some Notes on Macadam	197
Road Surfaces, High-Pressure Spray Treatment of	280
Road Oiling, An Efficient Method of	214
Road Construction, The Penetration Method in Macadam	177
Road Inspectors in New Zealand	153
Roads, Classification of Ontario	147
Road Surfaces for Various Kinds of Traffic, Suitable	135
Road and Pavement Work, A Few Comparative Costs in	333
Road Maintenance and Cost	398
Road Engineering, The Financing of	521
Road Equipment, The Protection and Upkeep of	672
Roads, The Treatment of Unsurfaced	718
Road Board, The British	490
Road Construction, Concrete	908
Road Construction, Essential Features in Good Brick	600
Road Congress, Over Fifteen Hundred at	599
Road Congress, The	182
Road Resolutions Adopted by the 1913 Congress	189
*Roads for Seasons 1909, 1910, 1911, 1912, Distribution of Expenditures on Coleman Township	434
*Roadway in Reinforced Concrete, A 150-Foot Arch-Bridge With Suspended	361
*Robb Water Tube Boiler, The	224
*Rod and Merchant Mills of the Dominion Iron and Steel Company, Limited, The	251
Royal Commission's Sewage Disposal Enquiry	548
Salt in Concrete	870
Sanitary Surveys of Rivers	709
Sand Travel in Harbors	617
Sanitary Survey of Rivers	619
Saskatoon, Arch Bridge at	881
*Saskatoon, Mechanical Gravity Filtration at	523
*Saskatoon Traffic Bridge, The	551
Saskatoon's Water and Distribution System	895
Sanitary Survey of Rivers	644
Salts in Alkali and Sea Water on Cements, Action of	233
Science in the Design of Streets	358
Scientific Selection of Pavements	127
Scientific Utilization of Natural Resources, The	154
Selection of Materials for Macadam Roads, The	740
Semi Steel Castings	902
Service Railway of the St. Lawrence Pulp and Lumber Corporation, Pabos Mills, Gaspé, P.Q.	631
Sewage Disposal Practice, The Development of	121
*Sewage Pumping Machinery and Appliances	720
Sewage Effluent, Purification of	556
Sewage Disposal Enquiry, Royal Commission's	548
*Sewage Disposal, A Departure From Common Practice in	623
Sewage—Observations and Experiments, Preparatory Treatment of	769
Sewage Disposal Plant, Features of the Springfield (O.)	808
Sewerage Systems, Important Factors in the Design of	669
Sewerage Systems and Disposal Works, New Jersey Regulations for the Design of	518
*Shear Legs, Design for the Foundation of 150-Ton	429
Sherbrooke, Que., Experiment at	881
*Shops of the National Transcontinental Railway at Quebec, P.Q., The Leonard Locomotive and Car	688
Shop Transportation Systems	370
Sidewalk Forms, Steel vs. Wooden	403
*Skip-Hoists	736
"Slabs," Re "Flat"	906
Smaller Towns, The Generation of Electrical Energy for	139
Smelting, Electric Iron	877
Some Phases of the Channel Tunnel Controversy	701
*Some Practical Examples of Provincial Land Surveying	497
Some European Pavements—Report	764
*Some Notes on High Railway Abutments	779
Specifications for Steel Highway Bridges, Typical	424
Specifications for Fuel for Heavy-Oil Engines	289
Specifications for Concrete Masonry in Highway Bridges	610
Specifications, Toronto Asphalt	837
Specifications, Toronto Filter	782
*Speedy Reinforced Concrete Construction at Fort William, Ont.	773
*Spiral or Screw Conveyers	389
Springfield (O.) Sewage Disposal Plant, Features of the	808
*Stadia, Long-Distance Measuring With a	183
*Standardization of Street Railway Special Work	674
*Stability, A Question of	342
*Statical Analysis of Reinforced Concrete Arch Bridge	746
*Steel Furnace, A Canadian Electric	627
Steel vs. Wooden Sidewalk Forms	403
Steel, Painting Structural	829
Steel to Wear, Resistance of	849
Steel, The Effect of Drilled Holes on Strength of Structural	809
Steel, Over-Oxidization of	806
Steel Production in the United States	404
Stone Production in Canada	111
*Stop-Log Apparatus, An Emergency	855
Storm Sewers for London, Ont	8
*Storage Systems, The Ottawa River	2
Strength and Ductility of Electric Furnace Steels, Effect of Heat Treatment on the	89
"Stresses in Circular Pipes," Discussion on	873
"Stresses in Circular Pipes," Re	904
Structural Steel, Painting	829
Structural Materials and Clay Products	851
Structural Steel, The Effect of Drilled Holes on Strength of	809
Streets, Cuts in Newly Paved	343
*Street Railway Special Work, Standardization of	674
Street and Pavement Construction	407
Strength of Wall and Column Footings, The	415
Streets, Science in the Design of	358
Streets, Tree-Planting on City	857
*Stresses in Circular Pipes	695
St. Lawrence Pulp and Lumber Corporation, Pabos Mills, Gaspé, P.Q., The Service Railway of the	631
Sub-Grade, Pavement	235
*Suction Conveyers	866
Surfaces for Various Kinds of Traffic, Suitable Road	135
Surveys of Rivers, Sanitary	709
*Surveying, Notes on Provincial Land	797
*Surveying, Some Practical Examples of Provincial Land	497
*Suspended Roadway in Reinforced Concrete, A 150-Foot Archbridge With	361
Swedish Water Powers and Their Utilization	614
Sydney Coal Fields, The	295
Taste in Treated Drinking Water, The Elimination of	114
Temperature Range in Concrete Arch Bridges, The Determination of Internal	329
Tensile Tests of Concrete	144
Tests of Caked Cement, Some	828
*Testing of Clays, Field Examination and	844
Testing Materials, Present Method of	635
*Testing Plant, A Maintenance-of-Way Department Railroad	330
*Timiskaming Dam of the Ottawa River Storage System, The	810
Third International Road Congress, London, 1913, The	287
Third International Road Congress, London	180
Tokyo, Hydro-Electric Installation, City of	193
*Tor Hill Reservoir, Regina	363
Toronto's Filtration Plant Extension, Concerning	247
Toronto Railway, The City of Toronto and the Acquisition of the	152
*Toronto's Second Intake Pipe, Laying	760
Toronto Filter Specifications	782
*Tunnel, Electric Locomotives for Mount Royal	796
*Tunneling, An Example of Difficult	575
Toronto Filtration Plant, Addition to the	184
Toronto Asphalt Pavements	837
Town Planning	377
Track Paving, Proper Inspection of	834
Transcona Elevator, Restoring the	730
*Transmission Line Work	831
Treatment of Unsurfaced Roads, The	718
Treatment of Worn-Out and Ravelled Macadam Surfaces	568
*Trenton, Ontario, Concrete Dam Construction Near	443
Traffic Census in Massachusetts	578

*Illustrated.

	PAGE
Traffic Suitable for Various Road Surfaces	870
Transportation Systems, Shop	370
Transit Facilities, Earnings and Investment in	243
Tree-Planting on City Streets	857
Trucks, Cost of Operating Electric	713
*Truss, Design and Graphic Method for Calculating a Steel	297
Tunnel Controversy, Some Phases of the Channel	701
Tunnel, Electrification of the Canadian Northern	622
*Tunneling	538
*Tunneling for Sewers, Notes on	261
Turbo-Generators, The Fire Hazard in	170
Use of Cement at Collieries	491
*Utility and Attractiveness in Economic Reservoir Design	171
Value of the Fixed Carbon Test	703
*Viaduct, The Boucanne River	350
Wall and Column Footings, The Strength of	415
Wants of Municipalities, Some	278
Water and Distribution System, Saskatoon's	895
Water Mains, The Corrosion of	899
Water-Powers in New Quebec	308
Water Waste Prevention in New York City	211
Water Wheel, The Economic Possibilities of the Overshot	279
Water Purification by Ozone, Air and	271
*Water Purification, The Application of Ozone to	142
Water-Powers of British Columbia, Progress in the Investigation of the	435
Water Supply for Winnipeg, A	431
Water Supply in America, Present Stage of Scientific	565
Water-Powers and Their Utilization, Swedish	614
*Water Supply Project, Ottawa	595
Waters, The Corrosion of Pipes by Raw and Treated	798
Waterproofing of Concrete	393
Waterfront, Municipal Control of	267
Waterway Improvement, Canada's Projects of	899
Waterway Structures	559
Waterworks, Improved Management of	583
*Waterwheel Generators	540
Wayne County, Mich., Concrete Roads in	553
*Welland Ship Canal, The New	325
Windsor Hotel, Montreal, Mechanical and Electrical Equipment of the	223
Winnipeg Rainfall	487
Winnipeg, A Water Supply for	431
Winnipeg-Shoal Lake Aqueduct, The	605
*Wire and Nail Mills of the Dominion Iron and Steel Company, Limited, The	416
Wood Block Pavements	217

CONTRACTS.

	PAGE
Additions to Factory, Vancouver, B.C.	6, 82
Addition to Filtration Plant, Edton, Alta.	1, 76
Additions to Selkirk Asylum, Winnipeg, Man.	4, 82
Agricultural Building, Kamloops, B.C.	3, 80
Alternators and Transformers, Ottawa, Ont.	16, 78
Alterations to Warehouse, Winnipeg, Man.	4, 82
Apparatus, Neepawa, Man.	25, 80
Apartment Block, Victoria, B.C.	13, 84
Apartment Block, Victoria, B.C.	3, 80
Apartment Block, Winnipeg, Man.	2, 78
Arch Span, Toronto, Ont.	18, 74C
Armories, Orono, Ont.	5, 80
Armories, Simcoe, Ont.	5, 80
Asphalt Pavements, Toronto, Ont.	23, 80
Bank of Ottawa Building, Prince Albert, Sask.	4, 82
Barracks, Toronto, Ont.	3, 80
Booming Ground, Victoria, B.C.	25, 84
Breakwater, Ottawa, Ont.	22, 82
Brick Building, Stratford, Ont.	14, 82
Bridge Construction, Toronto, Ont.	1, 78
Bridge, Unionville, Ont.	3, 76
Bridge, Dundas, Ont.	13, 76
Bridge, Fort George, B.C.	6, 76
Bridge, Bassano, Alta.	6, 76
Bridge, Saskatoon, Sask.	6, 78
Bridge, Ottawa, Ont.	24, 82
Bridge, Digby, N.S.	22, 80
Bridge at Covered Bridge, Fredericton, N.B.	18, 74C
Bridge, Montreal, Que.	14, 78
Bridge, Chambly Canal, Ont.	13, 76
Bridge of the Welland Canal, Ottawa, Ont.	11, 78
Bridge, Saskatoon, Sask.	5, 76
Bridges, Vancouver, B.C.	2, 80
Bridges, Ottawa, Ont.	24, 82
Bridges, Ottawa, Ont.	24, 82
Bridges, Ottawa, Ont.	24, 82
Bridges, Ottawa, Ont.	22, 80
Bridges, Edmonton, Alta.	4, 78
Building for Geodetic Survey, Ottawa, Ont.	21, 82
Building Additions, New Westminster, B.C.	13, 82
Building, Vancouver, B.C.	4, 82
Building, Vancouver, B.C.	4, 82
Building, Toronto, Ont.	4, 82
Building, Moneton, N.B.	6, 80
Building, Montreal, Que.	2, 78
Building, Winnipeg, Man.	2, 78
Building, Montreal, Que.	3, 80
Building, Collingwood, Ont.	5, 80
Building, Winnipeg, Man.	5, 82
Business Block, Edmonton, Alta.	5, 80
Business Block, Ottawa, Ont.	13, 82
Cable, Calgary, Alta.	14, 78
Cable, Winnipeg, Man.	14, 78
Cable, Toronto, Ont.	14, 78
Cable, Hamilton, Ont.	21, 80
Cables, Ottawa, Ont.	14, 78
Castings, Cast-Iron Pipes, Hydrants, Toronto, Ont.	23, 80
Castings, Toronto, Ont.	23, 82
Cement Dam, Galt, Ont.	6, 80
Club House, Medicine Hat, Alta.	4, 82
Club Building, Calgary, Alta.	13, 82
Custom Building, Ottawa, Ont.	6, 82
Coal, Saskatoon, Sask.	5, 80
Coaches, Passenger, Montreal, Que.	24, 78
College, Fort Garry, Man.	3, 78
Concrete Storehouse, Stratford, Ont.	15, 82
Conduit Main, Kingston, Ont.	24, 78
Construction of a Powder Factory, New Denver, B.C.	11, 82
Construction of Glen Arch, Montreal, Que.	17, 80
Completion of Foundation of Pump Station, Montreal, Que.	18, 74D
Concrete Tunnel, Saskatoon, Sask.	16, 80
Concrete Work, Toronto, Ont.	16, 80
Concrete Flow Line, Victoria, B.C.	19, 78
Concrete Piles, Regina, Sask.	13, 82
Concrete Piles, Toledo, Ohio	2, 78
Concrete Abutments, Saskatoon, Sask.	5, 76
Conduit, Steel, Toronto, Ont.	22, 78
Conduit Underground System, Hamilton, Ont.	10, 78
Conservatory Building, Victoria, B.C.	3, 80
Court House, Fort Francis, Ont.	5, 80
Court House and Registry Office, Temiskaming, Ont.	5, 82
Customs House, Ottawa, Ont.	1 76
Customs Building, Ottawa, Ont.	13, 82
Dam at Cedar River, Seattle, Wash.	2, 80
Damming of St. Charles River, Quebec, Que.	5, 80
Deepening Power Channel of Lake Superior Company, Sault Ste. Marie, Ont.	14, 80
Dominion Government Interior Storage Elevator, Saskatoon, Sask.	15, 82
Dredging, St. Andrew's, N.S.	4, 80
Dredging, Ottawa, Ont.	23, 80
Dredging, Oak Point, N.B.	23, 80
Dredging, Fraser River, B.C.	23, 80
Dredging, Killarney, Ont.	4, 80
Dredging, Bruce Mines, Ont.	4, 78
Dredging, Island River, B.C.	13, 80
Dredging, Rustico, P.E.I.	13, 82
Dredging, St. Stephen, N.B.	3, 80
Dredging, Ottawa, Ont.	3, 80
Dredging, Little Black River, N.B.	3, 80
Dredging, Collingwood, Ont.	3, 78
Dredging, Pitt River, B.C.	6, 80
Dredging, Chetieamp, N.S.	11, 82
Drill Hall, Maple Creek, Sask.	4, 82
Drill Hall, Madoc, Ont.	4, 82
Drill Hall, Bury, Que.	6, 80
Drill Hall, Armstrong, B.C.	5, 80
Drill Hall, Vancouver, B.C.	10, 82
Drydock, Quebec, Que.	18, 74D
Drydock, Lauzon, Que.	3, 80
Dock, Ottawa, Ont.	3, 80
Dormitory, Belleville, Ont.	5, 80
Double Track, Montreal, Que.	2, 75
Dump Scow, Ottawa, Ont.	23, 82
Electrical Equipment, Montreal, Que.	24, 80
Electrical Equipment, Montreal, Que.	24, 80
Electrical Energy, Toronto, Ont.	19, 80
Electric Installation, Ottawa, Ont.	25, 80
Electrical Work, Guelph, Ont.	22, 78
Electrical Sub-Station, Medicine Hat, Alta.	10, 82
Electricity, Toronto, Ont.	13, 78
Electrification of Mt. Royal Tunnel, Montreal, Que.	15, 76
Electrification of C.P.R. Line, Montreal, Que.	1, 75
Electric-Driven Pumping Plant, Vancouver, B.C.	15, 78
Electric Motors, Donnaconna, Que.	15, 78
Electric Motors, Abitibi, Ont.	15, 78
Elevator, Sault Ste. Marie, Ont.	3, 80
Elevator, Fort William, Ont.	1, 76
Engines, Ottawa, Ont.	21, 82
Erection of Station, Montreal, Que.	13, 76
Erection of Cable Office, North Sydney, N.S.	6, 82
Extension to Power Station, Winnipeg, Man.	3, 76
Extensions to Post Office, Lachine, Que.	6, 80
Factory, Additions to, Vancouver, B.C.	6, 82
Factory, Vancouver, B.C.	3, 80
Factory, Lethbridge, Alta.	5, 80
Feeder System, St. Vital, Man.	13, 82
Filtration Plant, Addition to, Edmonton, Alta.	1, 72
Fire Alarm System, Medicine Hat, Alta.	3, 76
Fire Station, Montreal, Que.	13, 82
Fire Hall, Edmonton, Alta.	4, 82
Floors and Fireproofing for Dominion Bank Building, Toronto, Ont.	1, 76

*Illustrated.

PAGE

Flow Line, Reinforced Concrete, Victoria, B.C. 25, 78
Foundry, Hamilton, Ont. 13, 82
Foundation for Shipbuilding Plant, Montreal, Que. 10, 82
Freight Shed, Westville, N.S. ...26, 76
Gas, London, Ont. 22, 78
Gate Valves, Winnipeg, Man. 11, 80
Gas Wells, Medicine Hat, Alta. ...2, 75
Gas Holder, Schenectady, N.Y. 3, 80
Generators, Winnipeg, Man. 10, 80
Generator, Rossland, B.C. 6, 78
Generator, Regina, Sask. 4, 78
Generators, Winnipeg, Man. 5, 76
Government Pier, Malbaie, Que. ..17, 82
Grandstand, Regina, Sask. 1, 76
Harbor Extension, Vancouver, B.C. 14, 82
Harbor Improvements, Thornbury, Ont. 26, 78
Heating of Industrial Building, Calgary, Alta. 17, 78
Heating Plant, Calgary, Alta. ...17, 78
Heating of O.A.C. Buildings, Guelph, Ont. 21, 80
Heating and Ventilating System, Winnipeg, Man. 1, 80
Heating System, Kingston, Ont. .5, 80
High-Pressure Main, Calgary, Alta. 2, 76
Hotel, Vernon, B.C. 10, 82
Hydrants, Stamford, Ont. 26, 76
Ice Piers, Ottawa, Ont. 14, 80
Improvements and Entrance at Rideau Hall, Ottawa, Ont. 1, 76
Installation of Underground Services for Parliament Buildings, Ottawa, Ont. 11,
Incinerator, Fort William, Ont. .5, 78
Intercolonial Tunnel and Harbor Halifax, N.S. 2, 75
Installation of Heating Plant, Calgary, Alta. 17, 78
Installation and Bricking in of Boilers, Winnipeg, Man. 15, 82
Installation of Telephone Train-Despatching Line, Ottawa, Ont. 23, 76
Iron and Bronze Work on Chateau McDonald, Edmonton, Alta. ...2, 76
Iron and Bronze Work on Building, Winnipeg, Man. 2, 78
Isolation Hospital, Newmarket, Ont. 14, 82
Jetty, Steveston, B.C. 6, 80
Jetties, New Westminster, B.C. ...5, 80
Launches, Vancouver, B.C. 4, 80
Lighting, Gananoque, Ont. 3, 76
Lighting Supplies, Victoria, B.C. 4, 80
Locomotives, Moncton, N.B. 22, 76
Long Marsh Drain, Windsor, Ont. 15, 78
Meurling Refuge, Montreal, Que. .1, 76
Motors and Electric Apparatus, Ottawa, Ont. 13, 78
Nassau Dam, Ottawa, Ont. 20, 82
Oil Burner for Dominion Dredge, Vancouver, B.C. 17, 82
Oil Tanker, Vancouver, B.C. 20, 84
Oil Tank Steamer, Vancouver, B.C. 20, 84
Ocean Section Halifax Terminals, Ottawa, Ont. 23, 80
Parliament Buildings, Winnipeg, Man. 3, 82
Pavilion, Edmonton, Alta. 4, 80
Pavement, St. Thomas, Ont. 5, 78
Pavement, Barrie, Ont. 5, 76
Pavement, St. John, N.B. 11, 78
Pavement, Kansas City, Mo. 10, 78
Pavement, Burlington, Ia. 6, 76
Pavement, Natrona, Pa. 6, 76
Pavement, Regina, Sask. 6, 78
Pavement, Vancouver, B.C. 6, 78
Pavements, St. Francis de Sales, Que. 13, 78
Pavement, St. John, N.B. 13, 78
Pavement, Jacksonville, Florida. .1, 78
Pavements, St. John, N.B. 2, 80
Pavements, Selma, Ala. 2, 80

PAGE

Pavement, Plairton, Pa. 3, 76
Pavement, Maplewood, Mo. 4, 78
Pavement, Barrie, Ont. 5, 76
Pavements, Springfield, Ill. 5, 78
Pavement, St. Thomas, Ont. 5, 78
Paving, Lindsay, Ont. 5, 76
Paving, Montreal, Que. 10, 78
Paving, Kingston, Ont. 11, 78
Paving, Vancouver, B.C. 11, 78
Paving Work, Vancouver, B.C. ...15, 80
Paving, South Vancouver, B.C. ...23, 80
Paving, Saanich, B.C. 1, 78
Paving, St. John, N.B. 2, 80
Paving, Brockville, Ont. 3, 76
Paving, Lindsay, Ont. 5, 76
Pier and Wharf, Ottawa, Ont. ...22, 82
Pier, Salmon River, N.B. 17, 82
Pipe, Regina, Sask. 3, 78
Piling of Sheds, Montreal, Que. .14, 80
Pipe, Fort William, Ont. 13, 78
Pipe, Fort William, Ont. 13, 78
Pipe Line, Calgary, Alta. 4, 78
Pipe, Toronto, Ont. 26, 76
Plant, Moose Jaw, Sask. 13, 82
Plant for Steel Company of Canada, Fort William, Ont. 2, 76
Plumbing for O.A.C. Buildings, Guelph, Ont. 21, 80
Plumbing, Heating and Ventilation System, Winnipeg, Man. 3, 82
Power House and Heating Plant of Parliament Buildings, Winnipeg. Man. 16, 78
Power Sub-Station, Calgary, Alta. 11, 78
Postal Station, Toronto, Ont. 4, 82
Post Office Building, Eganville, Ont. 6, 80
Police Station, Vancouver, B.C. ...4, 82
Pressure Pipes, Victoria, B.C. 10, 80
Public Building, Shelburne, Ont. .4, 82
Public Building, Preston, Ont. 4, 82
Public Building, Elmira, Ont. 4, 82
Public Building, Duncan, B.C. 4, 80
Public Building, Orillia, Ont. 1, 76
Pump, Port Arthur, Ont. 13, 82
Pump, West Toronto, Ont. 13, 84
Pump, Sarnia, Ont. 13, 80
Pumps, Caledonia, Ont. 13, 80
Pump, Toronto, Ont. 3, 76
Pumps, Montreal, Que. 3, 78
Pump, Montreal, Que. 4, 78
Pumps, Hamilton, Ont. 21, 78
Pumping Plant, Vancouver, B.C. 15, 78
Pumping Station, Port Arthur, Ont. 13, 80
Quebec Bank Building, Winnipeg, Man. 5, 82
Railroad, Ottawa, Ont. 5, 76
Railroad, Ottawa, Ont. 5, 76
Railway, Vancouver, B.C. 10, 76
Railway, Vancouver, B.C. 18, 74A
Railway, Victoria, B.C. 11, 76
Raising of Lorne Bridge, Brantford, Ont. 11, 76
Retort Buildings, Hartford, Conn. 4, 82
Rebuilding of Cathedral, Charlottetown, P.E.I. 2, 76
Repairs to Wharf, St. John, N.B. 20, 82
Reinforced Concrete Flow Line, Victoria, B.C. 23, 78
Reservoir, Winnipeg, Man. 5, 78
School, Montreal, Que. 3, 80
School, Victoria, B.C. 10, 82
School, Calgary, Alta. 3, 78
School, Medicine Hat, Alta. 2, 78
School, Victoria, B.C. 4, 82
School and Hospital, The Pas, Man. 4, 82
School, Calgary, Alta. 4, 80
School, Victoria, B.C. 2, 78
Sewer, Winnipeg, Man. 15, 78
Sewer, Windsor, Ont. 15, 78
Sewer, Outremont, Que. 15, 78
Sewer, Lindsay, Ont. 15, 78
Sewer, Toronto, Ont. 18, 74B
Sewer, Winnipeg, Man. 14, 78
Sewer Pumps, Edmonton, Alta. .1, 76
Sewer, Victoria, B.C. 3, 78

PAGE

Sewers and Water Mains, Edmonton, Alta. 4, 78
Sewers, Assiniboia, Man. 24, 78
Sewers, Montreal, Que. 16, 76
Sewers, Toronto, Ont. 16, 78
Sewers, Toronto, Ont. 23, 78
Sewers, Moncton, N.B. 13, 78
Sewage and Disposal Works, Bowmanville, Ont. 3, 78
Selkirk Asylum, Additions to, Winnipeg, Man. 4, 82
Sidewalk, Brantford, Ont. 11, 78
Sidewalk, Winnipeg, Man. 14, 80
Sidewalks, Amherst, N.S. 3, 76
Six Story Block, Saskatoon, Sask. 4, 82
....4, 82
Standpipe at Timmins, Ont., Toronto, Ont. 18, 74D
Station Building and Platform, College Bridge, N.B. 26, 76
Station, Shed and Office Building, Calgary, Alta. 22, 76
Station (Temporary), Calgary, Alta. 21, 76
Steam Boilers, Montreal, Que. 4, 78
Steamer, Vancouver, B.C. 20, 84
Steamers, Toronto, Ont. 3, 80
Steel Work for Freight Shed, Montreal, Que. 6, 80
Steel Work on Store, Regina, Sask. 2, 78
Steel Rails for Light Railway, Victoria, B.C. 20, 78
Steel Rivetted Pipe for Sooke Water Scheme, Victoria, B.C. .18, 74D
Steel Work, Brandon, Man. 15, 82
Steel for Burrard Street Viaduct, Vancouver, B.C. 2, 75
Steel Work, Fort William, Ont. ...2, 75
Steel Swing Bridge, Montreal, Que. 11, 78
Store and Office Building, Ottawa, Ont. 3, 80
Stokers, Toronto, Ont. 6, 78
Storage Tank, Toronto, Ont. 19, 88B
Storm Sewers, Wingham, Ont. 3, 78
Straightening North Transcona Elevator, Winnipeg, Man. 21, 82
Structural Steel, Montreal, Que. .14, 82
Sub-Main, Assiniboia, Man. 3, 78
Substructure of Bridge, Fredericton, N.B. 18, 74C
Substructure of Bridge, Montreal, Que. 14, 78
Substructure for Lennox Passage Bridge, Halifax, N.S. 22, 80
Substructure of Kettle Valley Bridge, Vancouver, B.C. 21, 80
Sub-Station Electric Equipment, Hamilton, Ont. 15, 78
Subway, Vancouver, B.C. 22, 80
Switching Signals, Ottawa, Ont. .20, 76
Swimming Bath, Winnipeg, Man. .5, 82
Taghun Bridge, Victoria, B.C. ...19, 80
Telephone Wire, Victoria, B.C. .23, 82
Telephone Train-Despatching Line, Installation of, Ottawa, Ont. ...23, 76
Terminal, Ottawa, Ont. 6, 76
Track for Intercolonial Railway, Ottawa, Ont. 14, 76
Transformers, Toronto, Ont. 15, 78
Tunnel Cutting, Edmonton, Alta. 6, 80
Turbine and Condensing Plant, Regina, Sask. 22, 80
Turbine Pumps, Toronto, Ont. ...21, 80
Turbines, Lindsay, Ont. 5, 78
Trunk Water Mains, Port Coquitlam, B.C. 2, 76
Triplex Power Pump, Toronto, Ont. 2, 78
Tug, Victoria, B.C. 25, 84
Valves, Stamford, Ont. 26, 76
Ventilation in O.A.C. Buildings, Guelph, Ont. 21, 80
Warehouse, Vancouver, B.C. 6, 82
Warehouse and Store, Calgary, Alta. 3, 78
Warehouse, Edmonton, Alta. 6, 80
Warehouse, Edmonton, Alta. 5, 80

*Illustrated.

PAGE

Warehouse, Alterations to, Winnipeg, Man. 4, 82
Water Wheels, Peterborough, Ont. 23, 78
Water Mains, Winnipeg, Man. ..19, 88A
Waterworks System, Port Arthur, Ont. 19, 78
Waterworks Filtration Plant, Edmonton, Alta. 11, 80
Welland Canal, Ottawa, Ont. 4, 80
Welland Canal, Section 1, Ottawa, Ont. 4, 80
Welland Canal, Section 2, Ottawa, Ont. 18, 74D
Welland Canal, Section 3, Ottawa, Ont. 10, 80
Welland Canal, Section 5, Ottawa, Ont. 22, 82
Wharf, St. John, N.B. 13, 82
Wharf, Ottawa, Ont. 14, 80
Wharf at Canoe, Ottawa, Ont. 14, 80
Wharf, St. Jean, Port Joli, Que. 23, 80
Wharf, Ottawa, Ont. 23, 80
Wharf, Ottawa, Ont. 22, 82
Wharf, Ottawa, Ont. 22, 82
Wharf, Vancouver, B.C. 22, 80
Wharf, Victoria, B.C. 10, 80
Widening of Aqueduct, Montreal, Que. 1, 76
Wire Cable, Ottawa, Ont. 10, 78
Wiring the O.A.C. Buildings, Guelph, Ont. 21, 80
Workshops, Quebec, Que. 13, 82

PERSONALS AND OBITUARIES

Adams, Dr. Frank D. 694
Adams, A. L. (ob.) 574
Andrews, H. C. 789
Armstrong, John B. 756
Armstrong, W. 260
Arnold, Bion J. 260
Aylmer, Hon. W. F. 420
Bailey, Sir William H. (ob.) 820
Barrett, Austin (ob.) 544
Beale, A. M. 634
Beck, Hon. Adam 884
Beer, A. N. 196
Bennett, E. H. 853
Billings, J. H. 452
Binnie, Sir Alexander 724
Blanchard, Arthur H. 260
Blanchard, A. D. C. 694
Blanchard, Arthur H. 228, 356, 514
Blanchard, A. H. 884
Bowden, W. A. 228
Bowring, F. T. 196
Brady, A. C. (ob.) 789
Bradley, E. F. 260
Breckon, J. T. 884
Brown, Oakley T. 420
Brown, Collingwood B. 131
Brockman, T. 228
Bruner, L. S. 356
Burnham, N. G. H. (ob.) 228
Cameron, Adam 854
Cantell, M. T. 634
Cantin, Arthur J. 324
Carscallen, Oswald Gurney (ob.) .. 820
Chace, W. G. 603
Chambers, J. L. 420
Chipman, Willis 260, 356
Clark, George T. 820
Clayton, Henry F. 356
Clement, W. A. 853
Cochrane, Hon. Frank 228
Condon, Geo. 452
Coulson, W. L. 853
Craig, Cunningham 663
Craig, J. D. 131
Creighton, F. A. 789
Creer, A. D. 574
Croft, George (ob.) 694
Cunningham, R. H. 917
Daw, Hilder 853
Deacon, T. R. 854
Diesel, Dr. Rudolph (ob.) 664
Duff, W. A. 163
Edmonds, Charles H. 356
Elmont, V. J. 485
Evans, W. A. 544
Ewart, D. 260
Finch, R. G. 420
Francis, Walter J. 663
Fuertes, J. H. 604
Gair, W. B. 574
Gardner, Obadiah 544
Gennet, C. W., Jr. 228
Gilbreth, Frank B. 756
Goad, V. A. E. 452
Gordon, Chas. B. 544
Grant, A. E. 260
Graham, R. P. D. 853
Grahame-Jones, E. (ob.) 544
Gray, L. C. 324
Griffith, J. E. 917
Grimmer, A. K. 820
Gunn, James Newton 356
Harkness, A. H. 789
Harvey, W. S. 603
Harris, R. C. 420
Harrison, James 604
Harvey, W. S. 663
Harvey, W. C. 356
Harvie, W. D. L. 884
Hastie, T. G. 634
Hazlett, John (ob.) 820
Herlihy, F. J. 574
Hogg, T. H. 884
Howard, J. T. 196
Hubbard, Prevost 514
Holmes, C. R. 634
Hubbard, Prevost 260
Hudson, J. G. S. 260
Imhoff, Dr. Carl 603
Jacobs, Francis A. 420
James, E. A. 853
Janin, Geo. A. 420
Kahn, Gustave 356
Keele, J. 514
Kribs, Gordon 853
Keefer, T. C. 694, 853
Krumbiegel, C. R. 604
Lang, J. L. 634
Lariviere, Alexander 196
Lee, Thomas B. 163
Lightfoot, Stanley 324
Look, Richard V. 260
Low, A. P. 544
MacFarlane, Alexander (ob.) 420
Manning, F. D. 452
Maclachlan, K. S. 260
McLachlan, J. S. 163
McMillan, J. G. 724
McLachlan, Donald J. (ob.) 544
McLaughlin, C. J. 756
McCullough, Dr. J. W. S. 163
McPhillips, Geo. (ob.) 789
McAlister, Fred. G. 356
McMillan, J. G. 356
Meurling, H. F. 544
Meredith, Wynn 634
Meadows, C. A. 420
Miller, Charles T. 544
Miller, W. G. 724
Mitchell, P. J. 420
Mitchell, Professor S. A. 228
Moore, Phil. H. 853
Murphy, Chas. 724
Morton, Guy H. 574
Morrison, Stephen 514
Murray, T. Aird 514
Nagato, Joro 574
New, J. H. (ob.) 228
Noble, Clarence W. 917
Nuttall, Albert 131
Oborn, Stanley M. 724
Odell, L. S. 356
Parr, F. Hill 487
Peters, F. W. 131
Peterson, P. A. (ob.) 790
Pennybacker, J. H. 604
Poensgen, Ernst 603
Porter, J. W. 789
Porter, J. 756
Power, Geo. H. 452
Preese, Sir William Henry (ob.) .. 724
Quail, H. C. 544
Randolph, Isham 452
Reid, M. A. 884
Reynolds, R. H. 604
Robertson, James Melville (ob.) .. 756
Roche, Hon. Dr. 324
Rose, Geo. G. (ob.) 604
Rundlett, Leonard W. 756
Seidl, Th. 884
Seton, B. W. 663
Service, George 756
Shaw, M. R. 820
Skammel, J. K. 884
Skinner, W. E. 820
Smith, A. D. 884
Smith, Angus 853
Stewart, J. W. 917
Storey, E. M. (ob.) 420
Streeter, Frank S. 544
Swan, Russell G. 634
Tayley, F. B. 663
Talbot, A. N. 163
Teltzel, W. F. 420
Thomas, Robert J. 163
Thomson, W. C. 196
Uniacke, R. F. 356
Wagner, D. P. 356
Watson, M. B. 452
Ward, P. W. 131
Welch, Patrick 853
Westinghouse, George 853
Weymorn, P. P. Von 820
Whittaker, E. J. 228
Whitmore, J. Darlington 131
White, Arthur V. 163
*Willson, Russell D. (ob.) 789
Willard, Wm. C. 452
Wynne-Roberts, R. O. 789

BOOK REVIEWS.

Concrete House and Its Construction 254
Conservation of Water 911
Design of Plate Girders 911
Diagrams for the Solution of the Kutter and Bazin Formulæ 659
D'Este Steam Engineers' Manual. 254
Electricity for the Farm and Home 254
Electric Interlocking 254
Elements of Specification Writing, The 509
Elementary Principles of Reinforced Concrete Construction 255
Engineering as a Profession; Scope, Training and Opportunity for Advancement 510
Gas Engines and Producers 253
General Metallurgy 786
Graphics and Structural Design 785
Highway Engineering 913
Hydraulic Turbines 659
Improvement of Rivers, The 510
Laboratory Manual of Testing Materials 660
Locomotive Boiler Construction 660
Logarithms for Beginners 253
Overhead Electric Power Transmission 785
Pocket-Book of Useful Formulæ, A 913
Railway Goods Station, The 913
Railways of Great Britain, The 911
Reinforced Concrete Construction. 660
Rivers and Estuaries 254
Simplified Formulas and Tables for Floors, Joists and Beams; Roofs, Rafters and Purlius 509
Steam Power Plant Engineering .. 658
Steel Rails 255
Switchgear and the Control of Electric Light and Power Circuits 786
Theory of the Flexure and Strength of Rectangular Flat Plates Applied to Reinforced Concrete Floor Slabs 253
Toothed Gearing 659

*Illustrated.

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Contents of this issue on page 117

The Canadian Engineer

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PLATE GIRDER BRIDGES IN RAILWAY CONSTRUCTION

PART II

CONSIDERATION OF SECTIONS OF MATERIAL—THE FRAMING OF THE VARIOUS SECTIONS—SHIPMENT AND ERECTION OF PLATE GIRDER SPANS—ADAPTABILITY OF DESIGN TO SHOP PRACTICE AND ERECTION CONDITIONS

By C. H. MARRS, C.E.

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THE first part of this article, appearing in June 26th issue, after enumerating the various advantages of plate girder construction, for example, simplicity and uniformity of construction, solidity and durability, speed in erection, and low office cost, went into the calculation of the stresses due to the loads. The methods by which the ordinary dead and live loads are obtained do not form a part of the article as the reader may refer to any authoritative text on the subject for them. Following, the various sections of material to be used in design are next in consideration.

The web plate is first determined, as its depth is already decided, and 10,000 pounds per square inch of gross section is the unit which is generally used in obtaining the required thickness of web. It may, however, be necessary in some cases, to use a thicker web than is required by this unit in order that the end shear may be transmitted to the flange angles in a length equal to the depth of the girder. This is only probable when the web is connected to the flanges by single lines of rivets and the number of rivets is, therefore, more limited.

The flanges of girders are determined, as in trusses, by dividing the total bending moment at any point by the product of the effective depth and the unit tensile stress. The difference between girders and trusses is that the flange stress varies gradually throughout the length of the girders, while in trusses it is constant between panel points. The bottom flange is usually figured at 16,000 pounds per square inch of net section, and the top flange is made the same total gross section as the bottom, with the restriction that the unsupported length of the flange must not exceed twelve times its width. This limits the spacing of floor beams and cross-brace frames.

As the centre of gravity of flanges cannot be known until the sections are determined, a great amount of time is usually wasted in assuming a centre of gravity and making approximate calculations, and this operation repeated several times until the section is finally settled. Table 1 gives a useful table for railway girders. By use of it the required flange can be determined by one calculation and the labor of figuring the net sections and centre of gravity is avoided.

The effective depth used should never be greater than the distance, back to back, of flange angles.

There is a wide diversity of opinion among engineers as to whether part of the web should be counted as flange area. For this to be so, the flanges and web must act as a solid beam and theoretically ⅙ of the gross section of web would act as flange section, but it is considered to be ⅛ on account of deduction of rivet holes.

Since the bending stresses in the web do not act at any one point, but over the total depth of the web, having a maximum intensity at the edge of the web and zero at the centre, it is very difficult to properly splice the webs to take care of these stresses. It involves a great many rivets and extra material, which, in cases of heavy girders, is worth more than the material saved in the flanges. Moreover, if the web is considered to take tension, it is good practice to plane its edges to avoid tearing, and this is additional expense.

In some cases where the web does not need to be spliced, owing to possible lengths that can be procured from the mills, there would be a saving of material and cost, to consider ⅛ of the web as flange section. But, since it is only an assumption that the girder acts as a solid beam, and since the flanges are figured the same as in trusses, it seems advisable to consider that the web resists shear only; the only difference being that the web acts continuously instead of at panel points. The top flange of deck plate girders is often made an H-shaped section of four angles and side plates. The main advantage of this section is its suitability to easy framing of the deck ties, as there are no rivets or cover plates to be taken care of. The objections to such a section are, that it is more difficult to manufacture, because extra drawings are necessary and the shop work is more expensive; this for the reason that in modern shops equipped with spacing tables, it is a big advantage to have both flanges similar. Moreover, the H-flange is not as strong to resist buckling from handling and from compression stresses, as is the more common section composed of two angles and cover plates. Hence, if it is used, the brace frames should be made with the top strut the same depth as the flange section. This is necessary because the top laterals are at the elevation of the bottom of the H-section, which is some distance below the deck, and because the web stiffener angles must break at the bottom of the H-shaped flange, which is a marked weakness.

Stiffener Angles.—These are an important factor in the strength of girders and, as their duty is not generally understood, they deserve some explanation. They may be divided into two classes, viz., those that resist concentrated loads and those which merely prevent web buckling. The end

stiffeners transmit the total end reaction to the web plate where it is converted into shearing stresses. As these stiffener angles are ground to fit the curved fillet of the flange angles, it is evident that a large part of the reaction is transmitted to the stiffeners by direct bearing of the outstanding leg on the flange angles, and it is therefore necessary to have this leg as wide as the flange angles will permit, and care should be exercised in the shop to ensure that these angles have an exact fit and true hearing. In arriving at the sections

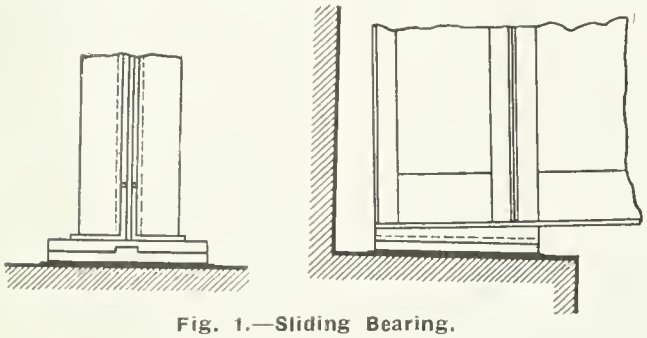


Fig. 1.—Sliding Bearing.

of end stiffeners, it is usual to consider that they act in conjunction with the filler plates, as a column of length equal to the depth of the girder, and that the end reaction produces a compression which is constant throughout the length of the column, whereas in reality, the stress diminishes from a maximum at the bottom to zero at the top. As the filler plates cannot be considered to bear on the flange angles in actual practice, the stiffener angles must take the entire stress at the break between the filler and toe of the flange angles; and it is at, or below this point, that the failure of end stiffeners would usually occur. Taking this into account, and also the fact that the bearing of the outstanding leg does not transmit all the end reaction, but that part of it will go into the other leg through bearing on the fillet and rivets at the bottom, it is a common practice to use end stiffener angles, the gross

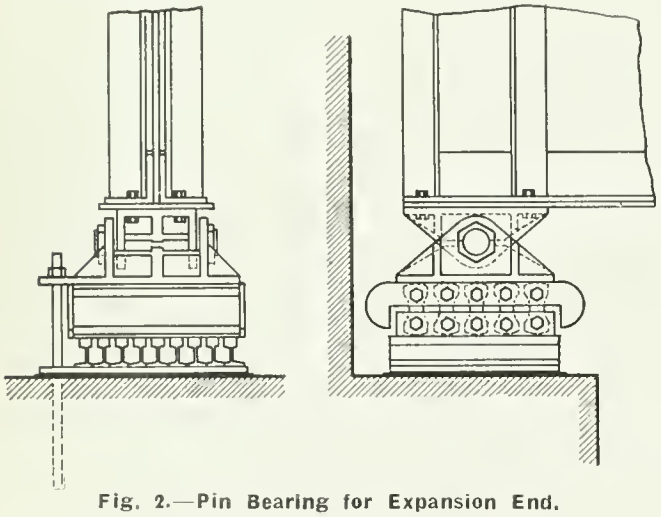


Fig. 2.—Pin Bearing for Expansion End.

section of which is considered to resist the reaction at 12,000 pounds per square inch. In addition to these considerations, the designer must use judgment in the selection of the angles, so that the outstanding leg will be thick enough to prevent its buckling near the bottom, where it is highly stressed. There should also be sufficient rivets connecting these stiffeners to the web to transmit the reaction intended.

Intermediate stiffeners which are merely intended to prevent the web plate from buckling, do not cause the designers of girders much worry, as all railroads have adopted standard sections for different depths of girders and certain limitations as to the spacing of them, but it is a satisfaction to know that their failure in actual structures has been very rare. They have been generally determined by formulae based on compression in the web plate due to shearing forces acting upon it. This seems the most reasonable method. The spacing of these intermediate stiffeners should therefore depend on the shearing stresses, and this would necessitate their being spaced closer towards the end of the girder.

Theoretically there is no reason for the intermediate stiffener angles to bear on the bottom flange, but it is always done in practice and makes a neater job. It is necessary, however, in the top flanges because it tends to prevent the outstanding leg of the flange angles from buckling and in deck girders it helps to transmit the loads from the track into the web plate.

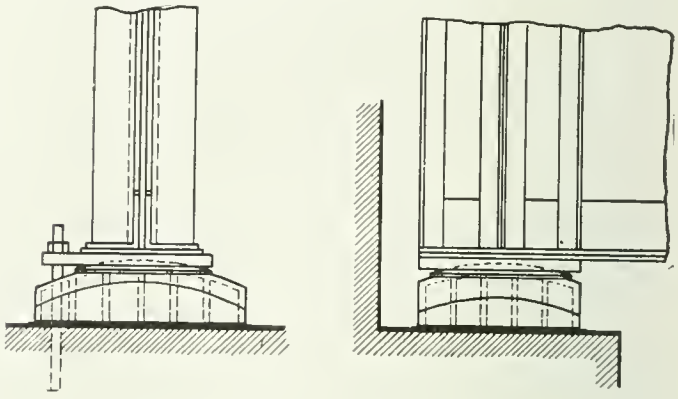


Fig. 3.—Disc Bearing for Fixed End.

Pier Members.—They are determined in area, by the unit, 400 pounds per square inch for concrete masonry. For spans up to 75 feet in length sliding masonry plates only are used, as indicated in Fig. 1, with a tongue and groove to resist side motion. The groove should be on the upper shoe plate as shown, so that dirt and water cannot lodge in it.

With this type of bearing it is advisable to consider that the stiffeners over the inside edge might have to take 75 per cent. of the total end reaction, because any deflection in the span tends to move the end reaction to this point.

For spans 75 feet long or over, pedestals are necessary to properly distribute the bearing pressure, and to adjust themselves to deflection and camber. Fig. 2 indicates the pin type which is generally used in the United States, and it may be made up of structural shapes, or cast steel. By means of the pin the bridge is securely anchored to the bottom pedestal.

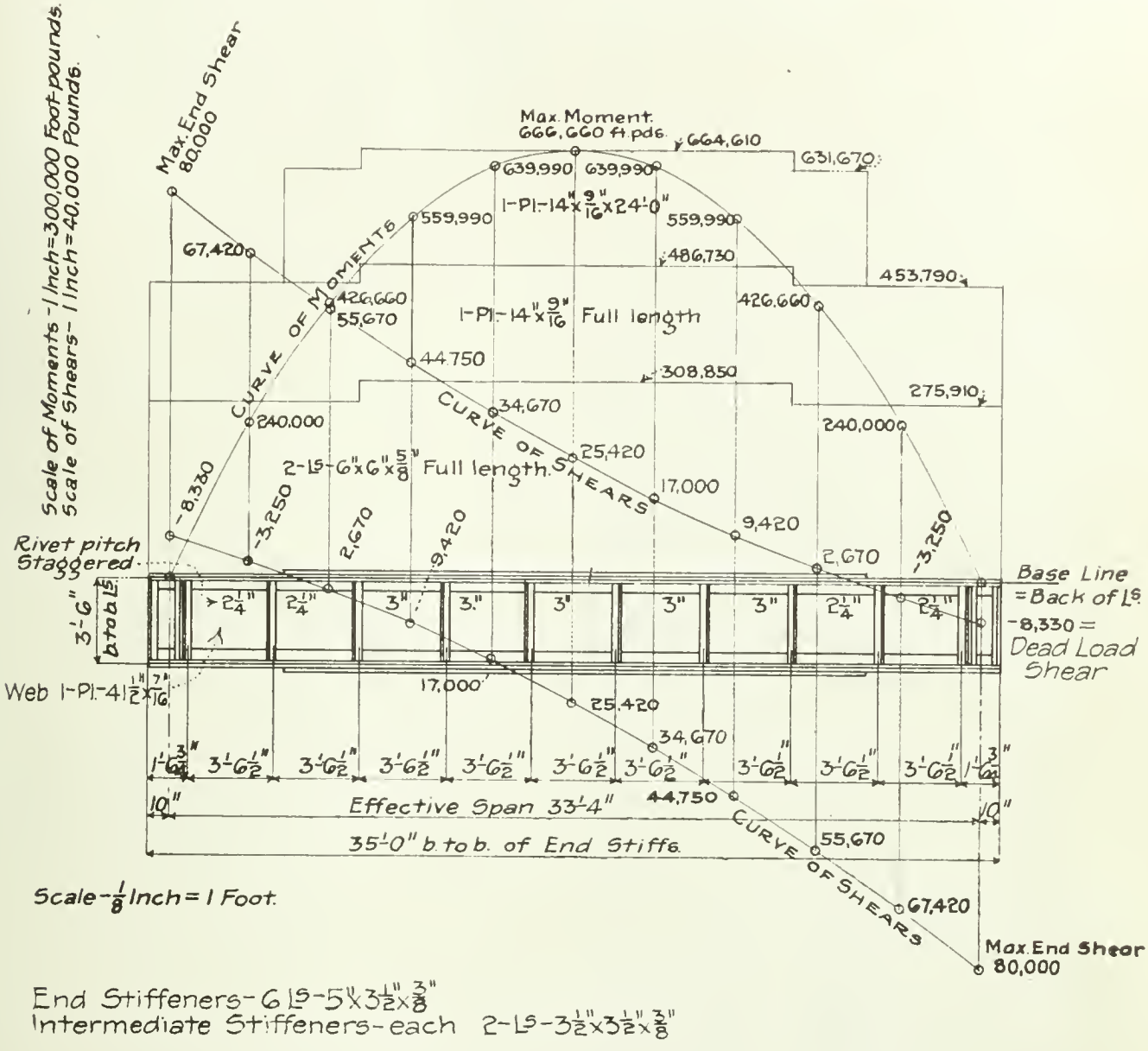
Nearly all Canadian railroads use the disc bearing, as shown in Fig. 3, and it is superior to the pin type in many ways. It is sure to have a true bearing, as it adjusts itself in all directions to suit uneven masonry and deflection in the span. It is also convenient in erection as the girders can be dropped into place with a minimum trouble in adjustment.

In the disc type most of the end reaction should he considered to enter the girder over the centre of the disc with a small proportion at each edge, while in the pin type, where the shoe is deeper, all the end stiffeners can he considered to take an equal share.

Expansion in Girders.—This condition should be provided for to the extent of one inch for each 80 feet of span, and for all spans over 75 feet in length roller nests must be used at one end. These should be constructed so that the sides may be taken off and the rollers cleaned and oiled; also in such a way that they will shut out as much dirt as possible and not hold water. Fig. 2 represents a good design

for roller nests, in which segmental rollers are indicated, the lower bearing surface being a nest of rails. The segmental rollers are convenient because they occupy a minimum space for a large diameter. The rails are important because dust will not lie under the rollers, but will fall through, affording easy removal. Bearing plates should always be made thicker, to allow for rust of ½ inch in thickness.

Stringers and Floor Beams.—These constitute the floor system in through plate girder spans. As the stringers are merely deck girders of reduced length, their design is similar. They should be made as deep as practicable, and should be riveted to the webs of the floor beams. Two lines of stringers per track is good practice, but four lines are more able to resist derailed trains, and do not require such large ties.



End Stiffeners - 6 L's - 5" x 3½" x ⅜"
Intermediate Stiffeners - each 2 - L's - 3½" x 3½" x ⅜"

Fig. 4.—Stress and Section Diagram for Deck Plate Girder.

Lateral Angles.—Usually these are made heavier than the stresses require, to ensure stiffness of the bridge. In deck spans the entire lateral forces are considered to be carried by the top laterals, through the end brace frames to the anchors, while the bottom laterals are merely considered to stiffen the bottom flanges against wind. The latter are often omitted in deck spans under 50 feet long, as the interior brace frames give sufficient stiffness to the bottom flange.

In through plate girder spans there is only one system of bracing, which necessarily carries all the lateral stresses, and the traction stresses in addition.

When rods are used as laterals, an initial stress of 10,000 pounds should be added to the other stresses to take care of the tension induced in the rods by tightening the nuts or turnbuckles.

With four lines of stringers, the common method is to assume that the inner and outer stringers take their share of the wheel loads inversely in proportior to the distance they are spaced from the rail. As a matter of fact, when the rail is midway, the inner stringer gets a greater proportion of the wheel load, because the ties are continuous beams over four supports. Some account should be taken of this.

Floor beams should also be made as deep as practicable. When the top flange is of moderate width it should be about one inch below the base of rail, so that it will support derailed trains; but when the top flange is 18 in. or 20 in. wide, it is good practice to drop it three inches below the base of rail, so that a wood strip can be placed on it to support the rail, as well as to be useful in the event of wheels passing over it.

Stress and Section Diagrams.—Such diagrams are convenient for reference on bridge plans, indicating graphically the bending moments and shears along the length of the span, and the flange and web sections which correspond. Fig. 4 shows a complete form, and needs little explanation. The two shear diagrams represent the change in web shear as the train passes over the bridge in either direction, the live load and impact shear changing, while the dead load shears remain unchanged. These curves determine the required web section and the web flange rivet spacing.

Table I.

DISTANCE OF CENTRES OF GRAVITY OF PLATE GIRDER FLANGES FROM BACK OF ANGLES

Flange Area does not include ⅛ of web
Net Area – 2-6"x6"L's 4-⅞"◆ rivets off
2-8"x8"L's 6-⅞"◆ rivets off
Cover Pls. 2-⅞"◆ rivets off

2-L's-6"x6"x⅝"				2-L's-6"x6"x11/16"			
Cover Pls	x (ins.)	Gross Area sq. ins.	Net Area sq. ins.	Cover Pls	x (ins.)	Gross Area sq. ins.	Net Area sq. ins.
None	1·73	14 22	11·72	None	1·75	15·56	12·81
14"x3/8"	1 21	19 47	16 22	14"x3/8"	1 26	20 81	17 31
14"x7/16"	1 14	20 35	16 97	14"x7/16"	1 19	21 69	18 07
14"x½"	1 07	21 22	17 72	14"x½"	1 13	22 56	18 81
14"x9/16"	1 01	22 10	18 47	14"x9/16"	1 07	23 43	19 56
14"x⅝"	95	22 97	19 22	14"x⅝"	1 01	24 31	20 31
14"x11/16"	89	23 85	19 97	14"x11/16"	95	25 18	21 06
14"x¾"	83	24 72	20 72	14"x¾"	89	26 06	21 81
14"x7/8"	73	26 47	22 22	14"x7/8"	79	27 81	23 31
14"x1"	63	28 22	23 72	14"x1"	68	29 56	24 81
14"x1⅛"	53	29 97	25 22	14"x1⅛"	59	31 31	26 31
14"x1¼"	43	31 72	26 72	14"x1¼"	49	33 06	27 81
14"x1⅜"	34	33 47	28 22	14"x1⅜"	40	34 81	29 31
14"x1½"	25	35 22	29 72	14"x1½"	31	36 56	30 81
14"x1⅝"	16	36 97	31 22	14"x1⅝"	23	38 31	32 31
14"x1¾"	08	38 72	32 72	14"x1¾"	14	40 06	33 81
14"x1⅞"	b of L's	40 47	34 20	14"x1⅞"	06	41 81	35 31
14"x2"	out	42 22	35 72	14"x2"	out	43 56	36 81
2-L's-8"x8"x11/16"				2-L's-8"x8"x¾"			
None	2 25	21 06	16 93	None	2·28	22 88	18 38
18"x3/8"	1 66	27 81	22 93	20"x1¾"	37	57 88	49 88
18"x½"	1 50	30 06	24 93	20"x1⅞"	28	60 38	52 13
18"x⅝"	1 36	32 31	26 93	20"x2"	19	62 88	54 38
18"x¾"	1 23	34 56	28 93	20"x2⅛"	11	65 38	56 63
18"x⅞"	1 10	36 81	30 93	20"x2¼"	03	67 88	58 88
18"x1"	98	39 06	32 93	20"x2⅜"	out	70 38	61 13
18"x1⅛"	87	41 31	34 93	20"x2½"	out	72 88	63 38
18"x1¼"	76	43 56	36 93	20"x2¾"	out	77 88	67 88
18"x1⅜"	66	45 81	38 93	20"x3"	out	82 88	72 38
18"x1½"	56	48 06	40 93	18"x1½"	64	49 88	42 38
18"x1⅝"	47	50 31	42 93	18"x1⅝"	55	52·13	44 38
18"x1¾"	38	52 56	44 93	18"x1¾"	46	54 38	46 38
18"x1⅞"	29	54 81	46 93	18"x1⅞"	37	56 63	48 38
18"x2"	20	57 06	48 93	18"x2"	28	58 88	50 38
18"x2⅛"	11	59 31	50 93	18"x2⅛"	19	61 13	52 38
18"x2¼"	03	61 56	52 93	18"x2¼"	10	63 38	54 38
18"x2⅜"	out	63 81	54 93	18"x2⅜"	02	65 63	56 38
18"x2½"	out	66 06	56 93	18"x2½"	out	67 88	58 38
18"x2¾"	out	70 56	60 93	18"x2¾"	out	72 38	62 38
18"x3"	out	75 06	64 93	18"x3"	out	76 88	66 38

The bending moment diagram determines the required flange areas and the length of cover plates. These plates are made to pass beyond the curve far enough to develop the strength of the plate in rivet connections. When the flange rivet spacing is less than 2½ inches, staggered, it is considered that two extra rivet holes are deducted from the net flange area, which explains the drop in the area lines shown in the diagram. Where web and flange splices are necessary this diagram is convenient for reference in getting out detail drawings.

The Design of Trough Floors.—The computation is different from that of regular plate girders, as the section is determined by their net moment of inertia, as in the case of a solid beam. When the troughs run parallel to the line of track, the axle loads are assumed to be distributed in a width of nine feet, which is the length of the ties, and this decides the amount of load carried on each trough. When the troughs run normal to the line of track, the axle load should be considered distributed over three ties of nine feet in length. A minimum thickness of 7/16 inch is recommended in trough floors to resist rust, and the surface to be covered with concrete should be left unpainted in order that the concrete will adhere better.

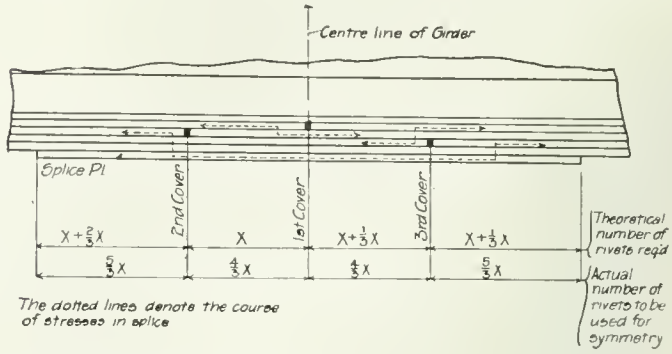


Fig. 5.—Flange Splice.

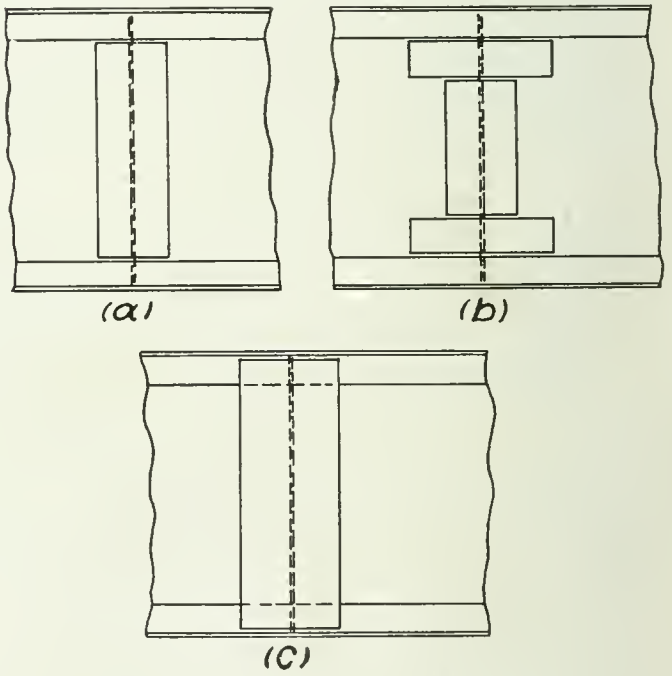


Fig. 6.—Plate Girder Web Splices.

Fabrication of Sections.—The details in connection with the framing of the various sections of a bridge may be the cause of its failure, as the strength of a structure is measured by the strength of its weakest point. It is necessary for the detailer to have an intelligent grasp of the action of stress through rivets and sections and he must keep in mind the sizes and maximum lengths of material that can be procured from the mills. He must be familiar with shop practices and erection methods, and must also consider the conditions of exposure of the bridge in actual service.

Splices should be avoided where possible, by the use of the longest angles and plates that can be obtained. Flange splices should alternate except in special field splices where it is necessary to have a compact joint. The theory connected with flange splices can be best explained by an example and the reasoning used in it can be applied in all cases. In the example shown in Fig. 5 the flange consists of two angles and four cover plates, and it is required to splice the two angles and three plates. The first cover plate breaks at the centre of the girder, and the second and third at equal distances each side of the centre. For convenience, consider the cover plates to be of equal thickness, and a splice plate added on the outside., thick enough to splice any one plate. Let X denote the number of rivets, in single shear, required to develop each plate, and let the arrow lines represent the lines of stress from one plate to another. When the stresses

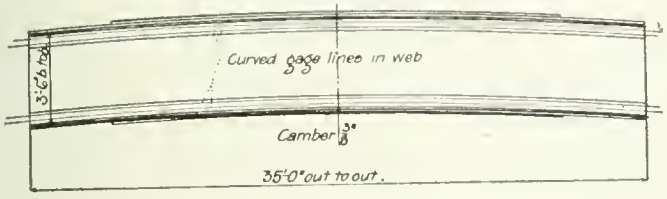


Fig. 7.—Plate Girder Without Web Splices Showing Camber.

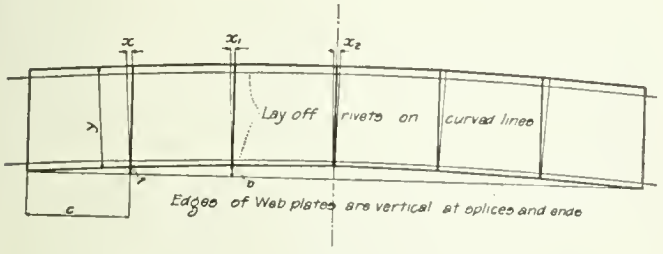


Fig. 8.—Plate Girder With Five Web Splices.

must pass through intervening plates, it is good practice to increase the number of rivets required by 33⅓ per cent. for each intervening plate, because the rivets are less efficient on that account. The number of rivets required theoretically is then obtained, as explained in the example, and in order to make the girders symmetrical about the centre line, extra rivets are added. To complete the splice the best arrangement is to break the flange angles just beyond the cover plate splices. They should alternate, one on each side of the centre line of girder. The number of rivets are obtained in the same way as for the cover plates. Where space is limited, the angles could be spliced in conjunction with the cover plates, but the method outlined above is better, because it does not require the use of such long rivets.

The Splicing of Web Plates.—This is a difficult detail and a subject of disagreement among engineers. If the web is considered to transfer shear only, the best solution for the splice, it to use a pair of splice plates of a depth equal to the clear distance between the flange angles, and attached with the necessary number of rivets, to properly develop the splice. This arrangement is indicated in Fig. 6 (a). If it is desirable to have the web carry its due proportion of the bending moment, this form of splice can also be used, but it is necessary to have a sufficient number of rivets in the connection to resist the web shears and also the amount of bending moment attributable to the web plates. This requires a large number of rivets and their value varies directly with the distance from the centre of the web plates.

A common form of splice is shown in Fig. 6 (b), in which the horizontal plates adjacent to the flange angles are considered to resist the bending moment, and the vertical plates to resist the shear. This is perhaps the cheapest arrangement, but not the best, for it concentrates the bending stresses at two points, whereas, in reality they occur over the entire depth of the girder; and it splices the web for shear, in a depth which is considerably less than the web, and thereby introduces unknown internal stresses. The horizontal plates are sometimes made to overlap the flange angles, but this arrangement has the same objections.

The splice shown in Fig. 6 (c) is recommended by some engineers as the best form of detail. It is similar to (a) except that the splice plates are extended over the flange angles and either crimped or placed on fillers. In this way the splice has the same depth as the web itself. This is expensive shop work, and requires a lot of rivets. It has the additional objection that the flange rivets in the splice are used in a double capacity, as they act with the splice and also have the same work to perform as all flange rivets.

Since there is evidently considerable uncertainty in the efficiency of web splices, where the web is considered to take bending stresses, it seems safer, as stated before, to consider that the web takes shearing stresses only. The best method, and one which is used by the Pennsylvania Railroad, is to use a splice which is considered sufficiently strong to develop the bending stresses, if ⅛ of the web acts as flange section, but to disregard the web in figuring the flange, by using sufficient flange section to resist the entire flange stress. In this way the factor of safety of the bridge is increased at very small cost, and this provides for future excessive loading.

Rivet Spacing.—The rivet spacing in flange angles is dependent upon the assumption that the shear at any cross section is transmitted into the flanges in a length equal to the depth of the girder. This depth should be considered the distance, centre to centre, of web flange rivets.

In the top flange of deck girders, there is also the direct load from the track to be considered, which makes the calculation more complicated. Some engineers consider that the axle load plus impact is supported by only two ties, but it is more common practice to consider that it is distributed over three ties. For an example, consider the case where none of the bending stresses is carried by the web plate, and assume that the direct load is distributed over 36 inches. As this distance is very short, the impact should be counted 100 per cent. of the live load. If W represents the combined wheel load plus impact, then W/36 will equal the vertical load per lineal inch on the flange rivets; and if S represents the shear in the girder at any cross section, S/h will equal the horizontal shear per lineal inch, where h is the depth.

The resultant stress on the rivets per lineal inch of flange will be $\sqrt{\left(\frac{W}{36}\right)^2 + \left(\frac{S}{h}\right)^2} = K$. The working value of one rivet in bearing on the web, divided by k, will give the required pitch of rivets in the web flange. This spacing is slightly less where ⅛ of the web acts as flange section because the entire shear does not have to be transmitted through the flange rivets.

The rivets in cover plates are spaced so that there will be a sufficient number between the ends of two successive plates to develop the strength of the longer one. This, however, usually gives too great a pitch, as practical reasons require a maximum allowable spacing in order that the surfaces will be held in even contact.

Camber in Girders.—As stated before, this is often specified, but it is only obtained by proper details. Where there are no web splices in the girder, it is necessary to punch the flange holes in the web plate in the form of a circle, as shown in Fig. 7, and the flange angles are pulled down to suit, when the girders are assembled in the shop.

When the web plate has splices at various points there are two methods of camber commonly used. In the first method, which is the cheaper and more common, the top and bottom flanges are considered as circles about a common centre. This is accomplished by adding the extra length required in the upper flange, at the points of web splice. This extra length is the same at each splice, and the web splice plates are detailed to suit.

The other method, which is used by the Pennsylvania and other railroads, is more to be commended, and is shown in Fig. 8. Here the upper and lower flanges have an equal radius and are of equal length, the ends of the girders being vertical. This arrangement has a big advantage in details and shop work. In the example given, the girder is 88 feet long over all, and requires a camber of 1 1/16 inches when figured at 1/1000 of the span. This would be increased by ⅛ of an inch for each web splice to allow for shop play, which makes a total required camber of 1 11/16 inches. For even figures 1¾ inches is considered.

The ordinates, a and b, are then figured at the various splice plates. By proportioning similar triangles, $X = \frac{a}{c} \times y$, and similarly Xl and X_2 are obtained. They diminish in value towards the centre of the girder. The web plates should be planed to these figured bevels, so that they will bear along the splice, and the splice plates are also detailed to suit. If the last method is used, and properly followed in the shop, good results should be obtained.

Many engineers put the same camber in the deck as in the girders, by using the same dap in the ties along the length of the span. The better practice is to take all camber out of the track for spans up to 75 feet, and to take out only one-half the camber for greater spans. This for the reason that the bridge looks better to have the track level under dead load only, and moreover, as there is always an excessive camber over that required to balance actual deflection from the ordinary fast trains, these trains would only produce a very slight dip in the track in passing; whereas, if the track had excessive camber, there would always be a bump which would be very objectionable in trains at high speed. With the heavier trains passing there might be a noticeable deflection, which would cause a dip in the track, but the heavy trains would be moving comparatively slowly, and this would not be a bad feature.

The ends of girders in deck spans are necessarily square at the top, in order to support the ties, but in through spans it is customary to curve the top flange for appearance. One method, as indicated in Fig. 9, is to round the corners in the form of a circle with a radius equal to ⅓ the depth of the girder. This is commonly done, and is a good detail as the web plate is not weakened, but the shop work is expensive as the angles must be bent hot and spliced.

Fig. 10 represents a detail which is a cheaper curve to make, as the radius is about 1½ times the depth of the girder. It is also more suitable to resist derailed trains, and cases are actually known where trains have hit the ends of such girders and skidded back on the ties. The main objection to this type of end is, that the web is shallow where the shearing stresses are greatest and it is necessary to reinforce the web by side plates, as indicated by "A" in the sketch. In this construction, and also in the case of girders where the bottom chord is bellied, an error is often made by detailers, as they neglect to add the horizontal plates marked "B" in the diagram. In other words, they reinforce the web against rupture from shear in a vertical plane, and forget that, in order to transmit the shear into the flanges in a length equal to the depth of the web, it is necessary to reinforce the web also against rupture in horizontal lines at the toes of the flange angles.

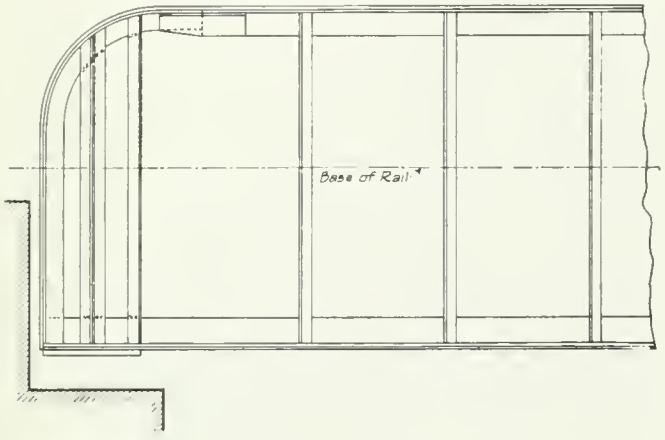


Fig. 9.—Curved End for Through Girder.

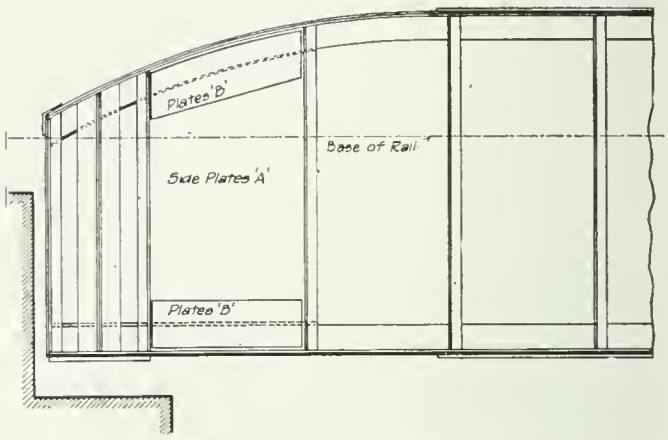


Fig. 10.—Curved End for Through Girder.

The grade of a track does not affect details of plate girder spans, except the sliding bearing plates of smaller spans, in which case either the upper shoe plate or the loose masonry plate must be planed on the bevel. Where the loose plate is bevelled the sliding plane is in the same direction as the expansion, which is an advantage where the grade is steep and the span is long; because if the upper shoe were bevelled there might be considerable rise and fall in the elevation of the track, when the bridge expands.

For smaller spans and light grades the best arrangement is to bevel the upper shoe, and thus keep the sliding surfaces horizontal, as shown in Fig. 1. Thus any tendency for the span to creep on a sloping surface is avoided.

Modern Methods in Shop Practice.—Shop methods, as well as the action of stresses and the strength of connections, should be well understood by the designer and detailer. Rivets should be spaced to suit the requirements of the spacing tables and multiple punches in common use, and which are specially adapted to plate girder construction. In this way the necessity for templates is reduced to a minimum and the shop costs are lowered.

Bridges should be so made that there is easy access for painting of all parts and no openings or pockets should be left where dirt and water might lodge.

In shipment, plate girders are sometimes troublesome and more expensive than other forms of lading. Where the girders are short and shallow and can be loaded on one car,

the method of loading is not very different from any form of heavy material. Where the girders are over sixty feet long and extend over two or more cars, it is necessary to adopt special pivoted bolsters in order that the cars will pass freely around curves. The bolster adopted by the Master Car Builders' Association, is recommended in practice and is explained in Figs. 11 and 12. The sizes of material given, are for girders weighing between 30,000 and 70,000 pounds, and vary slightly for other weights.

The weight of loading that can be placed on each car, where the load rests on one bearing point per car, varies from ½ to ⅔ of the capacity of car, depending on whether it is located at the centre or whether it is located midway between the centre and the position of the truck, and also depending on the construction of the car. The height of an ordinary flat car above the top of rail, is four feet and two inches, and this, in conjunction with the bolster, should be deducted from the minimum allowable overhead clearance along the line of shipment, in order to find the maximum depth of girder that can be shipped to various sites.

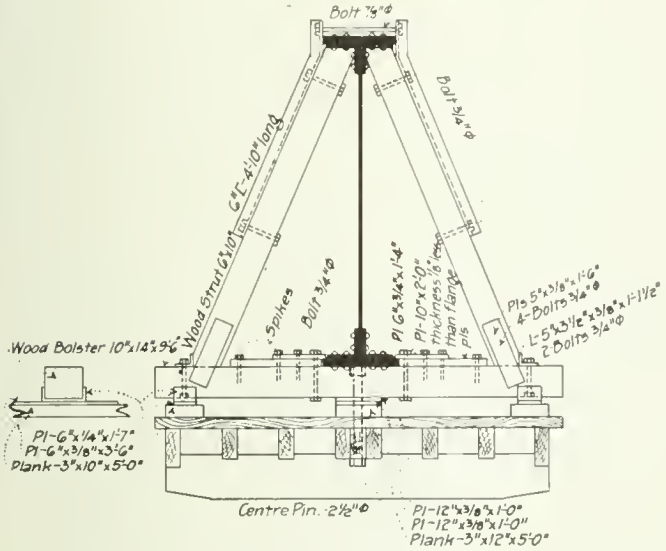


Fig. 11.—Method of Loading Girder on Flat Car.

The Erection of Plate Girder Spans.—This is accomplished with less expense and in shorter time than in the case of any other form of bridge. As it is an inestimable advantage in railroad construction to replace existing spans with no interference with traffic, the simplicity in erection of plate girder spans by modern methods is most important.

The old methods of erecting girders, where there was no falsework, was to place a gin pole in the centre of the span and gradually work the girders from the bank into position. Where there was falsework in place, which had been necessary for further construction of the road, there were several familiar methods employed. One was skidding the girders on the falsework and lowering by jacks. Another method was placing gantries at the abutments, or on cars, and from these gantries a set of falls was suspended which raised the girders off the cars, after they had been run out on the falsework, and which then lowered the girders into position. Lever cars and wood travellers were also used to lift the girders upon the falsework, after which they were pulled over into position.

The above-mentioned methods were dangerous and slow, and the modern erection car completely equipped, and properly manned, will take a plate girder span which is all riveted up, and drop it into position in less than one-half hour. Some companies use travellers which run on special wide-gauge tracks, but they require special provision in the design of the bridge to provide for this. The Hamilton Bridge Works Company, Limited, have eight erection cars in operation, which run on regular gauge tracks and, therefore, require little delay in rigging up at the site, requiring no provision in the design of the bridge, except that it is necessary to consider the load on the front trucks of the car. This very rarely affects the design, however.

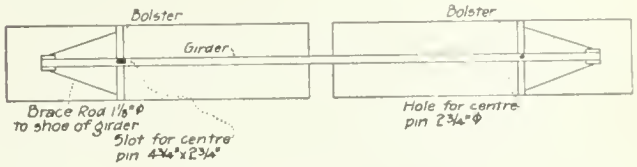


Fig. 12.—Plan of Loading.

Another advantage in the erection of plate girder bridges is that there are very few field rivets to be driven owing to the fact that the girders can be shipped completely riveted up. This is a big saving in costs, and is stronger construction, since rivets can be driven better in the shops, where machines are power-driven.

The evolution in plate girder bridges has been very pronounced since the year 1850, when they were first built of iron, and the principles of economy in design have changed to a great extent. It is impossible to foresee what changes will develop in the future, in regard to the limiting sizes that will be practicable; the composition and strength of metal that may be used, and the facilities for fabrication and erection that may be invented. For these reasons, the engineer in practice should be daily reminded that no set of specifications can cover all the questions he will have to decide, and that "The most perfect system of rules to insure success must be interpreted upon the broad grounds of professional intelligence and common sense."

THE PRODUCTION OF LIMESTONE IN CANADA.

The statistics given in the annual report of the mineral production of Canada, by John McLeish, B.A., do not include the value of the stone burned into lime by the quarry operators nor that of the stone used in the manufacture of cement, a record of lime and cement production being separately given. With these exceptions, the total value of the production of limestone in Canada in 1911 was $2,594,926, as compared with a value of $2,249,576 in 1910, or an increase of about 15 per cent.

There was a decrease in the production of limestone for building and monumental purposes and for curbstone and paving, but an increased production of crushed stone and rubble. The production of furnace flux was slightly less in tonnage, but of increased value.

The production during 1911 of limestone for building purposes was valued at $664,148, as against $695,729 in 1910. The value of crushed stone in 1911 was $1,066,559, as against $701,556 in the previous year. Curbstone and paving blocks were produced to the value of $36,902 in 1911, as compared with $125,637 in 1910. The value of rubble in 1911 was $374,327, as against $295,168 in 1910. The production of furnace flux in 1911 was 874,224 tons, valued at $452,990, as compared with 896,677 tons, valued at $431,486 in 1910.

CONCLUSIONS REGARDING MACADAM ROAD CONSTRUCTION.

Of the 1,001,823 square yards of experimental roads constructed by the Illinois Highway Commission, of which Mr. A. N. Johnson is engineer, 651,123 square yards were water bound macadam and 288,971 were bituminous macadam. A recently-issued report of the commission explains the construction of these experimental roads as an endeavor to determine the modifications necessary to adapt the usual methods of macadam construction to the particular conditions of soil, etc., encountered in the State of Illinois. With this end in view, frequent inspections have been made of all experimental roads built by the commission and information has been obtained as to their condition from year to year. As a result of this experience the following conclusions as to waterbound macadam and bituminous macadam under Illinois conditions are given.

Thickness and Width.—Roads have been constructed of varying thicknesses, sometimes because the local officials felt that on account of the cheapness of the stone, it would be as well to use plenty of it, and sometimes it was desired to demonstrate the possibility of economical construction by reducing the thickness of the stone where local conditions would warrant. The thickness has varied from 5 ins. to 12 ins., after being thoroughly compacted. Inspections made on these various roads from time to time show conclusively that there is no soil encountered in Illinois upon which it is necessary to use a thickness of crushed stone greater than 8 ins. after being rolled and have also shown there are many types of sandy soil in the State upon which a layer of stone 6 ins. thick will serve all purposes of traffic.

The width of roadway has also been varied considerably on the various sections of the road, the widths built being from 10 ft. to 30 ft. Observations of these roads under traffic indicates that there are very few places in the State where a roadway 10 ft. wide is sufficient. A road which does not have any large amount of traffic before improvement will, after improvement, attract a great deal of traffic, and consequently require a wider road than seems necessary from the traffic observed before improvement.

It is also apparent that roads constructed in the vicinity of cities of from 10,000 population upwards, should be wider than 12 ft. This is particularly true if the road will be subjected to any considerable amount of motor traffic, as is often the case in the vicinity of a city. These roads should be at least 16 or 18 ft. wide in order to accommodate both the motor and horse drawn traffic. While it may not seem desirable to build roads merely for motor traffic, yet it is evident that the motor traffic is here and must be taken into account in any comprehensive system of road improvement.

In general it can be said that in most communities where it is worth while to construct and improve roadways at all, a width of 12 ft. is desirable. And in many communities the roadways must necessarily be 16 to 18 ft. wide in order properly to accommodate the traffic which will use them. Moreover, the traffic census which has been taken by the Illinois Highway Commission during the past six years, shows that there is a large increase in motor traffic on these improved roads from year to year, and consequently a road which might be wide enough upon completion will be too narrow to accommodate the traffic in a few years.

Waterbound Macadam.—In regard to waterbound macadam construction, it may be remarked in general that there has been no difficulty, if reasonable precautions are taken for proper drainage, to support this form of construction on any of the soil conditions usually encountered in the State. Wherever isolated sections of macadam roads are exposed to mud marks tracked on at the ends and from adjoining roads, a disproportionate amount of damage is done, to that done on a larger mileage of road. The most serious damage to any of the macadam roads has resulted from tracking on of sticky mud, particularly the first year, before the road has become thoroughly seasoned and consolidated. The mud will pick out the binder and loosen the stone which will be carried with the mud on the wheels and deposited upon the road, which, when dry leaves the surface very uneven. Such action will be in evidence for 100 to 300 ft. from either end of the road.

It has been found, however, that if sand or gravel is placed on the earth roads adjacent to the macadam for 100 or 200 ft., that it will render the mud non-sticky and no damage is done to the macadam surface. If precautions of this nature are taken for the first and second winters, there does not seem to be much further difficulty experienced from this source, as the road in the meantime will have become thoroughly compacted and does not pick up.

Some roads have been much more affected by traffic than others, although it is a fact that the roads that have worn the best in some instances have carried the largest amount of traffic. On the roads with the lesser amount of traffic, it is usually the case that one vehicle follows the other, the majority of which have narrow tires, and all the wheels use a narrow space practically within 10 ins. in width. Where traffic uses a road in this manner, a rut or depression will form within a very short time after the road is thrown open to travel, and unless this depression is removed, practically every vehicle will follow in the track thus made.

If the incipient track is filled with a bonding gravel, the team traffic will avoid it, turning first to one side and then the other, according to the direction it may be going, and eventually consolidate the surface of the road. Wherever it is possible once to distribute the traffic over the whole road, there seems but little difficulty from the formation of ruts or concentration of wear in one track. Roads, however, that carry automobile traffic even in very limited amounts are difficult to repair in this manner, as the loose gravel will be soon thrown out by the motor traffic.

It has been found that a limestone road bonded with gravel to make a gravel surface is a very much better wearing road and will carry with less damage to the surface a very considerable amount more of motor traffic than a limestone road bonded with limestone screenings alone. It is to be noted that the damage done to a macadam road the first year is much more than during subsequent years. In general, if a small amount of gravel is distributed over the surface early in the first spring, the amount required being about one carload to the mile, and a drag is used on the road occasionally as wet weather permits, it is found that the road will pass through the next two or three seasons with little or no attention, save the occasional use of the drag during late fall or early spring.

With the majority of the roads built by the Commission, however, the general impression has been that such construction is permanent in a strict sense of the word, and once a road is built that nothing further needs be done. Thus very few of the roads have had any proper attention, so that their condition in many instances is much poorer than would have been the case under proper and systematic maintenance. As a result, when maintenance repairs have been made, the condition of the road is such that a very considerable amount of work is necessary to restore the surface, so that when this cost is distributed over the years which the road has been in use, the cost per year is often greater than would have been the case had a small amount of work been done more frequently, and the road surface in the meantime maintained in a much higher state of preservation.

In general, it may be said that waterbound macadam construction, particularly where gravel is used for the surface dressing, is a practical form of road construction for many miles of moderately traveled roads in the State; roads that carry a sufficient amount of traffic to make their improvement in this manner worth while at the same time have not developed an amount of motor traffic to prevent the maintenance of this form of construction at a reasonable cost. This applies particularly on those roads which eventually would become feeders to main roads where it is believed that this form of construction will prove serviceable for many years to come. But waterbound macadam is not advised on roads carrying a considerable amount of motor traffic or roads which will eventually become the main roads of a county or State system.

Table I.

Item.	Cost per sq. yd.	Cost per cu. yd.
Shaping roadbed, trimming shoulders and side roads	$0.03	.....
Applying bituminous binder	0.023	.....
Superintendence, watchmen, etc.	0.037	$0.12
Loading stone on wagons	.....	0.107
Spreading stone	0.028	0.093
Rolling and sprinkling	0.027	0.071

Bituminous Macadam.—The comparatively short experience that has been had with this form of construction with the work under the supervision of the Illinois Highway Commission and elsewhere, makes is impossible to draw any final conclusions. The results, however, of the experience so far gained, seem to show:—

1. The necessity in this form of construction for as stable a foundation course as possible, and that probably the best method would be to lay the first course of the road as waterbound macadam, applying the bituminous top about 3 ins. thick the following season when the foundation course had become thoroughly well compacted.

2. The necessity for using durable material in the bituminous top, and where under the conditions that exist in Illinois, limestone alone is available, the material used for filling the voids and dressing the surface of the bituminous layers as they are applied, should be of washed gravel and torpedo sand. The particles of the gravel are made up for the most part of silicious material, which is the hardest material available, but where the rock of which the road is made is tough and hard, then rock chips could be substituted.

3. It is necessary that the bituminous binder be spread so as to present as uniform a service as possible. This may not necessarily mean the uniform distribution of the binder as the texture of the surface of the macadam before the application of the binder may itself not be quite uniform. Therefore, the more finely divided form in which the asphalt can be applied, the better the control of its distribution. The form of the application whereby the material is spread by a jet of steam has given excellent results.

4. Too much binder should not be used as it will result in a less stable layer of bituminous concrete than if sufficient binder is used only to fill the voids in the stone.

5. It is essential that the surface of the road have very close texture and that usually this cannot be secured in less than three applications except by an excessive amount of binder. The most economical and best results can be secured when the binder is put on in three applications.

6. The bitumens which do not possess some ductility at freezing temperature have not been satisfactory.

7. There is some evidence to show that certain bitumens of low ductility at ordinary temperature are seriously injured by mud that may be tracked upon the road, particularly if the soil is of highly alkaline character. There does not appear to be an equal amount of injury done by mud from soils of slightly acid character, though in either case the results are not as satisfactory as with bitumens possessing higher ductility. It is important that bitumens be applied at high temperatures, and if possible, during hot weather, as some unsatisfactory results obtained can be attributed to the cold weather prevailing at the time of construction. The roads constructed with tar binder under ordinary traffic conditions seem to require a paint coat at the end of the second, or at the latest, during the third season, by which time the tar near the surface of the road seems to have lost most of its adhesive qualities.

Table II.—Estimated Cost of One Mile of Macadam Road.

			Average haul ½ mile		Average haul 1 mile		Average haul 2 miles		Average haul 3 miles	
Width ft.	Cu. yds. stone per mile	Sq. yds. per mile	Water-bound	Bitu-minous	Water-bound	Bitu-minous	Water-bound	Bitu-minous	Water-bound	Bitu-minous
12	2,200	7,040	$4,572	$ 5,859	$4,836	$ 6,123	$5,298	$ 6,585	$ 5,870	$ 7,157
16	2,637	9,387	5,659	7,375	5,875	7,591	6 429	8,145	7,115	8,831
18	2,805	10,560	5,960	7,892	6,297	8,229	6,886	8,818	7,615	9,547
20	3,116	11,733	6,624	8,770	6,995	9,141	7,649	9,795	8,459	10,605
24	3,740	14,080	7,948	10,524	8,397	10,973	9,182	11,758	10,154	12,730

8. A tar with approximately the following analysis has proved most satisfactory:—

Specific Gravity.—The specific gravity at 25° C shall not be more than 1.26.

Free Carbon.—The free carbon shall not exceed 20 per cent. by weight.

Consistency.—The consistency as determined by the Howard and Morse float appartus at a temperature of 50° C shall not be less than 1½ mins. nor more than 2½ mins.

Distillation.—Fractional distillation shall give results within the following limits, all measurements being by volume.

Up to 110° C the distillate shall not exceed 2 per cent. and shall be free from ammoniacal water.

Up to 170° C there shall be not to exceed 5 per cent. distillate, of which not more than one-fourth shall be naphthalene.

The total distillate up to 315° C. shall be at least 18 per cent.

Brittleness.—A cylindrical prism of the tar binder 1 cm. in diameter, after being maintained at a temperature of 0° C for 20 mins., shall bend into a semi-circle of 3 cm. diameter without checking or breaking.

9. A surface constructed with an asphalt binder apparently requires a paint coat during the third or fourth season. While the asphalt binders do not seem to lose their adhesiveness, the mat forming the close texture of the surface under ordinary traffic conditions will have become worn so as to make the application of a paint coat desirable as a protection against further wear of the road. The most satisfactory results with asphalt binders were obtained with those having closely the following analysis:

Class A.—Bituminous binders shall conform to the following specifications, the various properties described being determined by the methods proposed by the American Society for Testing Materials:

1. The material shall be free from water.

2. **Specific Gravity.**—The specific gravity at 25° C./25° C. (77° F.) shall not be less than unity.

3. **Total Bitumen.**—The bituminous material shall be soluble in chemically pure carbon bisulphide at air temperature to the extent of at least 99.5 per cent. for residuums and gilsonite products, 95 per cent. for Bermudez products, 80 per cent. for Cuban products, and 65 per cent. for Trinidad products.

4. **Naphtha Insoluble Bitumen.**—Of the total bitumen not less than 15 nor more than 28 per cent. by weight shall be insoluble in 86° B paraffine naphtha at air temperature. On evaporation of the naphtha solution the residue obtained shall be sticky and not merely oily.

5. **Fixed Carbon.**—The fixed carbon shall be not less than 8 nor more than 14 per cent.

6. **Penetration.**—The penetration as determined with the Dow penetration machine, using a No. 2 needle, 100 grams weight, 5 sec. time, and a temperature of 25° C (77° F) shall not be less than 12 mm., nor more than 16 mm.

7. **Loss on Evaporation.**—When 20 grams (in a tin dish 2⅜ ins. in diameter and ¾ in. deep with vertical sides) are maintained at a temperature of 170° C (338° F) for 5 hours in a New York testing laboratory oven, the loss shall not exceed 6 per cent. by weight. The surface of the residue at air temperature shall be smooth and show no sign of blistering or cracking, and when tested with the Dow penetration machine for 5 secs. at 25° C (77° F) with a No. 2 needle, and 100 grams weight, it should have a penetration of at least 5 mm.

8. **Ductility Test.**—The ductility at 25° C (77° F) shall not exceed 85 cm., according to the district of Columbia standard.

9. **Flash Test.**—The flash point in an open cup shall not be less than 163° C (325° F).

10. **Paraffine Scale.**—The asphaltic binder shall not contain more than 2 per cent. by weight of paraffine scale.

Class B bituminous binders shall conform to the following specifications, the various properties described being determined by the methods proposed by the American Society for Testing Materials:—

1. The bituminous material shall be free from water.

2. **Specific Gravity.**—The specific gravity at 25° C / 25° C (77° F) shall not be less than 0.965 nor more than unity.

3. **Total Bitumen.**—The bituminous material shall be soluble in chemically pure carbon-bisulphide to the extent of at least 99.5 per cent. by weight at air temperature.

4. **Naphtha Insoluble Bitumen.**—Of the total bitumen not less than 20 nor more than 26 per cent. by weight shall be insoluble in 86° B paraffine naphtha at air temperature. On evaporation of the naphtha solution, the residue obtained should be sticky and not merely oily.

5. **Loss on Evaporation.**—With 20 grams (in a tin dish 2⅜ in. in diameter and ¾ in. deep, with vertical sides) and maintained at a temperature of 163° C. (325° F.) for 5 hours in a New York testing laboratory oven, the loss shall not exceed 2 per cent. by weight. The surface of the residue at air temperature shall be smooth and shall present no greasy spots nor any sign of blistering or cracking. The penetration in the residue shall not be decreased more than 40 per cent. from the original consistency.

6. **Fixed Carbon.**—The fixed carbon shall not be less than 7 nor more than 13 per cent.

7. **Penetration.**—The penetration as determined with the Dow penetration machine, using a No. 2 needle, 100 grams weight, 5 secs. time, and a temperature of 25° C. (77° F.) shall not be less than 7 nor more than 12 mm.

8. **Paraffine Scale.**—The bituminous binder shall not contain more than 6 per cent. by weight of paraffine scale.

9. **Carbon-Tetrachloride Insoluble Bitumen.**—Of the total bitumen not more than 0.5 per cent. by weight shall be insoluble in chemically pure carbon-tetrachloride at air temperature.

10. **Brittleness Test.**—A cylindrical prism of the bituminous binder 1 cm. in diameter, after being maintained at a temperature of 5° C for 20 mins., shall bend in a semicircle of 3 cm. diameter without checking or breaking.

11. **Flash Test.**—The flash test in open cup shall not be less than 200° C (392° F).

12. **Melting Point.**—The melting point shall not be less than 60° C (140° F).

13. **Ductility.**—The ductility at 25° C shall not be less than 25 mm., according to the District of Columbia standard.

These binders are of two general classes, and it was found in practice that excellent results were obtained by using a mixture of three parts of low price blown oil or residual asphalt of class B combined with one part of a natural asphalt of class A.

10. The size of stone in the bituminous layer should range from 2½ ins. to ¾ ins. where limestone is used. When trap rock or other equally hard material is available, stone should not exceed 2 ins. in size; the chips for filling the stone not to exceed ¾ in. and the grit for the top dressing not to exceed ¼ in. and all of the materials to be free from dust.

11. The use of laboratory is absolutely necessary for making tests on materials and mixtures as construction proceeds.

12. Experience indicates that this form of construction is adapted to moderate traffic roads, that is, where there is no large amount of extra heavy hauling. Where the traffic is composed of automobiles and farm loads not to exceed two tons, this form of construction will prove satisfactory, although possibly not as durable as either concrete or brick. Where traffic consists of heavier loads, wholesale trucks, heavy coal hauling and loads reaching to five and six tons, it is believed this form of construction is not at all suitable.

It presents a pleasing appearance and is well adapted to horse drawn traffic, but requires close attention for maintenance, and there is some evidence that during warm weather, when the bitumen is least stable there is a tendency for the surface to creep and undulations develop.

The cost of this form of construction over that of first class waterbound macadam is approximately 20 cents per square yard, but there has not been had sumcient experience to determine definitely the maintenance cost and its final economy. The construction requires the utmost care in every detail, and owing to the small experience contractors have had with it, appreciation of this fact has not been realized, with the result that nearly everywhere work done under contract has not been as satisfactory as that done by day labor under the immediate supervision of skilled men. Where attention is given to the construction and where the services of a laboratory are available, to insure the character of the materials, there is no difficulty in duplicating results. Bituminous macadam is of doubtful value on those sections of road so situated that considerable quantities of mud will be tracked on them from adjoining roads.

Construction Cost of Macadam.—At the close of the season of 1912 there were available cost data obtained from the construction of about 150 separate pieces of road, involving the handling of 286,494 cu. yards of stone. A study of these data shows that the various unit costs are constant, regardless of the distance to the road from the tracks from which stone is hauled, except the cost per cubic yard for hauling stone. The costs of the various parts of the work shown in Table I., are the averages of these items for all of the roads constructed.

A study of the data on the cost of hauling stone shows that this cost increases constantly and almost uniformly from a distance of ¼ mile upwards. This variation is most readily shown by means of a curve which is given as Fig. 1. It is possible, with these data available, to make an estimate of the cost of the construction of a mile of macadam road for any length of haul for stone not exceeding three miles. When the width of a road and the thickness of the material have been decided, the fixed items of cost in the road can be immediately determined by use of the unit costs from Table I.

In this manner the estimates of cost of one mile of road, as given in Table II., have been made up. In the table, the cost of crushed stone is assumed to be $1.25 per cubic yard f.o.b., cars at the siding from which it is to be hauled. In bituminous macadam roads the cost of the bituminous binder is assumed to be 8 cents per gallon f.o.b., the siding from which it will be hauled, and it is also assumed that 2 gals. of binder per square yard of surface will be used. This table is based on the actual cost of the work which has been done by the Illinois Highway Commission, and makes no provisions for contractors' profits. It does, however, include cost of maintenance of equipment under the item of rolling and sprinkling.

It should be noted that the allowance for shaping the road bed, and trimming shoulders and side roads, while covering the ordinary earth work necessary on the average road encountered in Illinois, would not be a large enough allowance if the road to be improved included heavy earth work to reduce grades, or construct embankments.

The cost of labor on the various pieces of work varied from 30 cents to 50 cents per hour for teams and from 15 cents to 25 cents per hour for men, and the number of pieces of work where the lower price was paid was about as large as where the higher price was paid. It would probably be fair to assume that these costs are substantially correct where teams received 40 cents per hour, and men 20 cents per hour.

In Table II. the quantity of stone per mile is given and it will be noted that the quantity does not increase in proportion to the width. This is due to the fact that a road 12 ft. wide is made of uniform thickness, while the wider roads are made somewhat thinner at the edge than at the middle. The 12-ft road is estimated on a basis of thickness of 10 ins. of loose stone, while the 16-ft. road is assumed to be 10 ins. thick at the middle and 8 ins. thick at the edge, making the average thickness 9 ins. For roads wider than 16 ft., the average thickness has been taken as 8½ ins.

The cost of bituminous macadam roads exceeds the cost of waterbound macadam roads by the cost of the binder, plus the cost of application, and the experience of the Commission in the construction of bituminous macadam roads by the penetration method indicates that 2 gals. of binder per square yard of macadam is required.

MAINE HIGHWAY LAW.

Maine motorists are regarding the new highway law with mingled pleasure and pain. The pleasure part is experienced when it is considered that the bill provides that all trees must be removed from dangerous turns and at railroad crossings, and that no advertising signs can be erected within 500 feet of crossings. All state roads must be furnished with signposts of a uniform size and height, by the various towns. Part of the bill legislates against the motor truck, providing that trucks having a total weight of over nine tons must obtain a special license. Speed limits are set for all machines, ranging from fifteen miles an hour for light trucks to six for the heavy ones.

STONE PRODUCTION IN CANADA.

Statistics of stone production given in the annual report on the mineral production of Canada, by John McLeish, B.Sc., include the sales of all classes of stone used for building, monumental, and ornamental purposes, stone for paving purposes, curbstone, and flag-stone, rubble, rip-rap, and crushed stone, limestone for furnace flux, sugar factories, etc., but stone used for burning lime or the manufacture of cement is not included.

The kinds of stone quarried have been classed as granite, limestone, sandstone, and marble.

The records are practically confined to quarry operations or the production of sawn or polished stone when these operations are carried on by the quarry operators. In addition to this production of stone by regular operators, there is no doubt a large stone production by individuals, such as farmers and others, for house or barn foundations, concrete work, etc., of which it would be impracticable to obtain any satisfactory record. Much stone is probably also used in railway construction work and in road-building, of which no record has yet been obtained.

It is impossible, except in a few cases, to show the quantity of stone production, so that the value only of the shipment can be given.

The total value of the production of stone in 1911, according to returns received, was $4,328,757, as compared with a value of $3,650,019 in 1910, showing an increased production of $678,738, or 18.6 per cent.

The number of active firms reporting in 1911 was 191, the total number of men employed 5,437, and the total wages paid, $2,500,005. In 1910 the number of active firms reporting was 166, the number of men employed 5,105, and wages paid, $2,225,791.

Of the total value of the 1911 production, limestone contributed $2,594,926, or nearly 60 per cent.; granite, $1,119,865, or nearly 26 per cent.; sandstone, $451,183, or 10.4 per cent.; and marble, $162,783, or 3.8 per cent.

Stone was used for building purposes to the value of $1,368,693, or 31.6 per cent. of the total; monumental and ornamental stone, a value of $303,050, or 7 per cent.; curb, paving, and flagstone, $233,723, or 5.4 per cent.; rubble, $460,803, or 10.6 per cent.; crushed stone, $1,509,498, or 34.9 per cent.; and furnace flux, 874,224 tons, valued at $542,990, or 10.5 per cent.

By provinces, Quebec again shows the largest output, having a value of $1,894,892, or 43.8 per cent. of the total, being made up of limestone to the value of $1,296,577, granite valued at $462,678, marble, $135,187, and sandstone, $450. Ontario takes second place with a production of $892,305, or 20.6 per cent. of the total, of which limestone is credited with $680,461; granite, $131,816; sandstone, $54,032, and marble, $25,996. British Columbia ranked third in order of importance, with a total of $698,811, including granite, $460,851; sandstone, $179,580; limestone, $56,780, and marble, $1,600. The production in Manitoba was valued at $318,050, made up of limestone, $315,782, and granite, $2,268. The Nova Scotia production was valued at $292,914, comprising limestone, $245,216; granite, $24,258, and sandstone, $23,440. The Alberta production was reported as $158,344, all sandstone. New Brunswick is credited with $73,441, made up chiefly of sandstone and granite.

Official figures, recently compiled, place the cement production of the United States last year at 83,351,191 barrels, which is a new high record and an increase of more than 3,800,000 barrels in a year.

ALLOWABLE HEIGHTS AND AREAS FOR FACTORY BUILDINGS.*

By Ira H. Woolson, Mem. Am. Soc. M.E.

In the design of factory buildings, one of the vital eatures tending to control the spread of fire is a judicious imitation of height and area. It is self-evident that whatver restricts a fire reduces the life hazard. Owing to the upreme importance of these two subjects, a person contemlating the erection of a building of this class should give areful consideration to the history of fires in such buildings, nd the experience gained in fighting them. The question s more acute in this class of buildings than in any other ecause of the fire hazard which exists in them, and the conomic advantages due to reduced costs in construction nd supervision, when several large areas are housed under single roof. Just where to draw the line so as to produce easonable safety without prejudice to building investments s the problem.

Factory buildings of excessive heights or areas have ong been recognized by underwriting organizations as a grave danger to life and property, owing to the difficulty of controlling fires in them. They have for years urged limitaions which have been freely ignored by ambitious architects nd factory owners, because the suggested restrictions were considered unreasonably drastic. The evidence produced in his paper strongly supports the limitations which were dvocated.

It is logical to assume that the men best fitted to determine safe limits of heights and areas are the men who have made a life work of combatting fires under all conditions of weather and hazard. With this idea in mind, the writer communicated with all the fire marshals and fire chiefs in the United States representing cities of over 20,000 population. A set of eight questions and a letter of explanation were sent to each. Fire chiefs as a class are not good technical correspondents, therefore it was not surprising that only one-third of the men addressed responded to the appeal. However, replies were received from 117 representative cities well distributed as to size and geographical location. These have been summarized and form the basis of this paper. A few of the replies indicated a misunderstanding of the questions, and these were discarded. The questions were as follows:—

1. What should be the greatest height allowed for manufacturing or warehouse buildings **without sprinkler equipment?**

Brick and joist construction—
Height in ft. ..... or No. of Stories .....
Fireproof construction—
Height in ft. ..... or No. of Stories .....

2. Take the same question as No. 1, but assume the buildings to be fully equipped **with automatic sprinklers.** What height would you approve?

Brick and joist construction—
Height in ft. ..... or No. of Stories .....
Fireproof construction—
Height in ft. ..... or No. of Stories .....

3. What should be the greatest floor area allowed in the same class of building **without sprinkler equipment?**

Brick and joist construction—
Area in sq. ft. ..... or Width ..... ft. Length ..... ft.
Fireproof construction—
Area in sq. ft. ..... or Width ..... ft. Length ..... ft.

4. If the same buildings were fully equipped **with automatic sprinklers** what area would you approve?

Brick and joist construction—
Area in sq. ft. ..... or Width ..... ft. Length ..... ft.
Fireproof construction—
Area in sq. ft. ..... or Width ..... ft. Length ..... ft.

Each building was assumed as a good one of its class, with enclosed stairways and elevator shafts; and the chiefs were requested to base their answers upon experience in fighting fires in the class of buildings described, and to assume restrictions which would afford a reasonable chance of controlling a fire on any floor.

Naturally, and quite properly, the replies reflect the local conditions, such as the efficiency of the fire department, the water pressure, the combustibility of the goods being manufactured, the number of sprinkler equipments in service, and the degree of congestion among the buildings. However, all conditions were represented, and the summary of so large a number of opinions should indicate fairly well the average condition throughout the country. (See Table I.).

Table I.—General Average of 99 to 111 Replies Received From All Classes of Cities.[1]

Type of Building.	Stories in Height.	Area between Fire Walls in Sq. Ft.
Non-Fireproof, not Sprinklered..	3.1	6,300
Fireproof, not Sprinklered	4.9	12,300
Non-Fireproof, Sprinklered	4.6	12,800
Fireproof, Sprinklered	7.0	27,100

Average story height was 12 to 13 ft.

The answers regarding allowable heights were much more uniform than those relative to area. It is significant that 83 per cent. of the replies would limit the height of a fireproof sprinklered factory building to less than ten stories. The opinions in reference to height of the other classes of buildings were exceedingly uniform, and consistently low.

Replies as to permissible areas in sprinklered buildings were widely divergent, but for the unsprinklered classes they were more uniform than would naturally be expected considering the great diversity of conditions under which they were prepared.

It is evident from the figures given, that the fire chiefs have no settled policy among themselves as to the credit that should be given to an automatic sprinkler equipment as a fire extinguishing device. A few enthusiasts would permit unlimited area in a sprinklered building, while on the other hand a considerable number would give very little or no increase when sprinklers are installed. Two chiefs stated that their unfortunate experiences with sprinklers had caused them to lose faith in their reliability. As a whole, however, they are strongly in favor of sprinklers and are inclined to permit over generous areas in buildings so equipped.

In order that the replies may be intelligently interpreted they have been separated into three groups, Tables 2, 3, 4, according to size of the city represented, and each group has been analyzed to show the character of the answers given to each question.

In the cases referred to by an asterisk, where no limits to areas were given, they were not included in the averages, but were counted in the columns giving the number of answers above the average. In each group it will be noted that about the same number of men gave high answers to all questions, the proportion being one-quarter to one-half of the number in the group. The uniformity of height limits,

* From a paper read before the American Society of Mechanical Engineers in Baltimore, May 22nd, 1913.

[1] The variation in the number of replies (averaged) resulted from some incomplete answers.

and the lack of it in the area limits, is very apparent in all groups. It will be noted that the largest area values are given in Groups I. and II., comprising the smaller cities. This is significant, and needs explanation.

Table 2.—Group I. Summary of Answers from 52 Cities With a Population of 20,000 to 50,000.

Type of Building	Stories in Height			Answers above	Area in Square Ft.			Answers above
	Average	Max.	Min.	Average	Average	Max.	Min.	Average
Non-Fireproof, not Sprinklered....	2.8	6	1	13	6,000	20,000	1,150	15
Fireproof, not Sprinklered.....	4.4	10	2	24	12,600	60,000	1,150	15
Non-Fireprnof, Sprinklered....	4.1	8	2	17	12,300	*60,000	3,000	17
Fireproof, Sprinklered....	6.3	12	3	18	27,300	*180,000	5,000	20

* Four votes received in favour of "no limit to area" in this class.

Table 3.—Group II. Summary of Answers from 23 Cities With a Population of 50,000 to 100,000.

Type of Building	Stories in Height			Answers above	Area in Square Ft.			Answers above
	Average	Max.	Min.	Average	Average	Max.	Min.	Average
Non-Fireproof, not Sprinklered.....	3.2	6	1	8	8,300	40,000	2,500	5
Fireproof, not Sprinklered.....	5.2	10	1	6	14,800	60,000	2,400	4
Non-Fireproof, Sprinklered.....	4 8	10	3	5	16,300	75,000	1,500	5
Fireproof, Sprinklered.....	7 7	20	4	5	36,300	200 000	4,000	5

Table 4.—Group III. Summary of Answers from 36 Cities With a Population of 100,000 and Over.

Type of Building	Stories in Height			Answers above	Area in Square Ft.			Answers above
	Average	Max.	Min.	Average	Average	Max.	Min.	Average
Non-Fireproof, not Sprinklered.....	3.5	7	1	17	5,400	10,000	900	15
Fireproof, not Sprinklered.....	5.3	9	2	18	9,800	22 500	2,400	10
Non-Fireproof, Sprinklered.....	5.0	10	3	15	11,300	22,500	900	13
Fireproof, Sprinklered.....	7.5	12	4	16	19,400	*80,000	2,500	9

* Two votes received in favour of "no limit to area" in this class.

Occasionally the fire chief of a small city has experience which would abundantly qualify him to estimate properly the merits of fireproof construction and sprinkler equipment; more often, however, his city has meagre protection of this kind, and consequently he has little opportunity to judge of their efficiency, and it is not strange that he should be a bit extravagant in the credit he would give them.

The most rigid restrictions on area are found in Group III embracing the large cities. As fireproof construction and sprinkler equipments are common in most of our larger cities, it is reasonable to assume that the fire chiefs of such cities would have had much more experience with such methods of protection, and be better able to decide what increase should b given in the size of a building when such protection is provided, than their less experienced fellow officers in smaller towns. It is thought quite proper to assume that their figures are more nearly correct and should be given the most weight.

Significant evidence in support of this argument is found in the fact that four chiefs who give no limit to areas in non-fireproof and fireproof sprinklered buildings are located in cities having a population of less than 50,000 in which there are few fireproof factory buildings or sprinkler equipments. On the other hand only two chiefs, in cities over 100,000 population, suggest a "no limit area" in a fireproof sprinklered building, and none approves such areas for non-fireproof buildings.

With these thoughts in view, Table 1 has been changed somewhat to be more in accord with the weight of evidence. It is believed, therefore, that Table 5 represents more correctly the consensus of opinion among the fire chiefs of the country best qualified to judge as to what should be the proper limits of height and area for factory buildings.

Table 5.—Allowable Heights and Areas in Factory Buildings.

Type of Building	Stories in Height	Area between Fire Walls in Sq. Ft.
Brick and joist construction, not sprinklered	3	6,000
Fireproof construction, not sprinklered.....	5	10,000
Brick and joist construction, sprinklered	5	13,000
Fireproof construction, sprinklered	7	20,000

These values might be increased somewhat under the influence of especially favorable local conditions, as previously explained, but the writer submits that as they represent the average deliberate judgment of such a large body of men, so well qualified to estimate the hazard which the values involve, they should be given careful consideration, and should be increased only with the utmost caution.

Extracts From Fire Chiefs' Letters.—The following extracts from letters received from different fire chiefs in connection with this investigation may be of interest as indicating their attitude of mind in relation to the questions asked:—

"In my opinion, from a fire-fighting standpoint, **no building** should be built over eight stories."

"In our city there is room to grow on the ground without building high in the air. It is almost impossible for a public fire department to fight a fire from the outside above 75 ft."

"The figures given mean that every 66 ft. by 66 ft. should have a brick wall through length of building with Underwriters' doors; same to be double. As for width, in no case over 66 ft. wide; with solid wall, same to reach above roof at least 6 ft. **Build on ground not in air.**"

"A building 8 or 10 stories high, out in the open where it can be attacked from all sides should be handled very readily by a modern equipped fire department."

"I think that a factory should never be more than four stories high. I almost feel that there is no such thing as fireproof construction from my own experience. I know that it is possible to store enough material in any building to burn it. I am very much in favor of dividing rooms in factories with fire-resisting walls, provided with automatic fire doors."

"While fireproof construction is the best, it is the contents placed therein that is the hazard to life and property. Buildings should not be constructed to a greater height than can be reached by fire department ladders; 85 ft. to upper windows."

"In my opinion no warehouse building ought to be over one story in height. In regard to manufacturing buildings, I will say that I do not approve of any of these buildings being over three stories in height. If they want room, let them build in length and not so high; that is just what makes such bad fires. These buildings have all kinds of combustible material in them and they are sure to jump to another building if they are four or five stories in height."

"It is my opinion that all buildings for manufacturing and warehouses should be sprinklered, and not built higher than what the water supply will furnish and cover."

"Do you think any fire department can successfully fight a large fire over six stories high, and ten stories allowed only when there are two sources of water supply with good pressure."

"Area of sprinklered and unsprinklered buildings should be about the same, on account of increase in height allowed for fireproof buildings."

"All buildings of character named should be sprinklered:"

"Joisted brick construction should not be allowed without sprinklers."

"I think a good sprinkler system is one of the best fire preventions that has been invented in a great many years, and if kept up properly, it is pretty hard for fires to get away."

"If I had my way I would not allow any manufacturing plant to do business until it were properly sprinklered. It does things when they should be done."

"My experience with the 28 factories in this city has been that the sprinkler systems are out of order much of the time. Not looked after properly.

"This department has had no unfortunate experience with the sprinkler system, but, I do not feel inclined to depend upon them."

"The reason for not showing more favor to sprinklered risks, is because our experience with sprinkler systems in this city has shown them to be unsatisfactory, and not to be depended on."

"Stairs should be of steel without any wood sides; if any wood in the construction then there should be sprinklers. Should be sprinklers in all elevators even if they are enclosed, for an elevator is a bad air shaft. Brick factories cut up with wooden partitions are generally hard fires to fight."

"I do not approve of small rooms in factories, they make it very hard for a fireman to fight his way through smoke trying to find a fire when a building of this kind is partitioned off so much."

"In considering the limiting of height and area of a building, the question of accessibility should play an important part."

OUTPUT OF LIME IN 1911.

The production of lime in Canada in 1911, as contained in the annual report of the Mineral Production of Canada, by J. McLeish, B.A., and according to returns received from the producers, was 7,533,525 bushels, this being the amount sold or used (equivalent to about 263,673 tons), and valued at $1,517,599, or an average of 20 cents per bushel, or $5.75 per ton.

The production in 1910 was reported as 5,848,146 bushels (204,685 tons), valued at $1,137,079, an average of 19 cents per bushel, thus showing an increased production in 1911 of 1,685,579 bushels, or 22 per cent.

Returns were received from seventy-five active firms in 1911, as compared with seventy firms in 1910. The average number of men employed was 1,056, and wages paid, $523,518, during the past year, as against 976 men employed and $466,876 paid in wages in 1910. Statistics of labor and wages should be used with discrimination, however, as many firms producing lime are also engaged in quarrying stone for purposes other than lime making, and are unable to make separate reports as to labor employed. This is particularly evident in the record for Nova Scotia and New Brunswick, since for the first mentioned the record includes only the labor employed at the kilns, while for the latter the quarry costs are also included.

The average price per bushel varied from a minimum of 16 cents in Ontario to a maximum of 34 cents in British Columbia.

Hydrated lime was produced by three firms only, the sales being 5,023 tons.

A small quantity of lime is annually made in Prince Edward Island. The production is separately shown for 1911, but for previous years is included in the Nova Scotia figures.

THE ELIMINATION OF TASTE IN TREATED DRINKING WATER.

Dr. Arthur Lederer, a chemist and bacteriologist in connection with the Sanitary District of Chicago, and Mr. Frank Bachmann, assistant chemist, in commenting upon the abundant use of chlorinated lime in the treatment of water supplies, refer, in a paper read at the fifth annual meeting of the Illinois Water Supply Association, last March, to the surprisingly little which has been done towards meeting with compliance the frequent complaints about the resulting taste.

The first experiments on the removal of taste due to chlorinated lime were made almost twenty years ago by Traube, who also was the first one to recommend it for the disinfection of water supplies, although its germicidal action was known before. Traube applied 4.26 mg. of chlorinated lime containing 1.06 mg. of available chlorine to one liter of the water, and added after two hours' contact 2.09 mg. of sodium sulphite ($Na_2SO_3.7H_2O$). He claimed that an excess of sulphite up to 50% over the required quantity does no harm; for the reason that the salt is quickly oxidized in the water to sodium sulphate, which cannot be tasted in such low concentrations. For one million gallons of water Traube recommended 35.7 pounds of chlorinated lime and 16.8 pounds of sodium sulphite. The quantity of chlorinated lime applied may seem abnormally high in the light of more recent observations and experiences in this country, but it explains why the early observers were forced to look for means to remove the repugnant aftertaste in water thus overdosed. The need for remedial measures grew still more pronounced when later observers were led by laboratory tests to employ still larger quantities of chlorine in the form of chlorinated lime or sodium hypochlorite. Sickenberger and Kaufmann disinfected the turbid Nile water at Cairo with sodium hypochlorite equivalent to 2 mg. of available chlorine per liter, which corresponds to about 50 pounds of chlorinated lime per million gallons of water. Bassenge recommended for disinfection on a large scale the enormous quantities of 2,445 pounds of chlorinated lime for a ten-minute contact period down to 270 pounds of chlorinated lime for two hours' contact. To eliminate the taste a quantity of calcium bisulphite, $Ca(HSO_3)_2$, somewhat larger than the quantity of chlorinated lime employed had to be added. Bassenge decided on the use of calcium bisulphite for the neutralization of the excess of chlorine with the advice of Dr. B. Proskauer. Calcium bisulphite is a saturated solution of calcium sulphite in sulphurous acid. It has the strong odor of that acid. On standing it decomposes, forming calcium sulphite and water. The reason Bassenge did not make use of sodium sulphite as did Traube, was that it forms sodium sulphite in sufficiently large quantities to have a marked therapeutic effect which would not be the case with calcium bisulphite. An additional reason was that the free acid present would more readily combine with the chlorine than would the neutral sulphite. No definite quantity of bisulphite was recommended since it rapidly changes on storage. The quantity had to be determined each time by actual trial. Lode likewise used excessive quantities of chlorinated lime and advised the use of either sodium or calcium sulphite for the neutralization of the chlorine after 5 to 10 minutes' contact. Later he went quite thoroughly into the question of removing the taste by various chemicals, of which he preferred the neutral sodium sulphite, but also recommended for disinfection quantities of chlorinated lime as high as 1,250 pounds per million gallons of water.

It is also interesting to note in connection with the early disinfection experiments, that acids were brought into con-

tact with the water after the chlorinated lime has been added, in order to liberate the active chlorine which otherwise would not enter into the reaction. Lode adds for each pound of chlorinated lime about 1.2 pounds of concentrated hydrochlorite acid. Citric acid likewise has been used in quantities of approximately 15 grains per gallon of chlorinated water for the same purpose. It is said that the taste was not influenced by the addition of the citric acid.

From the foregoing it must be apparent that even if the taste was effectively removed by the addition of various chemicals, the treatment of water supplies at that time must have proven too expensive to be considered anything more than a temporary relief measure in times of epidemics. As such the Traube-Lode process was employed during a typhoid epidemic at the Austrian city, Pola, in the fall of 1896 and the winter of 1896-97, by Dr. Meerans on the recommendation of V. Kusy. A total of 450,000 gallons of treated water was supplied during that period and sodium thiosulphate ($Na_2S_2O_3.5H_2O$) served for the elimination of the taste. The consumers became eventually used to the water in spite of its high turbidity resulting from the chlorinated lime treatment. Lode criticized the use of sodium hyposulphite in Pola and assumed that it had been used by mistake, since in his earlier writings, he called the sodium sulphite "Antichlor," which as a matter of fact is the trade name for sodium thiosulphate.

The uncertainty of the quantity of chlorinated lime to be added to different waters and the almost general introduction of safer ground water supplies led the Germans to abandon altogether this treatment as a permanent procedure.

There are, however, industrial regions in Germany where similar conditions exist in regard to water supplies as in this country, which have caused renewed interest in the hypochlorite treatment. Such conditions are met with in the coal mining region of the Ruhr watershed and the disinfection of more than a dozen waterworks supplies carried on by H. Bruns with quantities somewhat smaller than those originally employed by Traube, gave with two exceptions very satisfactory results. The quantities of chlorinated lime varied between 12.5 and 25 pounds, (containing approximately 33% of available chlorine) per million gallons. While complaints were frequent when the treated water was used by the consumers, the complaints ceased as soon as sodium thiosulphate was added as a routine measure. The compound was added 15 to 30 minutes after disinfection in quantities equivalent to 50 to 70% of the weight of the chlorinated lime. As spoken of above, the disinfection was a failure in two cases. In one case the organic contents of the water expressed as "oxygen consumed" reached as high as 30 p.p.m. and in the other case the water contained 2 p.p.m. of iron.

The good results obtained on adding taste removing chemicals induced us to believe that like results could be obtained in our "hypo" plants where the amount of chlorinated lime approaches the limit of recognizable taste. In some of our own observations we found that 0.6 p.p.m. of available chlorine (equivalent to 15 pounds of chlorinated lime per million gallons) was about the smallest quantity which could be readily tasted but it is a fact that even smaller quantities are discerned by sensitive non-smoking consumers, particularly when the temperature of the water is high. We should remember that in plants where smaller quantities, such as 6 to 8 pounds of chlorinated lime per million gallons, are employed, accidental overdosing followed by a flood of complaints, is frequent. W. H. Dittoe and R. F. MacDowell, in reporting on the result of an inquiry among a large number of cities in United States and Canada, in which "Hypo" treatment is installed, state that a taste is not often noticed when chlorinated lime is applied in quantities of 7 pounds per million gallons or less, but that there is often complaint on using larger quantities. However, with certain waters even smaller quantities may produce tastes and odors. It would then seem an advantage to apply a "sure cure" remedy if this can be done without materially influencing the cost of the treatment. Our tests have been made on Lake Michigan water and, while the relation of the chlorine to the chemicals applied theoretically remains the same, it is possible that the actual quantities would require adjustment with different water supplies.

We know that storage of chlorinated waters by itself is a simple method by which to rid the water of the taste, depending on the time allowed for this purpose. The chlorine taste in lake water treated with 12.5 pounds per million gallons disappeared, at room temperature, in a little over 3 hours. Simple aeration will hasten the disappearance, reducing the time to something like 2 hours with the same quantity of bleach. The amount of air applied was 0.3 cubic feet per gallon of water. It may also be stated here that the elimination of the taste coincides well with the disappearance of the potassium iodide-starch reaction. There is no definite chemical reaction taking place on aeration which would account for the speedier elimination of the taste; the chlorine seems to be carried off by the air bubbles passing through the liquid. On a large scale a prolonged storage period or storage with additional aeration would be in most cases not a practicable procedure.

Contact of chlorinated water with wood charcoal will quickly do away with the chlorine taste but the water in our experiments absorbed certain ingredients from the charcoal which, by themselves, resulted in a pronounced taste. Whether other carbonaceous material will give like results we do not know, but it is probable that sedimentation or filtration would be subsequently required to rid the water of the matter in suspension.

The chemicals which seem of value for the purpose of removing the chlorine taste from waters are sodium sulphite and sodium thiosulphate, both of which are strong reducing agents and form tasteless compounds when brought into contact with chlorine. The calcium sulphite and calcium bisulphite which have been employed by some early observers have not been utilized by us for the reason that they are not readily obtainable and too expensive for practical application even when bought in bulk. The calcium sulphite, $CaSO_3.2H_2O$, is only sparingly soluble in water; the calcium bisulphite, $Ca(HSO_3)_2$, is very unstable on account of the presence of free sulphurous acid and it is not a commercial preparation. When coming into contact with chlorinated lime the reaction is analogous to the one taking place with sodium sulphite:—

$$CaSO_3 + CaOCl_2 = CaSO_4 + CaCI_2$$
$$Na_2SO_3 + CaOCl_2 = Na_2SO_4 + CaCl_2$$

Our experiments on the neutralization with sodium sulphite were made on late water treated with chlorinated lime as well as free freshly generated chlorine and practical tests coincided well with the theoretical quantities of chemical as determined by calculation. For 0.01569 gm. of bleach containing approximately 33% of available chlorine 0.01815 gm. of crystalline sodium sulphite were required, or 1.2 pounds of sulphite for each pound of chlorinated lime. When free chlorine is employed the reaction taking place is:

$$Na_2SO_3 + 7\ H_2O + Cl_2 = 2HCl + Na_2SO_4 + 6H_2O$$

One pound of liquid 100% chlorine would necessitate the addition of approximately 3.6 pounds of crystalline sodium

sulphite for neutralization. An important point to keep in mind is that it takes as much sulphite for the free chlorine as for the total available chlorine in chlorinated lime to remove the taste of treated waters. The reaction between the sulphite and the chlorine takes place instantaneously, thus removing the taste as well as the odor at the same time. No harm can be done with a reasonable overdose since the sulphite could not be detected in such low concentrations. Furthermore, it would take but a very short time for the dissolved oxygen in the water to convert the sulphites into sulphates. Medicinally the sulphites are of low toxicity and fairly strong antiseptics on account of their ability to withdraw oxygen from organic matter, but they are rarely used nowadays for that purpose. The average medicinal dose is 15 grains. Supposing we overdose a treated water containing 10 pounds of chlorinated lime per million gallons with 50% of the quantity of sulphite required, which would be an excess of 6 pounds, one would have to drink about 370 gallons of the water to get a single medicinal dose, not considering any oxidation into sulphates at all. Since the medical dose of sodium sulphate, which is formed in the reaction, is 240 grains, its therapeutic effect is surely negligible. The wholesale price of crystalline sodium sulphite is approximately 4 cents per pound when bought in 100 pound lots. This would add about 125% to the cost of the chlorinated lime, assuming that the market price of chlorinated lime containing 33% of available chlorine is 2⅛ cents per pound. Considering the benefit to be derived in many cases from the use of the sulphite, the additional cost would not seem unreasonable. There are, however, serious drawbacks to the continued use of sodium sulphite, one of which is the fact that it deteriorates readily, forming sulphates, which of course are completely inert as far as the taste-removing property is concerned. Weak solutions in particular will change from day to day. We have noted N/40 sodium sulphite solutions to weaken over 50% in less than a day. The aqueous solution of the sulphite is neutral or feebly alkaline and has a cooling, saline, sulphurous taste.

The sodium thiosulphate, $Na_2S_2O_3.5H_2O$, as first applied in Pola and recently recommended by Burns, has striking advantages over the sodium sulphite. It is commercially used very extensively as "Antichlor." When sodium sulphite comes into contact with chlorine the reaction taking place is the same as with iodine. With thiosulphate the oxidation is more complete, and this therefore alters materially the proportions of chlorinated lime and thiosulphate necessary to do away with the taste and odor. The reaction is as follows:

$$Na_2S_2O_3 + 8Cl + 5H_2O = Na_2SO_4 + H_2SO_4 + 8HCl$$

The acids formed in the neutralization process immediately combine with bases to form neutral salts. Lode stated that in his experiments he found it impossible to establish quantitatively corresponding values of chlorine and thiosulphate, and he recommended 0.8 to 0.9 of the quantity of chlorinated lime for the purpose of taste removal. Bruns recommends values of 50% to 70% of the quantity of chlorinated lime applied. As a matter of fact, it seemed impossible in our experiments to obtain checks when a chlorinated lime solution was titrated with a thiosulphate solution under addition of potassium iodide and starch in the absence of acid. Of course, when acid was added and all of the available chlorine became liberated, checks were readily obtainable. This was likewise the case when the same definite quantity of potassium iodide was added, each time without acid, and the solution immediately titrated. We have found, however, that the theoretical quantity of thiosulphate necessary to complete the reaction and remove the taste as well as odor coincide always with the amount necessary to satisfy the total available chlorine in the chlorinated lime employed. For one pound of chlorinated lime containing approximately 33% of available chlorine, the theoretical quantity would be 0.28 pounds of crystalline thiosulphate, or approximately 30% of the weight of the chlorinated lime. One need not be afraid to add an excess, since even 100 pounds of thiosulphate in one million gallons of pure water cannot be tasted. As a matter of fact, we should strongly recommend the application of thiosulphate in quantities of one-half of the quantity of the chlorinated lime to be on the safe side at all times and to take care of all reasonable overdosing with chlorine.

The commercial sodium thiosulphate is about 98% pure; it is a colorless, odorless salt possessing a cooling taste, afterwards bitter. It is very stable in air below 92° F., but loses moisture above that temperature. It greatly exceeds the chlorinated lime in stability. The salt is readily soluble in water and neutral or faintly alkaline in reaction. The medical dose of thiosulphate is the same as that of the sodium sulphite. Formerly it has been used to a limited extent as a weak antiseptic. The price of the commercial preparation is about 1.85 cents per pound when bought in 100 pound lots; it is therefore cheaper than chlorinated lime.

To summarize the advantages of the sodium thiosulphate over the sodium sulphite, we would say that it is much more stable, much cheaper, and that it requires less in actual weight to accomplish the same result. The combined cost of the treatment is within easy reach of a community, since it adds but 40% to the cost of the chlorinated lime, and the advantage of its application will best be appreciated in places where taste troubles are frequent. Even when less than the theoretical quantity of thiosulphate is added, it is bound to lessen the frequency of complaints. A very important point to keep in mind when such treatment is resorted to is that the thiosulphate stops the germicidal action of chlorine the moment it comes into contact with the treated water. This is not of serious consequences, however, since we know positively that the destruction of bacteria by the chlorine is extremely rapid and in most cases practically completed in the first five minutes. We should recommend, however, at least 10 to 15 minutes as a safe margin, or even more when conditions warrant. When the chlorinated water is stored, the simple addition of the thiosulphate in solution will suffice, care only being required to obtain a fair distribution. There is not much chance for the thiosulphate to unite with substances other than chlorine, since those compounds have a pronounced chemical affinity. Where the treated water is directly discharged into the mains, without previous storage, provisions will have to be made to dose the treated water continuously with thiosulphate at a point where disinfection has been practically completed. The thiosulphate does not attack metals, and therefore would not cause trouble in the dosing chamber, as does the chlorine. Where quantities like 2 to 5 pounds of chlorinated lime are applied and the dosing can be made reasonably automatic, the application of thiosulphate will hardly seem necessary. However, where larger quantities are required and taste troubles ensue, our observations would lead us to recommend the application of sodium thiosulphate as a permanent procedure.

Argentina owes a great part of her present prosperity to the excellence and extent of her railways, and in this connection a tribute is due to the courage and persistence of British railway men and investors, who were the pioneers of construction. As more and more the necessities and advantages of railways are being realized, so it may be expected that development will be even more rapid in the future than it has been in recent years.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

To Raise the Level of Lake Erie..... 117
The Engineer and the Language 118

Leading Articles:

Plate Girder Bridges in Railway Construction (Part II.) 101
Conclusions Regarding Macadam Road Construction 108
Stone Production in Canada 111
Allowable Heights and Areas for Factory Buildings 112
The Elimination of Taste in Treated Drinking Water 114
The Engineer and the Social Problems..... 119
Pressure Filtration Plant at Haileybury, Ont.. 125
A Scientific Selection of Pavements 127

Coast to Coast 129
Personals 131
Coming Meetings 132
Engineering Societies 132
Market Conditions 92-94
Construction News 75
Railway Orders 82

TO RAISE THE LEVEL OF LAKE ERIE.

Canada and the United States are equally interested in the recent finding of the International Waterways Commission as a result of its investigation into the possibilities of raising the level of the water in the upper Niagara River and Lake Erie. The problem has been under the Commission's examination for a number of years, and the recent recommendation is but one of a number of suggestions towards its solution.

Briefly, the International Waterways Commission, a body representative of both countries, has just recommended to their respective governments, the building of a submerged weir in the Niagara River at Hog Island, just above the Welland River, on the Canadian side, to extend toward the New York shore to a point opposite Gill Creek. If carried out, the restriction to flow will raise the level of the upper waters of the Niagara through a height of three feet for a distance of approximately one and a half miles. The effect opposite Buffalo would be an increased level at low water of 1.08 feet, and at flood of .19 feet. The level of Lake Erie would be raised .31 feet at low, .39 feet at mean, and .11 feet at extreme flood levels. Extending into the upper lakes, the mean level of Lake St. Clair would be influenced to an extent of .23 feet increase, and that of Lake Huron by .09 feet. The cost of the weir, including the levees necessary to protect adjoining shore properties, is estimated at $3,500,000.

Of particular importance, as it would be to the towns and cities on Lake Erie, whose docks and harbors will be rendered more usable, and whose water transportation facilities will thus be considerably enhanced, the proposed dam would have no appreciable effect, it is claimed, upon the waters below it. Lake Ontario and the St. Lawrence would not suffer from any perceptible decrease in flow from the Niagara. The only precaution necessary, below the weir, would be the construction of a guard-lock in the barge canal at Tonawanda, N.Y., to remedy the effect the new weir would have upon its level.

The Commission pointed out that the weir would be of further value in eliminating any injurious effect upon the level of Lake Erie, due to the diversion of water at Niagara Falls for the generation of hydro-electric power, and also that it would reduce the degree of variation in the Lake Erie water level by four and a half per cent.

Several years ago the Commission submitted a report on the advisability of constructing an ordinary dam across the Niagara for the purpose of controlling the Lake Erie level. The scheme did not meet with favor, the Commission considering as too great the possibility of consequent damage to property below the dam, and, although the present recommendation aims at only partial control, the disadvantageous possibility of detriment to property is largely eliminated. Surveys had also been made for a proposed site immediately below the mouth of the Welland River, but the probability of resulting floods from a weir built at that point defeated any advantages the location presented.

In connection with this scheme, it is of interest to recall the suggestions made some years ago by the United States War Department, that a weir be built along the crest of the Falls, having for its purpose the distribution of flow over the brink, and resulting, it was predicted, in increased grandeur of appearance. According to the report, however, this would have had no effect upon the level of the water in Lake Erie.

THE ENGINEER AND THE LANGUAGE.

In an address delivered in 1909 to one of the university engineering societies in the United States, Mr. Onward Bates, C.E., then the president of the American Society of Civil Engineers, states that engineers' opinions should be expressed with a regard for accuracy equal to that used in their mathematical computations, and that precision in written and spoken expressions of fact and opinion is most essential in a profession that is so exacting in its nature as that of engineering. Just how far the average engineer's command of the English language falls short of such accomplishment has its solution in the frequently aired criticism that engineering is a narrow and extremely one-sided profession. The engineer is prone to leave to the followers of other professions the copious use of language. Other people do the talking while he works—the drawing up of contracts and the writing of specifications and reports are the literary works of the average practising engineer. It is true that in these examples of literary ability one does not always find clear and distinct thoughts and correct representations. Serious complications frequently arise as a result of the derivation of divers meanings from expressions failing to convey a simple idea. This is a practical example, showing that the criticism is not without foundation.

Justly considered, the engineering profession is not inferior to the legal, ministerial, or medical professions, but, compared with them, it has a remarkably small amount of necessary writing associated with it. To this fact is attributable the impression among engineers that the careful attainment of facility of language is not as necessary in his profession as in the others. Experience has taught severe lessons in a manner mentioned above, in dislodging this erroneous idea.

Accuracy in engineering demands accuracy of expression, and has a severe handicap in lack of facility of language. According to Mr. Bates, and others, this shortcoming, and it is quite general among engineers, has its rising at the universities, from which men graduate insufficiently equipped in the matter of knowledge of the English language, a most important requirement. In these days of specialties in technical courses, one cannot expect to master all, and to the student, as to the instructor, the essentials of mathematics, the use of engineering instruments, and the general principles upon which engineering is based, leave little or no time for studying English. A man thus graduates with a university degree backed by a preparatory school certificate in English, which is not enough. It only requires such an address as that of Professor Swain, appearing in this and the last issue of *The Canadian Engineer*, to illustrate how important an instrument in the hand of the practical engineer is a thorough knowledge of language. Be a man's training what it will, in the literature at his disposal, and in the writing, for the benefit of others, of his own ideas, the engineer of to-day need anticipate no better opportunity for elevating himself in his profession, than by adding to his equipment, more of this necessary part.

One thing is certain, an engineer of all men requires such knowledge of the technique of the language that he can use it with accuracy and facility at all times. The bad construction of a sentence or the erroneous use of a word may result in costly litigation and heavy loss; therefore, the language merits far more study than the best technical courses provide.

EDITORIAL COMMENT.

The recent awards by the Hydro-Electric Power Commission of Ontario of contracts in connection with the construction and equipment of a hydro-electric power plant at Wasdell's Falls, on the Severn River, denotes an important event in the history of the Commission. The opening of the headgates of this power plant should be observed with ceremony, as it is an epoch-making event, announcing the entrance of Ontario into a period of extensive generation of hydro-electric power from its many inland waters, and the accompanying distribution of it throughout the Province by the Hydro-Electric Power Commission. It is likely that the plant at Wasdell's Falls will be followed closely by several others, and that at the close of present season plants will be in operation.

* * * *

The Canadian Pacific Railway Company will electrify a section of their line in the mountain division, it is announced, and if the results obtained warrant it, the electrification of many of their mountain branch lines will follow. The replacement of steam locomotives by electric tractive power, even in this small degree, marks a new period in Canadian transportation development. When the Canadian Pacific will realize, by this innovation between Rossland and Castlegar, the advantages of electricity over steam for mountainous traffic, other electrification units will follow in rapid succession. A 2,400 volt, direct current, trolley-system is the service that has been decided upon for the new project.

* * * *

In his report to the Minister of Lands, Forests and Mines, Ontario, Roads Commissioner J. F. Whitson recommends an expenditure of $1,000,000 in the construction in main and trunk roads and in the improvement of existing roads in the districts of Northern Ontario. The report, which covers the work accomplished in 1912, contains information concerning the construction of some thirty roads up to the end of the season in November. A statement of the expenditure on this road construction in Northern Ontario, which is carried on under the Northern Development Branch of the Department of Lands, Forests and Mines, is as follows:—

Wages of Workmen		$112,155 76
Amount paid on road construction under contract		32,633 64
Salaries of office staff, including assistant engineers and inspectors		7,726 48
Camp equipment—tools, implements, road machinery, tents, blankets, utensils, etc.		13,035 90
Supplies, provisions, freight and express charges, etc.		39,594 35
Insurance on warehouse and contents, Cochrane		380 00
Office expenses—		
Stationery and printing	$269 35	
Travelling, railway and hotel expenses	986 64	
Postage and telegrams	97 48	
Furniture, rent of offices, equipment and incidental expenses	897 31	
		2,250 78
Medical and surgical expenses for workmen		248 05
Other expenses, made up of small accounts, livery, etc.		421 35
		$208,446 31

THE ENGINEER AND THE SOCIAL PROBLEMS

THEY ARE WITHIN HIS PROVINCE — HIS CAPABILITIES FOR SOLVING THEM—THE POSSESSION OF CONSERVATISM AN ESSENTIAL SAFEGUARD — MORE RECOGNITION FOR EXPERIENCE, KNOWLEDGE AND SPECIALIZED TRAINING

By DR. GEORGE FILLMORE SWAIN, Pres. Am. Soc. C.E.

(Continued from last issue.)

[NOTE.—As stated at the beginning of this article in the issue of June 26th, *The Canadian Engineer* is preparing a forty-page pamphlet containing the entire address of Prof. Swain. A limited supply of them will be ready in a few days and will be mailed upon request.—ED.]

TWO of the most important requisites for authority in matters of opinion, seem to be a spirit of conservatism, and the possession of good judgment. The man who is slow to advocate a change, who adheres instinctively to old ideas and practices until there is reasonable ground for the belief that a change will be beneficial, is clearly a safer guide than he who rushes into all sorts of new schemes and is ever ready to throw aside the results of years, because perfection has not been attained. Conservatism is the brake which prevents our rushing to destruction. The possession of grasp and of good judgment is also essential. By these are meant the ability to see all the elements entering into a problem and to see them in their proper proportion. The narrow-minded man does not see all the elements in a problem; such a man lacks grasp. The unbalanced man, while he may see all the elements, exaggerates some and minimizes others; such a man has poor judgment. The advice of either is unreliable.

It is worthy of fuller inquiry what the reasons are, reduced to their elements, which cause men to differ in their opinions. Take almost any subject, except one dealing with abstract relations, and opinions may be cited which are diametrically opposite. Take such a subject, for instance, as the relation of forests to stream flow. Here we have a scientific subject, regarding which it might be supposed that experiments or observations might be made, scientific principles applied, and opinions reached which would be agreed upon by all intelligent men conversant with the subject. And yet, on this subject, and still more so on even more speculative subjects, men of equal authority or experience will be found holding diametrically opposite views. Why is it?

It seems to me that if intelligent men differ on any subject, it must be due to one or more of the following causes:

1. One or the other is not in possession of all the facts or principles involved.
2. One of the other may use facts or principles which are incorrect
3. One or the other may reason incorrectly.
4. One or the other may see the facts out of proportion, attributing too great importance to some and too little to others.
5. One or the other may illustrate the natural stubbornness or imperviousness of the human mind.

It is not always clearly recognized that facts cannot always be compared directly, because they cannot be expressed except in incommensurable terms. For instance, if we ask which is the greater, six feet or two meters, there will be no disagreement in the answer; but if we ask which is the more important, 10 feet or $5, or which is more important, truthfulness of beef steak, the reply is not entirely obvious. These are not fanciful illustrations. We are continually obliged to make comparisons between things which have to do with our physical well-being and those which have to do with our moral or spiritual well-being. They are incommensurable, yet they must be compared and an opinion formed from the comparison. In planning a railroad station, for instance, a certain design requires the passengers to walk a certain number of feet, while another design costs more but requires less walking. Here is a comparison which must be made between feet and dollars. In such a case, some will endeavor to express the comparison in commensurable terms. They will compute, perhaps, the value of the shoe leather that would be saved in a year if all the passengers using the station have to walk the given distance less, and compare it with the interest on the additional expenditure. Similarly, the expenditure of millions of dollars is asked for electrification, the advantage urged being the saving of a certain number of minutes each day for each passenger and because the aggregate saving of time in a year, valued at the average annual wage of an individual, amounts to a sum greater than the interest on the cost. Such comparisons are generally made by those who find their judgment unable to deal with the subject in any other way, who cannot compare except by measuring or weighing, as they have been trained or accustomed to do. Yet, such persons do not realize that the comparisons they make may be entirely deceptive. Although more rapid transit may render a journey quicker, it does not follow that the time is saved. It may be usefully employed in reading, or in conversation, or in sleep, or in meditation. An additional fifteen minutes spent in going from one's house to one's office, is not necessarily lost; it may be utilized like any other fifteen minutes in the day. Even if spent solely in meditation, it would be most beneficial, for, as Arnold Bennett says, the great defect of the age is the absence of meditation. In such arguments as that for electrification the mistake is also made of not considering whether the individuals who would make the saving claimed are the same individuals who would bear the increased cost.

Referring to the classification above, it is evident that an ability to observe correctly, the faculty of getting at all the facts, and of knowing when all the pertinent facts have been collected, the ability to reason from those facts, the possession of conservatism, the absence of stubborn persistence in holding a previously formed opinion in the face of proof of its error, and, above all, the faculty of seeing things in proper proportion, or good judgment, are essential in forming an authoritative opinion.

How can the absence of these qualities be detected? To discuss this would lead us too far, but there are one or two points to which I wish to refer. For one thing, dogmatism, or intellectual arrogance, in speculative or uncertain matters, is an almost certain indication of disqualification. The man who in such matters shows intolerance of opinion, may generally be disregarded. He who in matters of opinion is cocksure, who terms all men who disagree with him knaves or fools, who resorts to epithets and extreme statements, who asserts that all honest men should believe as he does, or who

makes similar assertions, is either wilfully trying to mislead, or is unworthy of credence. This is a fault which is observable particularly in the immature, whether old or young in years.

If, therefore, we find an author proposing changes in political or social conditions, who, referring to eminent men at least as honest and intelligent as himself, and more learned and experienced than he is, in terms of disrespect, we may be pardoned if we surmise that the temper and judgment of the author are not such as to entitle his words to be received with authority. So, also, if we detect what we believe to be frequent gross errors in reasoning, or a temperamental lack of the power to see things in what is clearly their proper perspective, we may save ourselves the trouble of pursuing such an author farther, even though his sentences are adorned with flowers of rhetoric or by Biblical quotations.

The Disregard of Experience.—One of the most serious tendencies of the present day, particularly in the United States, a tendency which, like the disregard of authority, seems to result from that to regard men as equal, is the disregard for experience. It is a tendency fraught with great possibilities for evil, which must be recognized by every serious thinker.

In any occupation, except those which have to do with the study of purely abstract relations, which, as above explained, may be arrived at correctly in the seclusion of the study, it is almost self-evident that experience is of great value. In any occupations having to do with pure and applied science, and particularly in those having to do with man and his relations to society—that is to say in politics, economics and government, as well as in engineering—experience is a necessary qualification for arriving at correct judgments. A person having a power of perception of mathematical relations may become a profound mathematician at an early age; indeed, the perception of mathematical truths is essentially a subjective faculty, and may be most correct and powerful when the mind is removed from the objective state. Some mathematical prodigies have reached their greatest power when mere boys, and have lost it with increasing age and contact with the objective world. But, in business affairs, no amount of reading of books or of closet meditation can take the place of actual experience. But, if all men are equal, then the boy's opinion is as good as the man's, and experience is a mere useless drag.

It seems to be an inherent tendency of our form of government, to disregard the value of experience; any man is considered good for any job; all he has to do is to get the votes, by one means or another. Men who have made little or no study of government, and who have had no experience in it, are considered capable of judging of and administering laws and of occupying any elective or appointive position. The butcher, the baker, the candlestick maker, are all eligible for the state legislature, for congress, for the senate, for the mayoralty, or the presidency. This condition necessarily results in gross inefficiency and waste, not always through evil intent, but perhaps more often through stubbornness, ignorance, conceit, or the unwillingness or inability to select and take good advice. We talk much of graft and rightly condemn it. But, as Lecky has pointed out, corrupt governments are not necessarily extravagant. Graft is injurious mainly to those who practice it. Inefficiency and inexperience are much worse for society in general; and laws which hamper industry, which harass property, or which—through unwise taxation, or extravagant state expenditures for the benefit of particular classes—plunder large portions of the community, are much more injurious to the general good than the pilfering of a few thousands of dollars a year. Sir Henry Maine remarks that the form of bribery which is most to be feared in a democracy, is that of "legislating away the property of one class, and transferring it to another."

Only in one department do we recognize experience, knowledge and specialized training as necessary, and that department is the administration of justice. No one but a trained lawyer is considered eligible for the position of judge, and in most instances, judges are appointed and not elected, and are, therefore, not driven to seek the votes of the mob, or subject to popular whim, or the arts of the demagogue. For this reason, our courts have been rightly deemed the safeguard of our liberties. Not until our legislators and our administrators of public affairs are chosen from men trained and experienced, and who have ascended from the bottom step by step, will efficiency, economy and wisdom be attained in our government. Whether this time will ever be reached may well be doubted. We are much less advanced in this respect than some of the countries in Europe, where the expert is more recognized and has a higher standing, and where knowledge, and particularly experience, are valued higher than here. If financial measures are under consideration, men experienced in finance should be sought and their advice followed. In our country, experience in finance seems to be to-day looked upon as a disqualification for giving sound financial advice, and the same in railway and other affairs. Under such conditions, satisfactory results cannot be attained. Either, as a people, we are more dishonest or more unwise than the people of Europe.

In these days, when higher education is a fad, there is an increasing tendency, in my opinion very pernicious, to regard book knowledge as the equivalent of experience. We are more and more inclined to regard those as able to speak with authority, whose knowledge is derived simply from books, who perhaps have spent their lives in a professorial chair, with no actual experience in the subjects they teach or write about. We shall in time learn the fallacy and danger of this; but, in my opinion, at the present time great harm is being done by talking too seriously, in questions of politics, government, economics, finance and business, and sometimes in engineering, the opinions of theoretical men and closet reformers, whose advice we would not think of following in the conduct of our own private affairs. Some of these men will come within the class of those who, to use the phrase of Mr. E. P. Ripley, president of the A. T. & S. F. Railroad, have "zeal without knowledge, and enthusiasm without sanity."

Of course, it must not be supposed that experience is everything. In some cases, experience only confirms a man in rule-of-thumb practice, works him deeper and deeper into a rut, and destroys his power of vision. Probably all of us have seen instances of men, whose long experience in doing a particular thing in a partcular way has only destroyed their power to see that there is another and a better way, and whose only reason for doing that thing in that way is that they have always done it in that way. Such men, however, would never, under any circumstances, be leaders. They are the soldiers in the ranks, whose only function should be to obey orders. It not infrequently happens, in the administration of some business affair, that a new man with a fresh mind, without experience in that line, but with a power of selecting good advisers, of grasping a new situation quickly, of seeing all the elements involved and of judging them correctly, will arrive at a truer decision than another man of less grasp and judgment, though experienced in the matter in question. This, however, is no argument against experience, but simply illustrates that experience must be combined with grasp and judgment: for the new man, before he becomes really proficient, must either gain his experience, or must be able to select his advisers well and to rely on them.

Not only is experience discredited to-day, but we actually find inexperience put forward as a virtue by men who should know better. One candidate for an important elective office, in an address to the electors just previous to the election, urged his qualification for election, on the ground that he had had no business experience which would prejudice his judgment in the matters which would come before him. Is not this a serious disqualification—an admission that his temperament is such that experience would prejudice him, and not teach him? Do we not want men in office experienced in the affairs they are to deal with, but fair-minded and of good judgment, whose experience, instead of warping their judgment, aids and matures it? Woe be to us as a nation when we place inexperienced men in office for fear that experience would warp their judgment.

It is, nevertheless, true that men differ greatly in the amount of experience which they need in order to perfect their powers. This will depend upon the rapidity with which they can assimilate it, and the philosophical character of their minds. It has been said that the wisest man is he who can do with the least experience; that is to say, the one who does not need to have an experience repeated again and again before he learns the lesson which it teaches, but who only needs one experience to learn its lesson, and who can extend that lesson to cover other possible experiences, thus rendering the latter unnecessary.

When we are asked, therefore, to believe and advocate any proposed policies, let us train ourselves to apply certain touch-stones before we commit ourselves. If the subject is one within our experience, knowledge and reasoning powers let us endeavor earnestly to think the matter out for ourselves and arrive at our own conclusions. In the many cases in which we cannot do this, let us carefully scrutinize the policies and their proposers, to determine how much credence we can give. Let us observe whether the author asserts them dogmatically or modestly; let us note whether he makes assertions without proof, and by incessant repetition endeavors to make us believe that assertion constitutes demonstration; let us ask whether he speaks from experience or simply from book knowledge; let us remember that he is not free from the frailties of human nature, and let us, therefore, inquire whether he has any personal interest at stake; let us assume an attitude of doubt and distrust toward all human opinions until that doubt and distrust are effectually removed. It is said that it is better to be deceived than to distrust; but, after we have been deceived, we shall be more inclined to reverse this saying, and to consider that, in the reversed form, it will be, upon the whole, safer and more conducive to our happiness. Let us be on our guard against assuming that good intentions are a guarantee of authority, and when we find ourselves in danger of being influenced by flowers of rhetoric, let us remember that "no man is more dangerous in a state than he who possesses in an eminent degree the power of moving, dazzling and fascinating his contemporaries, while in soundness of judgment he ranks considerably below the average of educated men"; and let us further bear in mind that "an excessive love and admiration of rhetoric is one of the diseases to which democratic communities are most liable."

The Tendency to Relax Discipline.—Another of the demoralizing tendencies of the equality of man is that which has led in recent years, it seems to me, to the gradual but steady relaxation of discipline. It will probably be denied by few that for the proper training and full development of the human being, discipline is necessary. Life itself is little more than discipline; it is not for pleasure; it is for work, accomplishment, development; without discipline there will be no proper development. He who is born with a golden spoon in his mouth and whose life is a continual round of pleasure, is likely to go out of the world less developed than when he entered it. "The beginning of wisdom," says Solomon, "is the desire of discipline." Work, which is itself an end, and rather to be sought than what it brings, consists largely in doing things which in themselves are uninteresting and perhaps distasteful, and we must accustom and train ourselves to be able to do this kind of work cheerfully and well. This ability will be attained only through discipline. Moreover, the man who attains a position of responsibility must be able to direct and command the work of others, and no one can command wisely until he has first learned how to obey. For this, too, discipline is necessary. Yet the tendency of recent years seems to me to have been toward a steady relaxation of the discipline imposed by law and custom upon the growing individual.

Dr. Swain then referred to the tendency toward the relaxation of discipline in educational institutions, and likewise in the application of our laws, whereby offences are condoned, and sympathy instead of sternness administered, thus encouraging a spirit of lawlessness and an unwillingness to submit to proper restraint.

The Spirit of Innovation.

Another of the tendencies very marked at the present time, is the spirit of innovation, which seems to pervade all things; whatever is, is wrong: the social custom must be changed in order to keep up with the time. This spirit is particularly observable among the young and the immature, especially if it has been preceded or accompanied by a lack of discipline in early training. It is an instance of what Ferrero terms "that youthful spirit of innovation which is in all ages the main source both of perversion and of progress." Many of our young men "all aflame with an enthusiasm unquenched as yet by any continuous contact with affairs," set out to reform the world, not so much because it needs reform as because they wish to justify their existence. This spirit of innovation is at all times a spirit to be expected and reckoned with. Every generation as it comes along, will endeavor to change the condition in which it finds itself, and will designate that change with the name of progress even though it be perversion.

This spirit of innovation which pervades all things seems to be largely a result of scientific progress; the rapid advances made in inventions of all kinds, the improvements in the arts and manufactures, have resulted in a complete revolution of the methods in many branches of industry within a comparatively few years. Men are now living who were born before there were any railroads, and almost all of us can remember the time when the applications of electricity were just beginning. An industrial plant but a few years old may be out of date and unable to compete with newer and more economical installations. We are accustomed in engineering matters to see things completely remodelled within a short time.

This familiarity with industrial change and the recognition if its benefits has naturally led to the idea that everything must be reconstructed, or it is old-fashioned and out of date, even though it be a thing in which there have been no new discoveries, warranting any change whatever; music painting, dancing, education—everything, in fact—must be completely reorganized. This willingness and desire for change affords the opportunity for unsuccessful mediocrity and for ambitious and unscrupulous failure to foist upon the public, which eagerly accepts it, forms of change which discerning men must characterize as gross, ridiculous, and demoralizing. The result, in many cases, is a deterioration pitiable to behold. Let any one compare, for instance, the

modern painting, dancing and music, with that in vogue fifty or one hundred years ago, and he will find abundant proof of this. In politics and government too, the same tendency, the same recklessness, the same demoralization, are equally observable.

Now, of course, an existing condition is not necessarily the best because it is old; neither is a proposed change advisable because it is new. In many cases, however, suggested changes, ignorantly proposed by those unacquainted with history, have been tried and have been found wanting centuries ago. History repeats itself. Nations, like individuals, will only learn by costly experience. Away with the old, make way for the new! We will not profit by the lessons of our forefathers, we must experiment and learn for ourselves. In all matters, then, let us try to cultivate the breadth of view, the tolerance of opinion, which will lead us neither to adhere to that which is old from extreme conservatism, nor to indulge in rash experiments; but let us study history, cultivate a sound and deliberate judgment, and endeavor to guide the inevitable spirit of innovation into proper channels; and let us remember, as Lecky well says, that "an appetite for organic change is one of the worst diseases that can affect a nation."

Improper Use of Wealth.

Advancing civilization and increase of wealth inevitably lead to increased luxury and extravagance; and, with our advancing civilization, this tendency is not wanting. If the experience of the past is of any value, however, it is a serious symptom of degeneration. The sudden accession of great wealth, particularly to those who are incompetent to use it wisely, engenders luxury and ostentation, and a contempt for those less fortunate; thus stimulating, to a certain extent, an attempt of the latter, particularly if endowed with the ballot, to recoup themselves and gain what they conceive to be their rights at the expense of wealth, by various forms of unjust taxation and other well-known expedients. If it is our duty to preach the gospel of content and the inequality of man, it is equally our duty to preach the proper use of wealth, and the proper attitude of the wealthy toward those less fortunate; and while believing that individual initiative should be stimulated to the utmost, and allowed to enjoy the fruits of its success, it may, nevertheless, fairly be questioned whether some of the rewards under present conditions are not too large, and whether men would not exert themselves as well for the prospect of a more reasonable recompense as for the prospect of unreasonable and excessive riches. But again history repeats itself, and things move in cycles. Peace causes prosperity, prosperity gives rise to wealth, wealth gives rise to luxury and extravagance, luxury and extravagance are the source of contention, contention results in war or social revolution, these result in poverty, poverty results in peace, and so the cycle is completed.

The Part for the Engineer.

And now you may very likely have asked what has all this to do with engineering, or with the engineering profession; what is the appropriateness of a discussion of social conditions before a society of engineers? My answer is that the engineer is primarily a member of the social body; that its problems are his problems; and that he cannot avoid the responsibility of taking a share in their solution. The problem of the twentieth century, it seems to me, will be preeminently, a social problem, and upon its solution will depend the happiness of mankind for years to come. Moreover, this social problem is largely, as I have shown, the outcome of the work of the engineer who, as the advance agent of civilization, has been the main factor in creating the conditions which give birth to this problem. It will be evident, therefore, that I differ from one of my predecessors who, in his annual address, intimated that social problems were out of the province of the engineer and that he should not meddle with them. On the other hand, I maintain that it is his duty to exert himself in their solution. Moreover, I consider this duty the more necessary because I believe the engineer to be well fitted—possibly better fitted than any one else—to solve these problems wisely. Let me briefly give you my reasons for this opinion.

The engineer is by training a scientific man. If his education is what I conceive it should be, and what it will be more and more in the future, it will consist of a training in mathematics, logic, science and in the technical branches of his profession, together with a sufficient amount of study of the humanities—history, economics, language, literature—to give him a clear view of the relations of things. He will be pre-eminently by training a scientific man, but with a power of understanding and grasping social questions. Now, a scientific training has this great virtue, that its end and aim is constantly the discovery of the truth. The truth for its own sake, independent of everything else, is the object of the scientific man and therefore of the engineer. In this respect, it is, in my opinion, the noblest as well as the most widely useful of the professions. The lawyer is not always concerned in arriving at the truth; he is too frequently tempted to make the worse appear the better reason. As one of that profession has expressed it, his object is not to get at the truth but to win cases. He is constantly under the temptation to pervert the truth, or to suppress it, if the exigencies of his case demand.

Furthermore, the engineer is exposed to a very direct personal responsibility which cannot but steady his character and increase his self-reliance and self-control. While he does not always receive the credit of his success, he cannot succeed in throwing the responsibility for his failures upon others. If a lawyer loses his case, as Mr. Choate once remarked, it is never his fault; he can always charge it to the prejudice of the judge, or the ignorance of the jury, or the untruthfulness of witnesses. He goes on and obtains new clients and new fame. If the doctor loses his patient, it is never his fault; he can always charge it to the disobedience or delay of the patient, or maintain that a cure was impossible. But if an engineer builds a structure which fails or a machine which will not work, the responsibility is his and he is held accountable.

Again, the engineer is a business man, for engineering is business and business is engineerig; he deals with men, he has to do with financial affairs, he learns the characteristics of human nature, and his training, therefore, tends to teach him tact, moderation and conservatism.

Of course, any sweeping eulogy or disparagement of any class of men cannot be truthfully made. Engineers will differ on questions of opinion, as other men will. there are dishonest, untruthful, unreliable engineers, as there are men of this type in every class. No doubt the ranks of our society include men who will widely disagree with me on the questions which I have discussed; there are men who will hold extreme views in one direction or in the other; men who will be dogmatic, intemperate in language and in thought, inaccurate in reasoning, insincere in opinion. No class of men has a monopoly of virtue or of error. Neither are these excesses confined to men of weak minds or deficient training. As Lecky says: "Strange veins of insanity and capacities for enthusiastic folly sometimes flaw the strongest brains, and the impetuous ebullitions of youth which impel some men into extravagances of vice, develop in other natures into not less wild extravagances of thought."

Nevertheless, on the whole, if there is anything in training and experience, may we not believe that engineers, as a class, have the training, temper, and experience which will best enable men to judge sanely and solve wisely the social problems which confront us?

What, then, may the engineer do to aid in the solution of the social problems of the 20th century?

In the first place, he should consider it his duty not to retire into the technical recesses of his professional work and content himself with being the servant of other men, but should actively exert himself and take the initiative in the great problems of the day. He will find that these problems in their details are largely of an engineering character.

What, for instance, is involved in the problem of administering the affairs of a great city? Do they not involve, in the main, the preservation of the health, safety, property and order of the community? and are they not, therefore, predominantly of an engineering character? Financial and legal questions of great importance are, of course, involved, but why should the engineering problems be considered secondary to these? Engineers can employ financiers and lawyers, as well as be employed by the latter. I see no reason why the position of mayor of a city could not be filled at least as satisfactorily by an engineer with proper breadth of view, training and experience, as by a man of any other profession. Yet, I doubt if the mayor of any city in the United States is or has been an engineer.

The same holds true of other administrative positions. The management of our great corporations involves problems largely of an engineering nature, and high administrative positions in these concerns are being more and more given to engineers. Even such a position as that of president of a republic is not one which the engineer should necessarily consider himself excluded from. Why is he not as well qualified to fill it as a soldier, a lawyer, or a college professor, provided his training and experience, judgment and breadth of view warrant. Two of our greatest presidents, Washington and Lincoln, while not engineers, did have some little practice in what was then termed engineering, and one president of the French Republic has been a professional government engineer.

There is perhaps a tendency to-day towards better recognizing the qualifications of the engineer in the administration of municipalities and larger political units. The position of commissioner of public works in a city is perhaps the most important municipal position next to that of mayor. Formerly, this position was monopolized in most cities by men who were mere politicians. Nowadays, it is quite common to appoint engineers to such posts. In Boston, Philadelphia, Cincinnati, and very likely other cities, these positions are now held by trained and educated engineers, and this recognition I consider significant and deserved. Engineers, however, will not and should not be recognized in this way unless they show their interest in public questions, unless they inform themselves about them, unless they study the economic and social, as well as the engineering problems involved, and unless they assert themselves before the public. This, I trust, they will do more and more as years go by. "The fault, dear Brutus, is not in our stars, but in ourselves, that we are underlings."

A question which is much before us at the present day is that of conservation. Conservation, as I understand it, consists in a wise economy and proper use of the materials and resources that are afforded us by Nature. It is essentially the avoidance of waste; it does not mean that natural resources shall be withdrawn from use, but that they shall be used wisely and economically. It does not mean that the present generation shall suffer for the benefit of future generations, but that the present generation shall not [illegible] generations. Now, the technical problem of the avoidance of waste and the proper use of natural resources, is a problem already solved. Applied scientists can tell just what to do and how to do it. They know how to utilize the power of falling water and how to transmit it; they know how to utilize coal most economically, they know how to utilize forest products without waste, how to prevent the erosion of the soil, how to conserve health. The unsolved problem of conservation—the problem which now concerns us most—is not an engineering problem, but a social one. It is to alter the public state of mind, to make people thrifty and economical instead of extravagant and wasteful. It is thus an attitude of mind that we have to deal with. If the attitude of mind of the public toward this problem could be made the correct one, if the individual man could be made thrifty, frugal, careful, thoughtful of the future, the problem of conservation would be solved. Why should not applied scientists, who know how to solve the problem technically, lead in educating the people to perceive the necessity for its solution? Should not mere self-interest, not to speak of public spirit, prompt us to do this? In education, too, where, as I view it, the tendencies I have referred to are plainly evident, we may as a profession exert a good influence. I have often expressed the opinion that an engineering education is the best possible education for any vocation, because it combines, or should combine in the best proportions, the study of abstract relations with that of natural science and of the humanities. These, combined with training and experience in the profession itself, should make the engineer as well educated as any class of men. He should be sane and sensible, not likely to be carried away by fallacious economic theories; conservative, and yet safely progressive. Engineers should, I think, exert more influence than they do in education, by actively interesting themselves in it, serving on school committees, and insisting on the maintenance of rigorous discipline and the scientific method. Above all, they should aid in maintaining the standard of engineering education, and prevent it from succumbing to the prevailing tendency to relaxation of discipline. The best students do not really seek such relaxation, and schools which make students work hard and which insist on a high standard of accomplishment, will attract strong men. The tendency of the times shows this, and proves that one movement to-day is towards utilitarian and vocational training. Some of the tendencies I have referred to may be in large measure only surface currents, and a strong undercurrent may perhaps be generated in another direction if the proper means are employed. This is indicated by the growth of the engineering department of our state universities within the last thirty years, and by the surprising development of such a school as the Massachusetts Institute of Technology from its first small beginnings to its position of recognized leadership in less than a third of a century. Let us make the engineering schools the place of refuge for those who are disgusted with the relaxation of discipline which prevails so largely elsewhere.

Finally, let us inquire what this society, representing the engineering profession, may do in the directions which have been suggested. We have been criticized in the past as being inactive, as taking no part as a society in the large public questions. I must frankly confess that the criticism has seemed to me in some measure deserved. Our society is large, rich, influential, but we have been too content to sit down in dignified ease, taking little or no initiative, and allowing other and younger societies to outstrip us in actual work performed and in real influence exercised. We have had some committees which have done good work in unifying practice in relation to technical matters. In these respects, however, we

have been far surpassed by two or three of the newer societies, whose committees after long and conscientious labor, have exercised far greater influence that we have in the solution of even professional problems. It is true that this is largely due to the fact that those societies are more specialized than ours, that they are composed of men all engaged in one line of work, who could co-operate and lay down the results of experiment, experience and opinion more easily than we could. This society, however, is the American Society of Civil Engineers, it includes engineers in all branches; there is no reason why the engineers in the different branches should not associate themselves together in sections, or why we could not do more committee work along the various engineering lines than we have done in the past.

I believe, therefore, that we should favor the establishment of branches of the society in various parts of the country, and of student branches in the several technical schools; and that we should urge our committees to activity, supply them with funds, and perhaps pay the mileage of members who attend meetings. The society is rich, and it is not a philanthropic institution. If members give their time to committee work, I see no reason why they should be expected to give money, and the expense of attending many meetings may not seldom be considerable.

Moreover, we have been very loath to take any steps in formulating answers to questions which are largely matters of opinion; and we have done, thus far, little or nothing to influence public opinion in regard to questions of the day. I believe that we could and should go much further in these directions; that we should step forward, take the initiative and become a moving force in the community. Let me make some more definite suggestions.

In the first place, I believe we should have a standing Committee of Public Relation, its province being to keep track of all public affairs involving engineering questions directly or indirectly, in all the states in the Union, and to take such action as may be deemed desirable to insure a wise treatment of such questions. This committee might perhaps consist of president and secretary of the society ex-officio, of a certain number of members of the Board of Direction to be appointed each year by the president, and of a certain number of members of the society not members of the Board of Direction, to be nominated by the Board of Direction. These outside members might be in considerable number, perhaps one or more from each state or group of states, so that the committee could keep in touch with public affairs affecting the profession in all parts of the Union.

Further, our Committee on Engineering Education should, in my opinion, be enlarged, supplied with funds, and encouraged to active and exhaustive work. If we could lay down the principles which we believe should govern in engineering education, the general curriculum which should be adopted, the proportion of the humanities which should be included, and similar matters, we might, I believe, do much good and, while still leaving ample room for individual initiative and divergencies in practice in different institutions, render effective aid to those teachers who are striving to resist some prevailing tendencies.

In the next place, I believe it will he wise to have more committees of the society, dealing with specific problems, than we have had in the past. You have before you at this meeting, I am glad to state, a report from the Board of Direction stating that, as provided in the Constitution, it has voted to appoint two special committees to deal respectively with the regulation of streams and with uniform water legislation. I believe that still other committees could be appointed to advantage. We have no reason to be afraid of having too many committees. We should, rather, be sure that we lose no opportunity to exercise legitimate influence on public opinion or to aid in the solution of large problems. We might well, I believe, have a standing committee on conservation, another perhaps on corporation legislation, another on the history of American engineering. Let us give our earnest attention to this matter and let us not hesitate to suggest any and every means that may occur to us to promote the welfare of the society, of the profession, and of the public. The Board of Direction will be always ready, I am sure, to act promptly with such members of the society who can show a proper field for all legitimate action.

Reviewing then, the points which I have brought to your attention, I have endeavored to show that the problem of the times is pre-eminently a social problem. I have outlined some of the tendencies of the day, as they appear to me. I have given the reasons for my belief that it is the duty of engineers to aid in the solution of these problems and that by training and experience they are well qualified to do so. If my tone has appeared to indicate a pessimistic attitude toward the tendencies of the day, I fear I must plead guilty in some degree to the imputation; whether wisely or not, as the years have gone by, I have grown more conservative and I find myself having little sympathy with many of the tendencies which I seem to see about me. I believe that this age will be looked upon by future generations, not as an age of progress, but more distinctively as an age of deterioration, an age of fads, frivolities, fancies and follies; of much reading and little thought; an age of impulse rather than an age of reason. I am not alone, however, in a feeling of dissatisfaction. M. P. Leroy Beaulieu, writing in 1890, expressed himself as follows:—

"Every age is characterized by its particular craze. The present craze is for education, unlimited and injudicious, and for philanthropy equally unlimited and injudicious, both absolutely superficial. By their aid we have succeeded in producing a mental condition and in creating certain social circumstances which are most unfavorable to the growth of the population."

But, after all, it is only an epoch in the history of man. It will pass away, and others will solve the problems that we leave to them. May we do our part, as members of one of the greatest professions, to help direct the tendencies of the day in such manner that our successors may look back upon us with approval and not with blame, and that we may aid in forwarding the true progress of mankind.

WIRELESS IN AUSTRALIA.

The acting Australian Postmaster-General states that the wireless station at Darwin (Northern Territory) now being built will cost about £90,000. The station will have a radius of 2,000 miles, touching Singapore on one hand, and Sydney on the other. It will form the apex of a wireless triangle, of which Sydney and Perth will be the other points. The surplus electric energy at Port Darwin, it is expected, will be supplied to consumers at a low rate. The Darwin stations will be capable of communicating with any system which may be established by the British Government. Already wireless stations have been provided at Perth, Adelaide, Melbourne, Hobart, Sydney, Brisbane and Port Moresby (Papua). At Townsville and Cooktown masts for new stations are already up, and at Rockhampton arrangements are well advanced for completing the equipment. At Geraldton, Esperance, Roeburn, Broome and Wyndham construction work is being pushed ahead, and it is expected that the chain will be completed before the end of the year.

PRESSURE FILTRATION PLANT AT HAILEYBURY, ONTARIO.

The town of Haileybury, Ontario, has been the first to follow the British practice in regard to the use of British pressure filters for the purification of its domestic water supply.

The installation of a chlorination plant did not satisfy all the requirements for a potable and safe water supply, on account chiefly of the large amount of vegetable matter present in their raw water.

In April the filtration plant which last year's council and the present mayor, Mr. N. J. MacAulay, decided to have installed was turned on, and has since been operating with considerable success.

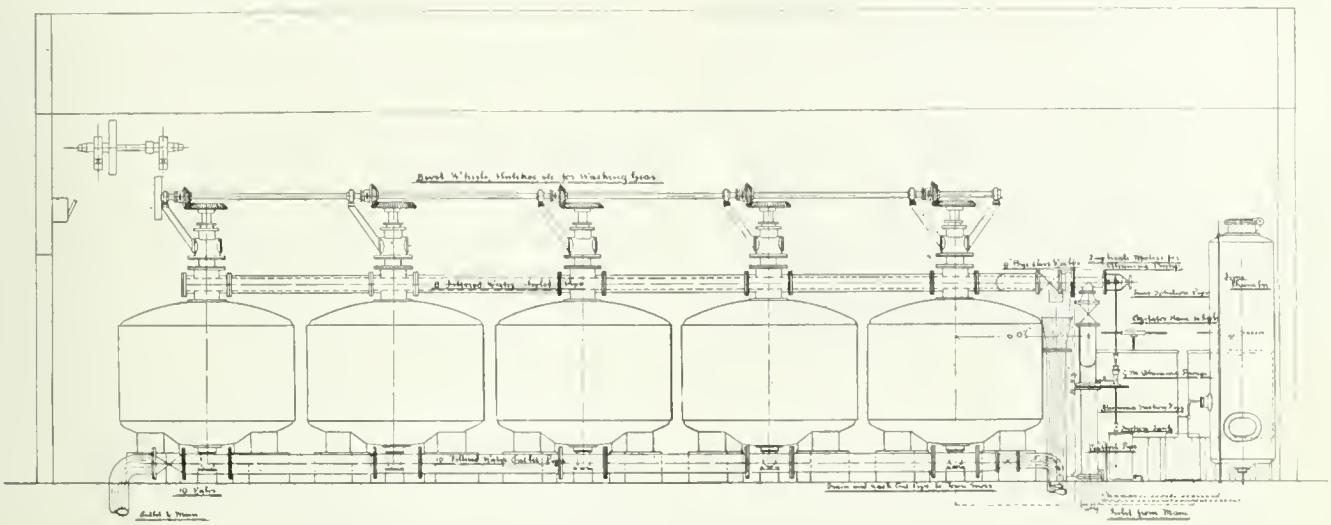
The source of the water supply is Lake Temiskaming, at the head of the Ottawa River. It is very highly colored, and is frequently very turbid with fine clay, while containing bacteria varying from 100 to 10,000 per cubic centimeter.

The alkalinity is also very variable owing to the rise and fall in the water level at different seasons, and most of the sewage of New Liskeard and Haileybury is discharged into the lake.

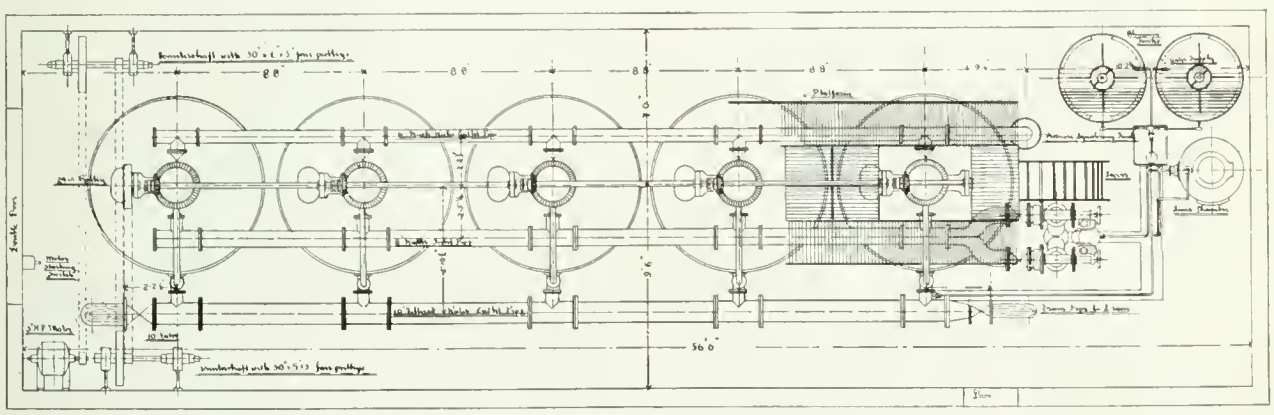
These conditions made the success of any filter plant very doubtful, but since the operation of that installed there has been a clear and sparkling water turned into the mains, without the slightest trace of color, or any turbidity, and according to the last bacterial analysis a reduction from 1,040 bacteria per cubic centimeter to 10 per cent. per cubic centimeter without the use of chlorine or any other disinfectant or sterilizer, or 99 per cent.

The cuts show a view of the plant and the platform for operating the cleaning mechanism, plans of the complete plant, there being no sedimentation basins or clear water reservoir, and a sectional view of one of the filters.

The inlet to the filter house is connected with the supply main, which was cut and had a branch inserted. The outlet end is connected in the same manner, except that a by-pass valve was placed in front of the branch to allow of the filters being cut out if necessary, or to diverge the raw water into the inlet to the filters.



ELEVATION.



PLAN.

Fig. 1.—General Arrangement of Haileybury Plant.

The plant has a capacity of one million Imperial gallons per day as a maximum, and operates under a working pressure of 100 lbs. per square inch. It is housed in a brick building 60 feet long by 18 feet wide, situated just above the pump house, which is placed alongside the lake. The water is delivered through the pump into the filters, through to the main, and thence on to the distribution system, and the town reservoir. The reservoir is placed on the hill above the town, so that a pressure of 85 lbs. per square inch is

available at the lowest points when the pumps are not in use, and is filled while pumping by the excess over the town's requirements in the five hours' pumping.

Inside the filter house is located a lime chamber, and duplicate alumina tanks constructed of steel, five Bell patent vertical type pressure filters, and the necessary piping, valves, washing motor and alum pumps.

As the raw water enters it passes through a venturi pipe into the throat of which is connected the down pipe from the lime chamber, while before entering the construction a pipe is led into the foot of the lime chamber. Lime is filled from

Fig. 2.—Interior View of Filter Plant at Haileybury.

a wrought iron platform on the top of the lime chamber in pails after being well slaked and the top closed. The addition of lime is then controlled by a valve on the town pipe, which is opened or closed until the manometer registers the desired quantity, so that the control is practically automatic.

In one of the alum tanks a solution for the day is made up, dissolved and put into use, while the duplicate tank is prepared for the following day's solution. Each tank is connected into the delivery pipe with a valve on each branch, so that by opening or closing either tank can be used at will. There are also drain pipes connected to the foot of tanks for cleaning and running off the liquor when it is required to do so. These are connected to a tile field drain running into the town sewer system.

A steel platform facilitates the operation of the alum tanks in which are placed agitators requiring to be revolved occasionally when the alum is dissolving. Under this is placed the equalizing tank, which is filled from alum tanks, controlled by a ball valve. From the equalizing tank the alum solution flows to the alum suction tank ready for delivery into the raw water, all the alum pipes being constructed of copper pipe with gunmetal fittings.

The raw water rises to the supply pipe to the filters, and revolves a turbine in proportion to its velocity situated inside the supply pipe. This turbine, by means of a worm gear, operates the gunmetal alum pumps also in proportion to the volume of water passing through the pipe, which pump up alum solution from the suction tank and deliver it into the raw water before it reaches the turbines. In this way the turbines can mix it intimately with the water and ensure absolute homogeneity in the distribution of the alum.

The supply pipe is brought by means of branches into the filter supply pipe. On each branch a valve is placed, and a turbine is connected. Only one of the branches is put into use at a time, and one of the alum pumps, the other being used as a duplicate in case repairing or overhauling is required.

Now that the raw water has received a definite proportion of lime and alum, it is in a 10-inch pipe delivering through branches into each of the filters, through which it passes into the collecting pipes out into the 10-inch outlet pipe in the town main.

In this plant and all others constructed by the same company the action of the chemicals added is to prepare the sand bed for effective operation in extracting the chemicals and impurities rather than to drug the impurities and then remove them, so that the minimum of chemical is required. Hence, the reason for the careful control of lime and alum, the latter being controlled by the strength of the solution and an ingenious arrangement on the alum pumps, whereby the length of the stroke can be shortened or lengthened at will, simply by turning a hand wheel while in operation.

The lime reacts on the alum and precipitates a sticky gelatinous matter which entangles the impurities in the water, and deposits them on the sand bed in the filters, in a similar manner to the work performed by the white of an egg in bringing down the grounds of coffee.

The section of one of the filters will explain fully the workings of these, while a wrought iron marine type platform is erected along the top of them to facilitate the other operations necessary, as will be further described.

Inside the filter house are placed two pressure gauges and two test taps, which are connected to the inlet and outlet side of the filters.

The test taps are tested periodically for alkalinity to show whether there is any alum in the water passing through the filters, or whether there is sufficient alkalinity to decompose the alum which is being added.

So far, since the plant commenced its operation, there has been no trace of alum in the filtered water, and it is guaranteed that none will ever be present.

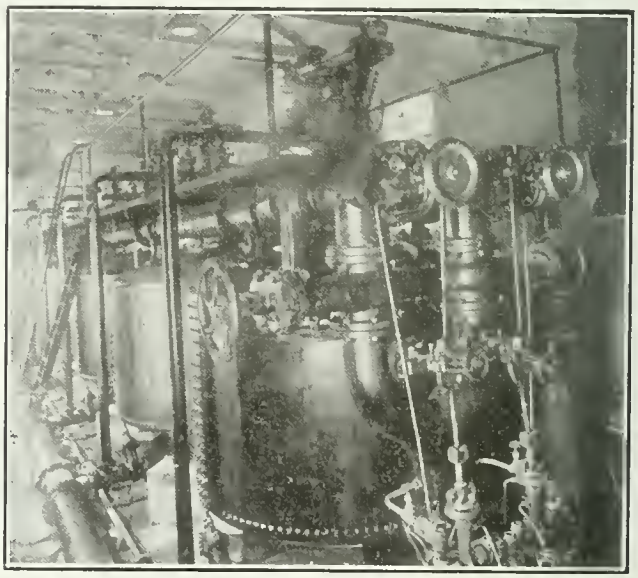


Fig. 3.—Installation at Haileybury, Ont.

When the pressure gauges indicate a loss of five pounds pressure between the inlet and the outlet side of the filters, the operator washes them out, as they are clogged up with the sediment which has been extracted from the raw water.

The wash-out is accomplished with less than one per cent. of wash water, occupies about twenty minutes of time, and is done by closing the inlet valve on the filter to be washed and opening the wash-out valve. The washing motor of 2½ horse power is switched on to revolve the washing gear shaft, and the clutch on the filter thrown in to allow of

agitation. Then the agitator valve is opened which directs high pressure jets of water through the hollow agitator arms into the sand in a lateral direction, forcing all sediment out so that the reverse flow raises it up and out to wash out the drain.

The wash-out water, when settled in a cylinder, is composed by bulk of one-third sludge and the remainder water. Each filter is washed in turn without any interruption taking place in the filtering action.

If it is desired to drain out any one filter all valves on that filter are closed, and the filter is then drained by means of a small drain pipe into the field drain.

The plant was erected and put in operation by the Bell Filtration Company of Canada, Limited, 305 Kent Building, Toronto, to the design and supervision of Mr. H. W. Cowan, C.E., their consulting engineer, and is very highly spoken of by all the residents of Haileybury, and those who have inspected it.

It is the first municipal plant of Bell patent filters to be installed in Canada, although every other country in the world, excepting the United States, have many installations. Several other plants are under way, and judging by the operation of the Haileybury plant, promise to solve the difficulty of treating water under conditions hitherto deemed untreatable.

AUSTRALIA'S RADIUM INDUSTRY.

In view of the cost and increasing use of radium, information as to radium mining in South Australia, contained in a review of mining operations in the state during the latter half of 1912, compiled by the chief registrar of the department of mines, is of more than ordinary interest.

At the Radium Hill mine, near Olary, 257 miles north of Adelaide, a considerable quantity of ore has been raised. This is concentrated at the magnetic separator plant in the mine, and shipments of the concentrate forwarded regularly to the company's works at Woolwich, on the Paramatta River, near Sydney. These works, which can now treat about ten tons per week, have, it is stated, cost over £15,000.

The directors report that "pure radium bromide has been produced. Although only 2½ milligrams were fully prepared, it proves that radium bromide of a purity of between 1,800,000 and 2,000,000 radio-activity can be procured from the company's ore, and there are, approximately, 350 milligrams of radium in the laboratory in various stages of purity, which will receive its final preparation and be available for sale automatically week by week henceforth. One hundred and twenty tons of concentrates have been smeltered, of which 95 tons have been treated for about 350 milligrams of radium, which is equivalent to an extraction of 32.3 milligrams per ton of concentrates." The company also proposes to utilize the various by-products contained in the ore.

The South Australian Radium Proprietary holds leases adjoining and to the northeast of the Radium Hill Company's property. Four shafts have been sunk, and a considerable amount of development work has been done. The Rare Metals proprietary, working on claims about three miles northeast of the Radium Hill mine, has done a considerable amount of prospecting work, and raised about seven tons of lode material, analyses from which are satisfactory.

At the property of the Radium Extraction Company of South Australia, Mt. Painter, no work was done during the period under review. The directors' report states that some good ore was picked out and despatched before work ceased, and one shipment of about 2¼ tons realized very satisfactory prices.

THE SCIENTIFIC SELECTION OF PAVEMENTS.

By W. W. Crosby, D.Sc., M. Am. Soc. C.E.*

The following article has received a good deal of press comment recently, especially from engineers in Great Britain. The writer is of the opinion that the science underlying the development of good roads is in need of careful study for the purpose of mathematically comparing the many kinds of road materials and construction methods with which highway engineers have become fairly familiar during the past few seasons. He claims that the problem of proper selection is most pressing, considering the fact that knowledge of road materials, new and old, is rapidly advancing, and that the demand for efficiency is making strides of even greater proportion. It would seem possible that a large amount of the personal element could be eliminated and that the practice of basing the selection on opinion alone could be replaced by scientific methods.

The suggestions which have been presented in various forms on previous occasions in the engineering press are called to the attention of highway engineers by Major Crosby in "The Municipal Journal." He further suggests the immediate commencement of steps for the standardization of the scientific method of selection. The importance to the roadway movement in Canada of the suggestions contained, and the value of impressing upon road builders the superiority of proper selection over methods of more or less personal nature, are factors which indicate that "The Scientific Selection of Pavements" is a paper which will be of great interest.

For convenience, in this paper any artificial road crust will be referred to as a "pavement," and "road" will be considered synonymous with "street" or "alley."

On a road requiring a pavement for reasons of economy and satisfaction, conditions are seldom duplicated. A pavement ideal in one instance may or may not be so in another. It has been suggested that, in general, the requirements for being ideal will be the same in all cases, but the various classifications may have decidedly different importance in different cases. That is, in one case low first cost and low maintenance cost may be most important. In another case, ease of hauling and lack of slipperiness may govern; while in another, sanitariness and noiselessness may overbalance all other considerations.

The main classifications suggested for consideration in the selection of an ideal pavement for any case are given as follows:—

First cost (on a basis of dollars and cents).

Maintenance cost (on a basis of dollars and cents plus interest on first cost).

Durability (ease and infrequency of repairs).

Resistence to traction (self-explanatory).

Non-slipperiness (self-explanatory).

Sanitariness, cleanliness and noiselessness (self-explanatory).

Acceptability or agreeableness (æsthetic or personal).

In assigning values to these qualities, it will be found in the interests of accuracy and convenience to subdivide them somewhat further, and in order to assist in getting farther away from the personal factor, the writer suggests for consideration the following table, with the values opposite the classifications as assigned by various authorities:—

*Chief Engineer, Maryland Geological and Economic Survey, Baltimore, Maryland.

Table I.—Showing Relative Values of the Various Qualities of an Ideal Pavement.

Qualities.	Baker.	Tillson.	U.S. Bulletin.
First cost—cheapness	15	14	14
Maintenance cost—cheapness	—	—	—
Durability	—	21	20
Ease of maintenance	20	10	10
Ease of cleaning	10	15	14
Low tractive resistance	10	15	14
Non-slipperiness	5	7	7
Sanitariness	25	13	13
Noiselessness	—	—	—
Acceptability	15	—	4
Favorableness to travel	—	5	4
Total	100	100	100

While the authorities quoted have not done so, the writer would suggest the sub-division of the items on the following bases:—

"Maintenance cost" into "maintenance cost" (i.e., on a basis of dollars and cents), and "durability" (i.e., on the basis of ease and frequency of repairs required). "Acceptability" into "noiselessness" (which explains itself), "acceptability" (i.e., on a basis of personal or local preferences of abuttors and æsthetic considerations), and "favorableness to travel" (i.e., on the basis of absence of bad effects on animals and vehicles using the pavement).

He would then base his values for "ease of maintenance" in the list on the ease of actually making the repairs necessary (i.e., whether or not special outfits, such as asphalt plants, were required or not), and "ease of cleaning" on the requirement for unusual machines, the frequency of cleaning required, and the actual cost in dollars and cents.

It will be noted that, while the values assigned by Tillson and the U.S. Bulletin are practically identical, a considerable variation exists between them and those given by Baker, and it has been suggested that this variation results from consideration of different conditions. Apparently Tillson and the U.S. authorities had in mind pavements subjected to heavy hauling, while Baker was considering a type of pavement for residential streets. This illustrates the former reference to differences in ideals or to the relative importance of the classifications composing the ideal.

Hence, it seems to the writer that the standardization of a table for the selection of pavementts covering all conditions, character of traffic and with positive values assigned to each kind of pavement is impracticable. Rather, on the other hand, should the effort be made for the standardization of a set of tables—one for use with each class (not amount) of traffic under each class of circumstantial conditions. That is, the writer would suggest a set of tables as follows:—

Table A.—For use on streets in a commercial district where heavy hauling is prevalent or likely to be so; such, for instance, as along the docks or freight depots.

Table B.—For use on streets in a commercial district where heavy hauling is not preponderant nor likely to be so; such, for instance, as about the retail stores of a city.

Table C.—For use on streets carrying occasional heavy loads, occasional pleasure vehicles, and a large proportion of vehicles of moderate weight; such, for instance, as the main thoroughfares of the "down town" portions of a city.

Table D.—For use on streets of the residential portions of a city and where street railway tracks do not exist. (Where street railway tracks exist, use for the width occupied by the rails plus 4 ft., Table C.)

Table E.—For use on city streets where special conditions exist; such as around hospitals, court-rooms, etc.

Table F.—For use on boulevards and on places where æsthetic conditions are preponderant.

Table V.—For use on main country roads, such as "State roads" carrying fairly heavy mixed travel.

Table W.—For use on secondary country roads carrying moderate travel.

Table X.—For use on minor country roads carrying farm travel almost wholly.

Note that the classification is based on the kind of travel known to require support by the pavement, or likely, from the situation of the road, to so require, and not the amount of travel. Consideration of the latter factor will enter when, for any particular case, comes the entering of figures of value for each kind of pavement.

Assuming that the main classifications of travel are given in the above list (though, of course, it is possible to extend the latter), a set of values for the components of the ideal in each case can be made, as shown in Table II.

Table II.—Showing Values for Components of Ideal for Different Tables.

Components	Tables A	B	C	D	E	F	V	W	X
First cost—cheapness	10	10	10	12	10	8	15	15	15
Maintenance—cheapness	20	20	20	15	10	10	25	25	20
Durability	5	5	5	5	5	7	7	7	7
Ease of maintenance	5	5	5	5	5	5	8	10	10
Cleanliness	5	5	7	10	10	12	5	5	5
Low tractive resistance	20	15	10	5	5	5	10	5	5
Non-slipperiness	15	15	12	10	10	10	10	10	10
Sanitariness	5	8	10	13	15	10	5	5	5
Noiselessness	5	7	8	10	20	8	5	5	5
Acceptability	5	5	8	10	5	20	5	5	8
Favorableness to travel	5	5	5	5	5	5	5	8	10
	100	106	100	100	100	100	100	100	100

The application of the tables to the selection of a pavement would be as follows:—

If the case of a street along the freight station is taken, Table A may be applied thus:—

Example I.

Qualities	Ideal (Table A)	Values for Vit. brick	Grouted stone block	Pitched stone block	Grouted Durax	Sheet asphalt
First cost	10	10	8	8	7	10
Maintenance cost	20	8	18	15	20	6
Durability	5	2	5	4	5	3
Ease of maintenance	5	5	5	4	5	2
Cleanliness	5	5	4	3	4	5
Low tractive resistance	20	20	15	10	18	19
Non-slipperiness	15	3	8	13	15	2
Sanitariness	5	5	4	3	4	5
Noiselessness	5	4	1	2	3	5
Acceptability	5	4	4	4	5	4
Favorableness to travel	5	2	2	3	5	4
Totals	100	68	74	69	91	65

Or, in the case of a residential street without street railway tracks:—

Example II.

Qualities	Ideal (Table D)	Values for Vit. brick	Durax	Sheet asphalt	Water-bound macadam
First cost	12	6	3	7	12
Maintenance cost	15	12	15	10	8
Durability	5	4	5	3	2
Ease of maintenance	5	4	4	2	5
Cleanliness	10	10	8	10	4
Low tractive resistance	5	5	4	5	4
Non-slipperiness	10	3	8	2	10
Sanitariness	13	12	8	13	6
Noiselessness	10	6	4	10	8
Acceptability	10	8	6	10	8
Favorableness to travel	5	3	2	4	5
	100	73	67	76	72

And in the case of a secondary country road, we have:—

Example III.

Qualities	Ideal (Table W)	Values for Vit. brick	Plain concrete	Pitch macadam	Water-bound macadam
First cost	15	8	10	10	15
Maintenance cost	25	25	20	20	10
Durability	7	7	5	5	3
Ease of maintenance	10	7	8	8	10
Cleanliness	5	3	3	5	2
Low tractive resistance	5	5	4	4	4
Non-slipperiness	10	4	7	5	10
Sanitariness	5	4	4	5	3
Noiselessness	5	3	3	5	4
Acceptability	5	2	3	4	5
Favorableness to travel	8	3	5	6	8
	100	71	72	77	74

The foregoing will perhaps serve to illustrate the idea the writer has in mind that mathematics can aid the highway engineer and help to reduce the personal equation in the important matter of selecting the proper pavement for any particular case. Of course, the tables suggested may be amplified or altered at the discretion of the individual. The principle remains the same.

For general cases and in order to furnish proper starting points to modifications for particular instances, it seems to the writer that the attention of the profession, the discussion of the question and the standardization of a set of tables as suggested above, and of their components and their values for an ideal pavement in each case, would be well worth while.

When this shall have been done, there will next be needed accurate information from records, uniformly kept, as to the cost of maintenance of the various kinds of pavements, and as to their behavior as to the other items or components of the tables under stated conditions of travel, so that values can be properly assigned, with as little "guessing" as practicable, to such components for the comparison of different pavements under any particular travel which is known to be expected in a specific case. Such records are now being collected and will probably soon be available.

NEW BRITISH CABLE SERVICE.

The new cable direct from Land's End (England) to Hongkong by way of Suez, Aden, Colombo, Penang, and Singapore, is to be laid during the present year. The Malta section to Alexandria is already finished, so that about 9,000 miles remain to be completed out of a total distance of 12,000 miles. The section from Colombo to Penang is expected to be ready by July, and the work on the other sections is to begin shortly. With the exception of a small land cable from Alexandria to Suez, the whole line will be under sea. It is said to be the largest ever laid, and is estimated to cost about $7,500,000. At present the time taken to transmit a 20-word message from Bombay to London in 2½ hours, while the distance from Colombo to Bombay occupies another hour or hour and a half. By the new cable it will take only ten minutes to transmit a message from Colombo to London, while the cost of cabling will be greatly reduced. By means of the "slot" system the message is mechanically transmitted from section to section, and is not touched by hand till it reaches its ultimate destination, thus reducing to a minimum any chances of mutilation in retransmission. The cable will be under European management, and will be worked entirely by European operators.

COAST TO COAST.

Toronto, Ont.—C. A. Magrath, former member for Medicine Hat, Alta., in the Dominion House, and a member of the Canadian section of the International Waterways Commission, has been named as the probable choice of the Ontario Government for the chairmanship of the Provincial Highways Commission, through which the Government will carry out the vast road development scheme promised last session. It is generally understood that W. A. McLean, present provincial highways engineer, will be a member of the commission, with supervision over the engineering and construction end of the scheme. Just now Mr. McLean is abroad, where he went partly to attend the International Roads Congress, but chiefly to journey about and study advanced road construction methods of Britain and Europe. Upon his return, and after the appointment of a commission, it is probable the commissioner will visit the United States and study methods there. The government's third choice is somewhat in doubt, but the name of Reeve Henry, of the York Highways Commission, has been spoken of. Reeve Henry is a road enthusiast, and would represent the farming interests of the province on the board.

Victoria, B.C.—A meeting of leading state highway commissioners and the manufacturers of horse-drawn wagons and motor-driven trucks is the suggestion of Chairman George C. Diehl, of the American Automobile Association national good roads board, who contends that the time has arrived when those interests can advantageously discuss the drafting of suitable legislation governing the width of tires and the weight of loads. After an interchange of views he holds a committee could prepare laws, the passage of which would be practically assured when put forward by the chief highway officers of the various states. "Many states have enacted laws which endeavor to regulate the width of tires of vehicles, but unfortunately there has not been strict enforcement of these regulations," says Mr. Diehl. "The width of tires is one of the important factors in highway construction and maintenance. Narrow tires, especially during the wet season, form ruts in improved roads, and in many instances, where the roads are weak, break through the surface, causing subsequent rapid destruction of the highway. One great difficulty in enforcing wide tire ordinances with horse-drawn vehicles has been that while less traction is required, with wide tires, on slippery clay or hilly roads it is very difficult in wet weather to manage a horse-drawn vehicle with wide tires, owing to its tendency to skid and slide into the ditches. Instances are frequent where in a journey a farmer must drive over miles of slippery road and only have a few miles of improved highway, in which case he would naturally prefer to use narrow tires for the entire distance, rather than to attempt the use of wide tires over the slippery section of the road. There is no question that protection and economical maintenance of improved highways require that narrow tires should be discarded, and ordinances must be enforced which will prevent their use on main travelled highways which have been improved at great expense. If a vehicle owner desires to use narrow-tired wagons on slippery roads, he must be absolutely prevented from using the same tires on improved roads. Equal, if not greater, damage can be done to the highway with tires of insufficient width on motor trucks.

Victoria, B.C.—Preparations for more active work on the Sooke Lake waterworks system are being made by Water Commissioner Rust, and a few more men have been added to the force on the ground, about fifty being now engaged. A camp is being established at the lake, and supplies and

materials required for the same are now being shipped out. The city has made a satisfactory arrangement with the receiver of the Westholme Lumber Company whereby the plant required by the city can be secured on a valuation to be decided by independent valuators. This plant consists of tents, light rails, tools of all sorts, and other necessary apparatus, which, unless its use was permitted by the receiver, the city would have to purchase. Water Commissioner Rust stated that as soon as work actively commences the force of men will be increased to about 150. Mr. Wynn Meredith, the city's consulting engineer on the work, has prepared the specifications for the tenders for which the city is now calling for the supply of cement pipe and steel plate for the pipe line. Cement pipe for about twenty-seven miles will be secured for the flow line from Sooke Lake to Humpback Reservoir, and the steel pipe will be required for the pressure line from that reservoir to the city. The estimated cost of this part of the work is between $700,000 and $800,000. With the recent sale of debentures the city has on hand ample funds wherewith to permit of active prosecution of the work, and as soon as the preliminaries are fully settled the undertaking will be proceeded with as fast as possible.

Toronto, Ont.—It is understood that the plan of the Ontario Government for establishing a good roads commission to supervise construction in the older parts of the province embraces several features. There is likely to be a joint chairmanship, one official to be in charge of the practical administration, and the other will deal with financial and the general outline of the scheme. In addition, there will be a complete reorganization of the co-operative system, in which the government advances to counties desiring it a grant of one-third the amount to be expended in the good roads movement. A change in the percentage has long been considered by the cabinet, and legislation will in all probability appear at the next session to change the rate from one-third to one-half. The fact that the maintenance of roads by the counties is not popular has been instrumental in resolving the government to assume the upkeep in future. The actual means have not yet, however, been decided on, but it has been suggested that the government grant be reserved in large part for that purpose. Premier Whitney recently stated that the personnel of the commission had not yet been decided upon. It is understood, however, that Provincial Engineer W. A. McLean will occupy a place, probably as administrative chairman. The interests of Eastern Ontario may be regarded in choosing a commissioner from that district.

Victoria, B.C.—A prominent automobile man, in discussing the relative merits of the telephone and motor car, made the following interesting statements: "The telephone and the motor car have done more for the farmer than any other invention, with the possible exception of the reaper. We have heard a great deal of late about the necessity of a return to the farm. That is, various social and economic conditions of modern life have prompted a movement to turn the tide which has been running cityward back to the farm. Farmers' sons for a while were irresistibly lured to the city, and the reason was that farm life was too sordid, uninteresting, too limited in its opportunities for rational enjoyment for the young man who had argued that the high cost of living, the congestion in cities, the bitterness of competition in all walks of life could be reduced and alleviated if farming as a profession was made more attractive. The telephone and the motor car have been doing a great work in solving this problem by doing just what the students of sociology and economics have asserted must be done. That is, they have revolutionized farm life by modernizing it, keeping it in close touch with the outside world and bringing the city almost to the isolated farm. Nowadays the farmer without a telephone is an exception. This great convenience keeps him in instant touch with his neighbors and with the city. It has had an untold effect in making the life of the farmer more bearable and attractive. No less important in achieving a revolution in living conditions is the motor car. Beyond all that it has proved of economic value because a machine is serviceable for many tasks that can be accomplished far more efficiently and expeditiously than with the horse and wagon. Any one who doubts that the farmer has taken kindly to the automobile should visit the country churches, the country fairs and the county seats, and see the machines parked. The number of automobiles in evidence will certainly prove illuminating."

Ottawa, Ont.—There will not likely be any opposition to the city co-operating with the Dominion Government in preparing plans for the enlargement and beautification of the Capital and its development along proper lines. The board of control in its report to the city council will recommend that the city concur in the suggestion which was made by the minister of finance for the appointment of a commission to prepare plans covering Ottawa, Hull and their environs and dealing with parks, transportation and other features that are serious problems in the development of the Capital. The proposition made by the government was that half the cost of the commission should be borne by the government and the other half by Ottawa and Hull. The board of control is recommending to the city council that Hull be asked to bear one-fifth of half the cost and that Ottawa bear the remaining four-fifths of half. The city council seems unanimously in favor of co-operation and it is not likely that any opposition will be raised. It is understood that as soon as the cities agree to the proposal the government is prepared to name its commissioners, the mayors of the two cities also being members.

Toronto, Ont.—An important conference between the city of Toronto and the townships of Etobicoke, York and Scarboro' was held recently. City planning beyond the limits of Greater Toronto was discussed, a plan for diagonal roads in Etobicoke, York and Scarboro' engaging the attention of the delegates. It was decided to adopt the principle that no road must be less than 66 feet wide, and that through roads must be 86 feet wide. The townships interested in the schemes will have to obtain legislation before they can establish building lines to prevent people from building up to the street line as at present. Ald. Sam. McBride presided, and promised that the city would do everything that could be done to help the townships secure the necessary legislation. Assessment Commissioner Forman explained the principles of the homologated line and its power to fix street building lines indefinitely. As a result of the conference each township will prepare a map showing which of the proposed diagonal streets will be 66 feet wide and which will be 86 feet wide. Then a general map will be prepared to conform with the smaller maps, the township maps being submitted first at another meeting of the city and township officials.

Ottawa, Ont.—Canada will have the longest and loneliest motor road in the world, according to the recent decision of the government to build a motor road into Dawson City. Fifty thousand dollars has been voted for the purposes of this road, and a couple of other such votes will be necessary to finish it. At the present time Dawson is only reached by stage in winter, when there is a deep coating of snow on the ground. It is the intention of the government to build a road for motors 400 miles in length, from White-horse at the

head of Yukon's two thousand miles of navigation, right into Dawson City. Dr. Alfred Thompson, M.P. for Yukon, who obtained this grant, will take surveyors with him into the territory to start the work on his return to his constituency. At the present time the motor has penetrated into the heart of Africa, and almost everywhere else. Tourists go thousands of miles in order to travel over some road, hitherto unknown to the power car. And thus, when this motor road is finished into Dawson, it will not only open that Canadian city to the tourist traffic of the world, but attract tourists from many lands.

Ottawa, Ont.—The improvement works and storage reservoirs on the Upper Ottawa by dams at Temiskaming and Quinze are dealt with in the annual progress report just published by the public works department. The storage of the surplus water of the Ottawa River has been demanded by various interests for a great number of years. In 1902 and 1903, the matter was particularly brought to the attention of the government, memorials being presented asking that this work be undertaken as a national enterprise. During periods of low water in the river, navigation is rendered difficult, and the power developments supplying energy for industries and public utilities suffer severely. To remedy these conditions, it was represented that the best scheme would be to establish some system of storage reservoirs at the head waters of the Ottawa River, by which some of the surplus waters of the spring could be collected and conserved, to be released gradually during the low period and thus augment the low flow. The total appropriation in 1912 for construction work was $353,000, and the total expenditure since storage commenced is $609,347. The principal feature of the report is that by C. R. Coutlee, engineer in charge, who tells in detail of the work accomplished by the department by day labor on the storage dams at Quinze and Temiskaming, and who makes some interesting general comment. He says in part: "The full benefits of the great storage system now nearing completion, will not be felt until subsidiary reservoirs are created all the way down stream. The Mississippi, for instance, is not benefited by its reservoirs much below St. Paul, say 150 miles down stream. Now, if private capital begins building dams in the river, there will be no general system observed and chaos will result. Owing to the great cost and the divided control of the river between Ontario and Quebec, companies would often pen up only one side of the stream. This would ruin the river for navigation and an attempt to use the other side for power would be met with law suits and great construction difficulties. Private dams take no heed of power possibilities above and below their immediate site and the money is not always available to make them strong beyond chance of accident. Inspection would be lacking both as to upkeep and as to the control of the water flow and riparian rights." The dams now are practically finished and their benefits are already apparent in low water seasons.

Ottawa, Ont.—That the government is fully alive to Canada's greatest problem, that of transportation and its allied facilities, is indicated in the more than generous appropriation for the purpose made this year. The engineering staff of the public works department is applying itself to the preliminary arrangements for calling of tenders on several new and very expensive works and of proceeding with other undertakings already in progress. After session there is always a demand by members of parliament to have works in their respective constituencies started immediately. This cannot always be done, as time is required for the preparation of plans. However, the intention is to have all the works comprised in the forty-five million dollars appropriations under way before the year terminates. All parts of the country have been looked after in what may be described the big national works. Halifax is to have new terminals and docks for the I.C.R. costing eight or ten millions, while a big dry dock is also to be built. St. John has the extensive Courtenay Bay improvements in full swing including also a dry dock. In a few days a contract will be awarded for the largest dry dock in America at St. Joseph de Levis, opposite Quebec, while the River St. Charles is being deepened and many new terminal facilities added for railway and steamship services. At Montreal the harbor board is proceeding on the strength of government advances with the yearly stage of improvements to aggregate in cost $18,000,000. Tenders will be called this week for the Toronto harbor works to cost $6,000,000, while a good start has been made and bigger plans are in view for similar works at Hamilton. On July 17, the tenders for the first section of the Welland Canal will be in and those for other sections will be called in a month or so. On Georgian Bay extensive dredging works are in progress and work being rushed on the Trent Canal, while at the Soo, with its abnormal shipping, a subsidized dry dock is under construction. Port Arthur and Fort William improvements consist of new docks and warehouses, grain elevators and harbor improvements. A system of internal elevators will be built on the prairies, those at Saskatoon and Moosejaw being already decided on. Out at the coast Vancouver is to have big docks and harbor facilities and a dry dock, while the similar works and breakwater at Victoria are well started. Esquimalt, in the extreme west, gets a first-class dry dock. Departmental expenditures in two years have doubled with the growth of the country and its coincident demands for up-to-date facilities for handling traffic have both necessitated and justified the extensive outlays now being started.

PERSONAL.

MR. F. W. PETERS, general superintendent of the British Columbia division of the Canadian Pacific Railway, who has been in Europe since April, has just returned.

MR. J. D. CRAIG, of the Department of the Interior at Ottawa, is in charge of the boundary survey from Mount St. Elias to the Arctic Ocean, and arrived in Skagway recently, expecting to complete the work before the end of the summer. The survey has been in progrss during the past four years.

MR. J. DARLINGTON WHITMORE, A. M. Can. Soc. C.E., has been appointed boro' engineer at Whangareé, New Zealand, and is taking up his duties at once. Mr. Whitmore was city engineer at Moose Jaw, Sask., for five years, until, in 1910, he opened offices as consulting, municipal and sanitary engineer.

MR. ALBERT NUTTALL, formerly erection superintendent, Structural Steel Company, and for the last two years superintendent of construction for Canada of the Cleveland Bridge Company, has been appointed superintendent of erection, bridge department, Canada Foundry Company, Limited, with headquarters at Toronto.

MR. P. W. WARD, who for the past two years has occupied the position of eastern manager for E. R. Watts & Son, Canada, Limited, and who resigned a short time ago, has accepted an appointment to the position of eastern sales manager for the Eugene Dietzgen Company, Limited. Mr. Ward will manage the eastern business of the firm in engineering and architectural instruments and supplies from the company's headquarters at 432 St. Catherines Street West, Montreal.

MR. COLLINGWOOD B. BROWN has been appointed to the position of chief engineer of the government railways

in Canada. Mr. Brown is a graduate of Cornell University and has been with the Canadian Pacific Railway for the last fourteen years, for the past two years of which he has been principal assistant engineer. Previous to that time he was division engineer at St. John, N.B., and at Montreal, and assistant division engineer at Calgary. He is a Canadian by birth with Kingston as his native city.

PACIFIC COAST CONVENTION OF THE A.I.E.E.

The Pacific Coast Branch of the American Institute of Electrical Engineers will be in convention in Vancouver, September 9, 10 and 11. The convention is in charge of a committee of prominent members, of which Mr. R. F. Hayward, of Vancouver, B.C., is chairman. A number of papers have been arranged for by the committee. The proposal is to present one paper at each session, giving ample opportunity for comprehensive discussions. Several interesting trips are also being arranged.

COMING MEETINGS.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelfth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

CANADIAN PUBLIC HEALTH ASSOCIATION.—Annual Meeting in Regina September 16, 17 and 18. General Secretary, Major Drum, Ottawa; Local Secretary, Dr. Murray, Regina.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

NATIONAL ASSOCIATION OF CEMENT USERS.—Tenth Annual Convention to be held at Chicago, Ill., Feb. 16-20, 1914. Secretary, E. E. Kraus, Harrison Bld., Philadelphia, Pa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—176 Mansfield Avenue, Montreal. President, Phelps Johnson; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

MANITOBA BRANCH.—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack, 83 Canada Life Building, Winnipeg. Regular meetings on first Thursday of every month from November to April.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, A. B. Lambe, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

QUEBEC BRANCH—Chairman, A. R. Decary; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, E. A. James; Secretary-Treasurer, A. Garrow. Meets last Thursday of the month at Engineers' Club.

CALGARY BRANCH—Chairman, H. B. Mucklestone; Secretary-Treasurer, P. M. Sauder.

VANCOUVER BRANCH—Chairman, G. E. G. Conway; Secretary-Treasurer, F. Pardo Wilson, Address: 422 Pacific Building, Vancouver, B.C.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1230. Meets 2nd Thursday in each month at Club Rooms, 534 Broughton Street.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSIOCATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. W. Lines, Edmonton; Hon. Secretary, W. D. Cromarty, Edmonton, Alta.

ALBERTA ASSOCIATION OF LAND SURVEYORS.—President, L. C. Charlesworth, Edmonton; Secretary and Registrar, R. W. Cautley, Edmonton.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, A. C. Garner, Regina; Secretary-Treasurer, H. G. Phillips, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont; Secretary-Treasurer, Wm. Snaith, The Thor Iron Works, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, C. E. Bawden, Birkbeck Bld., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Hon. W. A. Charlton, M.P., Toronto; Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, James Coleman; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, F. C. Mechin; Corresponding Secretary, A. W. Sime.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Edmund Burke; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Bedford McNeill; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. J. B. Porter, H. E. T. Haultain and W. N. Miller and Messrs. H. W. Claudet, S. S. Fowler, R. W. Leonard and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, J. L. Doupe; Secretary-Treasurer, W. B. Young, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, N. Vermilyea, Belleville; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, J. S. Dobie, Thessalon; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

QUEEN'S UNIVERSITY ENGINEERING SOCIETY.—Kingston, Ont. President, W. Dalziel; Secretary, J. C. Cameron.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman. Alfred Burton, Toronto, Secretary.

TECHNOLOGY CLUB OF LOWER CANADA.—President, F. E. Came; Secretary-Treasurer, E. B. Evans. Meets twice yearly.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan, Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*. +—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

PLANS AND SPECIFICATIONS ON FILE.

The following plans and specifications are on file for reference only, unless otherwise noted, at the office of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg, Man.:

BIDS CLOSE — NOTED IN ISSUE OF

16-7—Construction of sewer and water-works, Prince Albert, Sask. 26-6

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Battery Point, N.S., extension of breakwater	July 14.	June 19.	76
Duncan Station, B.C., public building	July 7.	June 26.	76
Huntsport, N.S., construction of a wharf	July 17.	June 26.	78
Ottawa, Ont., supplying coal	July 14.	June 19.	84
Ottawa, Ont., Welland Canal	July 17.	June 12.	84
Ottawa, Ont., dredging rivers	July 8.	June 26.	78
Prince Albert, Sask., construction of sewer and waterworks	July 16.	June 26.	84
Prince Rupert, B.C., residence	July 7.	June 26.	78
Regina, Sask., construction of pavement	July 9.	June 26.	84
Saskatoon, Sask., bridge	July 15.	June 26.	84
Sea Gull, Ont., extension of wharf	July 14.	June 19.	78
St. Rose, Que., construction of works	July 7.	June 19.	76
St. Thomas, Ont., post-office	July 9.	June 26.	78
Toronto, Ont., concrete viaduct.	(No date)	.....	86
Toronto, Ont., cutting pulp-wood	Aug. 15.	.....	78
Toronto, Ont., supplying fire apparatus	July 8.	June 26.	78
Toronto, Ont., decoration work.	July 8.	June 26.	78
Victoria, B.C., laying reinforced concrete pipe	July 15.	June 26.	86
Walton, N.S., extension of wharf.	July 17.	June 26.	80
White's Bluff, N.B., construction of wharf	July 9.	June 19.	78

RAILWAYS—STEAM AND ELECTRIC.

Halifax, N.S.—Important plans for the improvement of the Intercolonial Railway are under consideration following the visit of Hon. Frank Cochrane to the Maritime Provinces. These plans involve the double tracking of the line from Moncton to Halifax. Mr. Cochrane and F. P. Gutelius, the new general manager of the I.C.R., have been making a thorough study of the conditions of the road as the time at their disposal would permit, and it is understood that the decision to have a double line of railway from Moncton to the new terminals at Halifax has been reached.

Montreal, Que.—The activities of the Canadian Pacific Railway and its influence on the financial, mercantile, manufacturing, and laboring interests of Canada are great. In the current year, the company's appropriations for the construction of additional railway mileage for cars and locomotives, terminal facilities at St. John, Montreal, Toronto, Fort William, Winnipeg, Calgary, Vancouver, and elsewhere, for ocean steamships, and hotel extensions on the telegraph system, shops, sidings, and improvements, generally in Canada, will approximate no less a sum than $100,000,000.

▲—**North Toronto, Ont.**—Tenders will be received up till the 12th of July for the construction of the substructure of a subway. Plans and specifications may be obtained from B. Ripley, engineer of grade separation, Toronto.

▲—**Ottawa, Ont.**—Tenders will be received up till the 29th of July, 1913, for supplying a steel pontoon gate lifter for Trent Canal. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, secretary.

Ottawa, Ont.—The Morrisburg and Ottawa Electric Railway Company desires to receive tenders for construction of ten miles of its line of railway, commencing from the city of Ottawa and extending in the direction of Morrisburg; such tenders to be based on the company's plans and specifications. Tenders will be received up to and including the 8th day of July, 1913, and the plans and specifications for proposed work can be inspected at any time up to the said date at the office of the Morrisburg and Ottawa Electric Railway Company, Canada Life Building, Sparks Street, Ottawa.

Regina, Sask.—The street car lines in this city will be extended at a cost of about $28,000, made up as follows: $12,000 for steel rails; $1,692 for ties; $11,000 for cement; $2,192 for street poles; $844 for trolly wires and overhead materials.

LIGHT, HEAT AND POWER.

+—**Montreal, Que.**—The Canadian Pacific Railway has awarded the CANADIAN GENERAL ELECTRIC COMPANY the contract for the electrification of the company's line between Castlegar and Rossland. It is intended to use 2,400 volts, direct current trolly system.

Vancouver, B.C.—Anticipation of the future power requirements of greater Vancouver and the probability of the electrification of the coast section of the Pacific Great Eastern Railway, the Bridge River Company, recently incorporated, plans to develop at least 200,000 horse-power in the Lilloette district. The expenditure involved will be about $8,000,000. The project calls for the building of a large dam on Bridge River and a tunnel one and three-fourth miles long through the mountain.

Victoria, B.C.—Tenders will be received up till the 7th of July for supplying poles, cables, etc. Plans and specifications may be obtained from W. Galt, city purchasing agent.

Winnipeg, Man.—Tenders will be received up till the 9th of July, 1913, for the manufacture and delivery of one-100 K.W. motor generator. Plans and specifications may be obtained from the Board of Control. M. Peterson, secretary.

GARBAGE, SEWAGE AND WATER.

Bolton, Ont.—Tenders will be received up till the 15th of July, 1913, for sinking a test well. Plans and specifications may be obtained from John McDonald, clerk.

+—Edmonton, Alta.—The Board of Commissioners have awarded the NEW YORK CONTINENTAL JEWELL COMPANY the contract for the addition to the filtration plant. The contract price is $117,000, and the contract must be finished by April 15th, 1914

+—Edmonton, Alta.—The Board of Commissioners have awarded W. H. ALLAN, SON & CO., the contract for supplying sewer pumps.

Fort William, Ont.—The ratepayers of this city have passed by-laws to provide for additions to the waterworks system and sewer system.

Hamilton, Ont.—Work on the west-end sewage disposal works will be commenced at once. The tender of the City Engineer for $62,000 was the lowest received and consequently he will do the work.

North Toronto, Ont.—According to a report of Commissioner Harris, $4,000,000 will be the cost of the construction of a trunk sewer and the outlets for a sewer service. At least three years will be required to complete the work, and Commissioner Harris strongly advises the use of septic tanks in the meantime.

▲—Prince Albert, Sask.—Tenders will be received up till the 16th of July, 1913, for the construction of sewer and water mains. Plans and specifications may be obtained from the office of *The Canadian Engineer*, Winnipeg; M. H. Baker, city engineer, and the City Commissioners.

▲—Toronto, Ont.—Tenders will be received up till the 8th of July, 1913, for the construction of a large number of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Mayor.

▲—Victoria, B.C.—Tenders will be received up till the 15th of July, 1913, for the laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit. Plans and specifications may be obtained from the Sooke Water Supply office, and C. H. Rust, Water Commissioner.

BUILDINGS AND INDUSTRIAL WORKS.

Bassano, Alta.—The ratepayers have passed the following by-laws:—$25,000 for expenditure on gas well and $5,000 on municipal hospital. G. R. Bond, secretary-treasurer.

Edmundston, N.B.—Tenders will be received up till the 14th of July, 1913, for school building on Indian Reserve. Plans and specifications may be obtained from the Department of Indian Affairs, Ottawa. J. D. McLean, secretary.

+—Fort William, Ont.—Messrs. Davidson and Smith have awarded the BARNETT-McQUEEN COMPANY the contract for the erection for the first unit of the elevator. It will be reinforced concrete construction and will have a concrete dock built facing the slip to the Government elevator. The contract price is $358,000.

Halifax, N.S.—Tenders will be received up till the 10th of July, 1913, for large supply of paint. Plans and specifications may be obtained from H. Donkin, Road Commissioner, Commissioner of Public Works and Mines, Halifax, N.S.

Hamilton, Ont.—The Victor Saw Works, Limited, the Canadian company of the Massachusetts Saw Works, of Springfield, Mass., will erect a plant in this city.

Hanover, Ont.—Tenders will be received up till the 21st of July, 1913, for the erection of a public building. Plans and specifications may be obtained from Thos. Hastings, Toronto, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Montreal, Que.—The Board of Control has awarded THEODORE LESSARD the contract for the construction of the Meurling Refuge. The contract price is $116,000.

+—Montreal, Que.—The Board of Control have awarded the COOK CONSTRUCTION COMPANY, of Sudbury, the contract for the final widening of the city aqueduct. The tender of the Cook Construction Company was for $2,322,552 with boulevards alongside the aqueduct banks from Pointe St. Charles to Lachine, and the tender of Quinlan and Robertson for the same work was $2,621,180.

+—Orillia, Ont.—The Dominion Government has awarded the SIMCOE CONSTRUCTION COMPANY the contract for the erection of a public building. The contract price is $40,000.

+—Ottawa, Ont.—The Dominion Government has awarded the PETER LYALL CONSTRUCTION COMPANY, Montreal, the contract for the new entrance and other improvements at Rideau Hall. The contract price is $125,000.

+—Ottawa, Ont.—The Dominion Government has awarded the SIMCOE CONSTRUCTION COMPANY, Simcoe, the contract for the erection of the new Customs House. The contract price is $995,000.

Port Arthur, Ont.—The Mackenzie and Mann interests are contemplating plans for a huge steel plant. The estimated cost of the plant is between five and eight million dollars and the work will occupy a mile of waterfront.

Quebec, Que.—As a result of the meeting of federal ministers in Quebec, it has been decided to immediately issue orders for the beginning of the public works promised for the city of Quebec, which include the building of a tunnel with entrance at Wolfe's Cove to St. Malo to connect with the Union passenger station; the Transcontinental Railway workshops at St. Malo, a grain elevator in the vicinity of Priest's wharf, Champlain Street; docks for shipping accommodation, and a passenger and freight depot for local traffic.

+—Regina, Sask.—The exhibition committee has awarded Mr. J. T. TRAUT, Regina, the contract for the erection of the new grandstand, the contract of $19,300 being the lowest, the five others ranging as high as $27,000.

Saskatoon, Sask.—Dr. G. E. Holmes has awarded MR. JOHN DAVIS the contract for the excavation of a new skyscraper. The building when finished will cost $250,000.

Simcoe, Ont.—Tenders will be received up till the 7th of July, 1913, for the construction of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

South Edmonton, Alta.—Tenders are being called for the erection of the new C. N.R. station at South Edmonton. The new building will be built of brick and stone, and together with the iron covered freight shed will cost about $40,000.

Toronto, Ont.—Plans are being prepared for the new Dominion Government buildings and Union passenger station to be built between Yonge and York Streets. It is proposed to widen both Front and Yonge Streets to provide ample approach to the new customs and station buildings. This means the removal of the present customs buildings. They will be replaced by a handsome seven-story building, the estimated cost of which will be between a million and a half and two millions. The union station, plans for which are being completed, will cost probably two millions.

Toronto, Ont.—In connection with the proposed construction of a viaduct, the Harbor Commission will make provision for the accommodation for over sixty ocean freighters. None of the slips will be narrower than 200 feet, but a number of those especially required by the coal firms will be considerably larger on account of the amount of machinery required for loading and unloading purposes. The Bay at this point will be dredged to a depth of thirty feet, in conformity with the depth of the Welland Canal. The construction of these extra dockage facilities will entail an expenditure of $5,000,000.

+—Toronto, Ont.—The Dominion Bank has awarded the NATIONAL FIREPROOF COMPANY the contract for the tile floors and fireproofing for the new building. The contract price is not given.

▲—Valleyfield, Que.—Tenders will be received up till the 18th of July, 1913, for the construction of a protection for the Government dam. Plans and specifications may be obtained from Chief Engineer, Ottawa, Supt. Engineer, Quebec, Canals, Montreal and the Department of Railways and Canals, Ottawa. L. K. Jones, secretary.

Tarvia

Preserves Roads
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Atwater Avenue, Montreal, Quebec. Constructed with Tarvia Modern Pavement

Tarvia vs. Plain Macadam

THE right-hand side of the above roadway was built with "Tarvia X." The left-hand side is plain macadam. The tarviated side is adequate to cope with the traffic. The plain macadam side is in persistent disrepair.

In previous years this roadway washed and gullied very badly in the spring and many tons of macadam were dislodged from different parts of this hill and deposited at the bottom by the spring rains.

Now, after a rain, the tarviated side drains quickly and easily to the gutter. The plain macadam side gets muddy and stays so for some time.

The tarviated side gets more than its share of the traffic because it affords superior traction, yet it is free of dust except for what is blown upon it from its dusty neighbor on the other side of the tracks.

As to maintenance, the tarviated side needs no attention, while the plain macadam is in frequent need of care. The cost of upkeep in the long run will be considerably greater for the plain macadam, and the results will be very inferior.

The initial cost of the plain macadam may have been a little lower, but the high maintenance more than wipes out the saving.

"Tarvia X" which was used on half of this road is a dense, viscid coal tar product which is immune from damage by water and frost. It forms a dense, plastic matrix about the stone, prevents internal movements of the roadway, and by reason of its plasticity, develops a surface that grows smoother with traffic.

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BRIDGES, ROADS AND PAVEMENTS.

Halifax, N.S.—Tenders will be received up till the 9th of July, 1913, for the construction of smaller bridges and culverts in the county of Halifax. Plans and specifications may be obtained from E. H. Armstrong, Commissioner of Public Works and Mines, Halifax, N.S.

+—Jacksonville, Florida.—The city has awarded the DOLARWAY PAVING COMPANY the contract for the construction of 26,141 square yards of Dolarway pavement.

▲—Oakville, Ont.—Tenders will be received up till the 10th of July, 1913, for the construction of 12,800 square yards of armoured, reinforced concrete pavement and 9,000 lineal feet of curbing. Plans and specifications may be obtained from J. A. Bell and Son, St. Thomas, and C. H. Cross, chairman Streets Committee.

Peterborough, Ont.—City Engineer Parsons has been authorized to advertise for tenders for paving with bitulithic pavement, to cost $30,084. The Hunter section will be paved with concrete as an experiment; the pavement will be laid a grade lower than George Street, so that it may be topped with bitulithic or some other material should the concrete not stand the wear and tear.

▲—Regina, Sask.—Tenders will be received up till the 9th of July, 1913, for the construction of 500,000 square feet of concrete sidewalk. Plans and specifications may be obtained from City Engineer F. McArthur, City Commissioners, L. A. Thornton, J. A. Reed and J. Martin, mayor.

+—Saanich, B.C.—The Council have awarded the following contracts for paving:—The WORSWICK PAVING COMPANY will pay, according to their tender, 95 per cent. for the municipal bonds, will lay the paving at $1.715 with a five years' guarantee, or at $1.87 with a ten years' guarantee; wooden margins $51 per 1,000 feet, and crushed rock or gravel binder at 98 cents per square yard. The WARREN CONSTRUCTION COMPANY will pay 95 per cent. for the municipal bonds, will lay the pavement at $1.725 per yard with five years' guarantee, or for $1.825 with ten years' guarantee, wooden margins, $50 per 1,000 feet, and crushed rock or gravel binder, 97 cents per yard. The prices of the competitive tenderers were contained in the issue of June 26th of *The Canadian Engineer.*

▲—Saskatoon, Sask.—Tenders will be received up till the 15th of July, 1913, for the construction of a concrete bridge over the South Saskatchewan River. Plans and specifications may be obtained from the Board of Highway Commissioners. A. J. McPherson, chairman.

▲—Saskatoon, Sask.—Tenders will be received up till the 21st of July, 1913, for supplying boulevard posts. Specifications may be obtained from Mr. E. Harrison, City Electrical Engineer, and the Board of Commissioners. F. E. Harrison, chairman.

▲—Toronto, Ont.—Tenders will be received up till the 7th of July, 1913, for the construction of a concrete beam bridge over the Humber River. Plans and specifications may be obtained from Frank Barber, township engineer.

▲—Toronto, Ont.—Tenders will be received up till the 7th of July for the construction of concrete abutments for concrete bridge over Grand River, Township of Amaranth. Plans and specifications may be obtained from Frank Barber, township engineer.

▲—Toronto, Ont.—Tenders will be received up till the 7th of July, 1913, for the construction of the abutments for the Eckardt Bridge. Plans and specifications may be obtained from Frank Barber, Bridge Engineer and E. A. James, Chief Engineer of the Highway Boards.

+—Toronto, Ont.—Messrs. CARLYLE AND SONS have been awarded the contract for bridge construction in the county of York. The contract price is $3,100. Frank Barber, County Engineer.

The by-law to provide for the extension of the Orillia waterworks system, concerning which a call for tenders appeared in June 19th issue of *The Canadian Engineer*, met with defeat at the hands of the ratepayers. It is understood that the town will take another vote upon the question in a short time.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending June 16th, 1913:—

A Nova Scotia correspondent interested in Labrador sawmill, with a capacity of 100 tons of pulpwood per day, is desirous of being placed in communication with buyers in Great Britain.

From the branch for city trade inquiries, 73 Basinghall Street, E.C.

A Yorkshire manufacturer of stationary steam engines wishes to arrange for their sale in Canada.

A Lincolnshire company manufacturing a specialty in pig iron desire correspondence with Canadian importers.

A London company manufacturing oxy-acetylene welding and cutting plants are desirous of opening up in Canada.

A North of Englaud company manufacturing cast iron spigot and socket pipes wish to arrange for their sale in Eastern Canada.

A Sheffield company manufacturing steel in bars and sheets, castings and forgings, also a large variety of light and heavy edge tools, etc., are about to send out a representative to Canada, and would be pleased to hear from responsible Canadian firms who would be prepared to act as their resident agents.

A London importer asks to be placed in communication with Canadian producers and shippers of ores (iron, nickel, copper, silver, gold, etc., who seek export trade.

A Glasgow firm desires the addresses of Canadian manufacturers of tar, of which they are seeking supplies.

An Ottawa firm recently organized for the purpose of handling engineering supplies and machinery would be glad to hear from United Kingdom manufacturers of motors, metal working machinery, wood-working machinery, etc., seeking Canadian representation.

A Canadian company producing mica upon a large scale ask to be placed in communication with United Kingdom dealers, more particularly with buyers of ground amber mica.

The following inquiries have been received relating to Canadian trade: 602.—A mining engineer residing in Berlin is prepared to transact business and to act as agent or representative for mining and engineering firms and metallurgical works. Reports on mineral deposits and properties undertaken, or existing reports revised and translated for intending continental investors. Agent sale or financing of mineral or industrial propositions. Patent agency and representation. 605.—A Newfoundland firm desires communication with a Canadian manufacturer of interlocking rubber tiling. 610.—A London company manufacturing belting, hose and tubing, valves, hydraulic rings, washers, etc., from a special material, wish to appoint reliable resident firms as agents for the sale of their products in the principal Canadian cities. 611.—A Glasgow firm desire the addresses of Canadian manufacturers of tar, of which they are seeking supplies. The names of the firms making these inquiries, with their addresses, can be obtained upon application to: The Inquiries Branch, the Department of Trade and Commerce, Ottawa, or the secretary of the Canadian Manufacturers' Association, Toronto, or the secretary of the Board of Trade at Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary and Chambre de Commerce du District du Montreal.

ILLUMINATING ENGINEERING SOCIETY.

The last regular meeting of the section until October was held at the Monadnock Block Auditorium, Western Society of Engineers, Chicago.

A paper was read on "Notes on Postal Car Illumination," by A. J. Severt, Milwaukee, Wis., dealing with the result of a series of tests recently conducted in connection with the lighting of United States Mail Cars.

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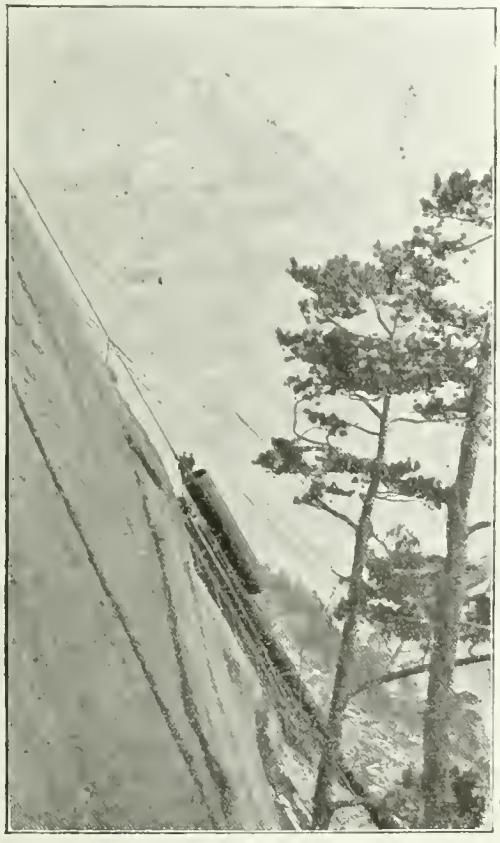

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ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

19494—June 6—Authorizing Corporation of city of Regina, Sask., to construct its Municipal St. Rly., across Commercial Spur of C.P.R., at intersection of Winnipeg St., and Eighth Ave., at rail level, subject to certain conditions.

19495—June 6—Authorizing city of Regina, Sask., to construct Municipal St. Rly. across Commercial Spur of C.P.R., at rail level, on North Railway St., on Dewdney Ave., Regina, subject to certain conditions.

19496—May 30—Granting liberty to C.N.R. to remove spur serving lots 23 and 33, part of Block 1, D.G.S., Lot 1, Parish of St. John, Plan 129, owned by W. A. Taylor.

19497—May 15—Dismissing application of Kelowna Board of Trade, B.C., for Order directing C.P.R. to discontinue charge of $1 made on all incoming and outgoing cars delivered from and taken to its car barges.

19498—June 6—Directing G.T.P. Ry., at its own expense, to provide and construct cattle pass 14 ft. wide and 7 ft. high, under its railway, and two farm crossings, at points on farm of Fred. W. Green, of Moose Jaw, Sask., to be agreed upon between the parties.

19499—June 5—Authorizing Esquimalt and Nanaimo Ry. Co. to construct bridge No. 30.4 over Tsable River, Comox Extension; B.C.

19500—May 29—Directing C.P.R. to move to west of Government Road Allowance all portions of its tracks on south side of main line, passing track switch to be located not closer than 500 ft. from west side of Government Road Allowance; no cars be left standing closer than 450 ft. from said road on Commercial or Elevator tracks, or 500 ft. on Mill or Spur track, etc., and rescinding Order No. 18613, dated Feb. 1st, 1913.

19501—June 7—Authorizing C.P.R to construct spurs for Builders' Supply Co., Limited, of Winnipeg, Manitoba.

19502—June 6—Authorizing city of Regina, Sask., to construct its Municipal St. Rly. across Commercial Spur of C.P.R. at rail level, on Dewdney Ave., immediately west of Broad St., subject to certain conditions.

19503—June 5—Authorizing C.N.O.R. to construct undercrossings on farm of J. J. Stinson and Robert Moore, at stations 667.80 and 668.10, Lots 11 and 12, Con. 2, Tp. Nepean, Ontario .

19504—May 14—Authorizing Lake Erie and Northern Ry. Co. to construct across G.T.R. Co.'s 17th District Main Line between Paris and St. George, Ontario, at Station 538.16.9. by means of an undercrossing.

19505—May 12—Authorizing Lake Erie and Northern Railway Company to construct across Six (6) highways in Tp. South Dumfries, Ontario.

19506—June 7.—Authorizing city of Regina, Sask., to construct Municipal St. Rly. across C.N.R. at rail level, on Fourth Ave., between McIntyre and Lorne Streets, Regina, subject to and upon certain conditions.

19507—June 6—Authorizing city of Regina, Sask., to construct Municipal St. Railway across G.T.P. Branch Lines Company, at rail level, at intersection of Elphinstone Street, immediately north of Sixteenth Avenue to station of said company, Regina, subject to certain conditions.

19508—June 6—Authorizing city of Regina, to construct Municipal St. Rly., across C.N.R., at rail level, on Albert St., where Rly. intersects Albert between Chicago and Washington Avenues, subject to and upon certain conditions.

19509—June 6—Authorizing city of Regina to construct Municipal St. Rly., across G.T.P. Branch Lines Co., where same crosses Fifth Ave., between Ross and Parliament Sts., Regina, Sask., subject to certain conditions.

19510—June 6—Authorizing city of Regina to construct Municipal St. Rly. across G.T.P. Branch Lines Co., at rail level, where same intersects Thirteenth Ave., between Ross and Allan Sts., Regina, Sask., subject to and upon certain conditions.

19511—June 6—Authorizing C.N.R. to construct across and divert public road between Secs. 12 and 13, Tp. 6, R. 18, W. 2 M., Sask.; and after diversion is made and grade crossing constructed company may close portion of present road allowance to be diverted within limits of its right-of-way.

19512—June 9—Establishing the collection and delivery limits of the Dominion Express Co., in the city of Kelowna, B.C.; and rescinding Order No. 16514, dated May 14th, 1912.

19513—June 7—Directing that Esquimalt and Nanaimo Ry. Co. construct steel span girder bridge, with clearance of 14 ft., and a width between abutments of 40 ft. upon and over Hereward Rd., Victoria, B.C.; work to be done within 6 months from date of this Order; city of Victoria to do work of re-grading highway; cost of construction of bridge be apportioned as follows;—20 per cent. out of "The Railway Grade-Crossing Fund," the remainder as follows:—one-third by Rly. Co., and two-thirds by Applicant, (Mun. Council of Corporation of city of Victoria, B.C.).

19514—June 9—Directing that G.T.R. operate trains over crossing of Queen St., village of Mount Forest, Ont., at a speed limit not exceeding 10 miles an hour: all switching movements on siding to be flagged over said crossing.

19515—June 9—Dismissing application city of Calgary, Alta., for an Order extending express delivery limits in said city, authorized under Order No. 15149, dated September 8th, 1911.

19516—June 7—Approving plans showing proposed new piers of St. Francois River bridge, between St. Francois du Lac and Pierreville, P.Q., on Quebec, Montreal and Southern Ry.

19517—June 9—Authorizing Toronto Suburban Ry. Co., to connect with C.P.R., at Cooksville, Lot 12, Con. 1, north of Dundas St., Tp. Toronto, Co. Peel, Ontario.

19518—June 9—Authorizing C.N.O.R. to construct across public road between Lots 3 and 4, Con. 3, Tp. York, Ontario.

19519—June 9—Authorizing C.N.O.R. to divert public road on Lot 11, Con. 1. Tp. Pembroke, Co. Renfrew, Ont., and to construct across same by means of structure carrying railway over highway.

19520—June 9—Directing the form of bond required to be given the municipality, of the village of New Toronto, by the G.T.R., in connection with the laying of an additional 6-inch water main 4 ft. below surface of ground, for purpose of conveying water from Lake Ontario to G.T.R. terminals at New Toronto, across Lake Shore Road, under track of Toronto and York Radial Ry. Co., along 6th St., and across New Toronto St., as authorized by Order No. 18794, dated February 26th, 1913.

19521—June 9—Authorizing C.P.R. to operate bridge No. 0.55 to Sortin, Smith's Falls Subdivision, Eastern Div., Ontario, and Bridge No. 1.85, Montreal Terminals Bethune, Ave., Subway, city of Westmount, Quebec.

19522—June 9—Authorizing C.P.R. to operate bridge No. 140.5, Calgary Subdivision, and bridge No. 96.6, Calgary Subdivision.

19523—June 7—Authorizing C.P.R. to construct extension of said storage siding across road diversion in Lot 21, Con. 13, Tp. of Medonte, Co. Simcoe, Ontario, at mileage 74.87, by means of a grade crossing.

19524—June 9—Authorizing C.P.R. to construct spur for Regina Trading Co., Limited, Regina, Saskatchewan.

19525—June 9—Authorizing C.P.R. to construct spur for Rumely Products Co., Inc., Regina, Saskatchewan.

19526—June 9—Authorizing Esquimalt and Nanaimo Ry. Co. to construct bridge No. 25.0 over Rosewell Creek, Comox Extension, B.C.

19527—June 9—Amending Order No. 19319, dated May 15th, 1913, by striking out paragraph 4 in operative part of said Order and substituting therefor the following: "4. That the conductors of Applicant's cars operate the said half-interlocking plant."

19528—June 9—Directing G.T.R. to install improved type of illuminated electric bell at crossing known as Fort Erie and Port Colborne Road, east of Sherkston Station; 20 per cent. of cost of installing bell be paid out of "Railway Grade-Crossing Fund," remainder by Railway Company.

19529—June 9—Directing that cost of constructing subway under C.P.R. at Hunter and Bexley Sts., Woodstock, Ont., authorized under Order No. 16986, dated July 8th, 1912, be apportioned as follows: 20 per cent. out of "The Railway Grade-Crossing Fund," and the remainder by Railway Company.

19530—June 9—Establishing collection and delivery limits of express companies in city of London, Ontario.

19531—June 9—Establishing collection and delivery limits of Dominion Express Company in town of Taber, Alberta.

19532—June 9—Establishing collection and delivery limits of express companies in city of Sault Ste. Marie, Ont., and a portion of adjoining town of Steelton.

19533—June 9—Establishing collection and delivery limits of express companies in city of Windsor, Ont.

19534—June 9—Establishing collection and delivery limits of express companies in town of Walkerville, Ontario; and rescinding Order No. 15399, dated October 24th, 1912.

19535—June 4—Authorizing G.T.R. to construct sidings and additional tracks, or yard extensions, to and into premises of Canadian Furnace Company, village of Port Colborne, Ontario.

19536—June 10—Requiring C.P.R. to operate two first-class trains, each way, per day, on week days, between Ottawa and Prescott; time of run to be not more than two hours; this Order to be made effective 1st day of July next. Railway Company is restrained from hauling freight on said trains.

19537—June 9—Establishing collection and delivery limits of express companies in city of St. Thomas, Ontario.

19538—June 9—Establishing collection and delivery limits of express companies in town of Haileybury, Ontario.

19539—June 9—Extending eastern and southern limits of area within which railway companies undertake the cartage of freight in city of London, Ontario, at toll therefor published and filed.

19540—June 10—Refusing application of Dominion Townlots, Limited, for authority to construct a highway across C.P.R. at Broadway, Saskatchewan, near present farm crossing, in N.½ Sec. 16-17-19, W. 2. M.

19541—June 10—Authorizing Esquimalt & Nanaimo Ry. Co. to divert Comox waggon road to connect with public road crossing its railway at mileage 13.0 on its Comox Extension, B.C.; and rescinding Order No. 9843, dated March 10th, 1910.

19542—June 10—Authorizing G.T.R. to reconstruct bridge No. 134 at mileage 222.32, 2nd Dist., carrying railway over St. Francis River, near Richmond, Quebec.

19543—June 10—Authorizing C.P.R. to construct bridge No. 10.8 over South Spitler Creek, Port Burwell Sub. Div., near Ostrander Station, Ontario.

19544—June 10—Directing C.N.R. to construct suitable culvert under its tracks on Winchester Ave., municipality of Fort Garry.

19545—June 10—Directing C.N.R. and C.P.R. to deepen culverts under their tracks 3 feet, as well as ditches across their respective rights of way, with exception of that portion of C.P.R. right of way which provides roadway to station buildings at village of Maryfield, Sask.; culvert at this point to be lowered 1 foot; ditch to and from railway companies' right of way to be lowered by complainant (village of Maryfield, Sask.); work to be completed by August 15th, 1913.

19546—June 10—Authorizing Hamilton Street Rly. to construct two tracks on its railway, at grade, across T. H. & B. Rly. at intersection of Main and Trolley Sts., Hamilton, Ont., subject to and upon certain conditions.

19547—June 10—Authorizing C.N.O. Rly. to construct across public road between townships Pembroke and Stafford, Co. Renfrew, Ont., by means of structure carrying railway over highway.

19548—June 10—Authorizing C.N.R. to construct, at its own expense, across six (6) highways in province of Saskatchewan.

19549—June 10—Extending until June 30th, 1913, time within which G.T.R. installs bell at crossing of first highway, 150 feet west of St. Hilaire Station, Quebec.

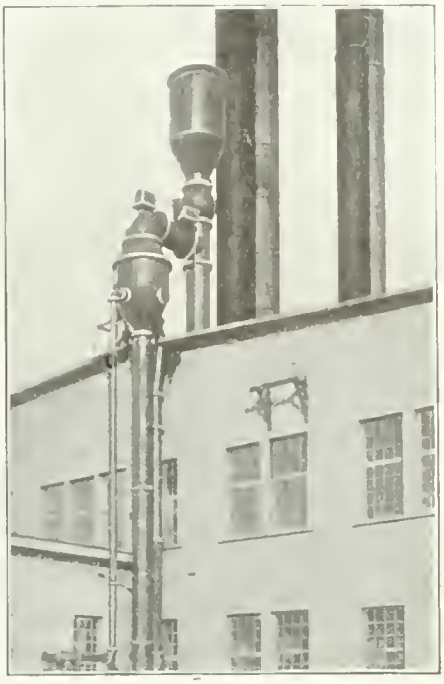
19550—June 7—Authorizing G.T.R. to construct siding for J. B. Mustard, on Lot 16, Con. 1, Tp. Stanley, Co. Huron, Ontario.

19551—June 10—Authorizing C.P.R. to cross, temporarily, with its Bergen North Easterly Cut-off the C.N.R. Co.'s Oak Point Branch; crossing to be protected by watchman, at expense of applicant company (O.P.R.).

CONDENSING APPARATUS

specially designed to secure

GREATER STEAM ECONOMY



WORKS: WILLIAM and SEIGNEURS STREETS, MONTREAL

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Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

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Used in connection with an electrolytic hypochlorite treatment, the process is **ABSOLUTELY ODORLESS** and the effluent is free from disease germs.

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The Hampton Tank reduces the cost of any subsequent treatment.

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Sterilization Co.

Union Building, Clinton Street

NEWARK, N.J.

Also engineers for the electrolytic treatment of water.

A Perfect Weir Gage

Carries an unusually large card and will register without any reduction through a variation of two feet or on a two to one reduction through a variation of four feet.

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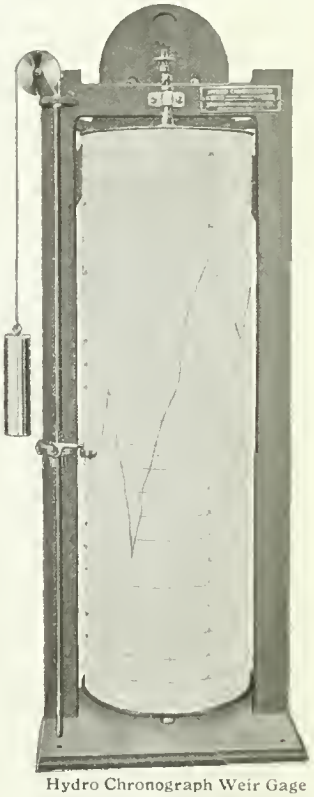

Hydro Chronograph Weir Gage

Hydro Manufacturing Co.

700 BULLITT BUILDING, PHILADELPHIA, Pa.

19552—June 10—Authorizing C.P.R. to construct spur for Messrs. R. MacFarlane & Co., Limited, Montreal, Quebec.

19553—June 12—Dismissing application of Harry Simpson and others of Niverville, Manitoba, for an Order directing C.P.R. to stop express trains travelling in both directions, at station at Niverville, on Emerson Branch of C.P.R.

19554—June 10—Directing C.N.R. to place station agent at D'Arcy, Saskatchewan, on or before August 1st, 1913.

19555—June 11—Directing that crossings of highways by C.N.R., known as Central Ave., and First Ave. East, City of Prince Albert, Sask., be protected by watchmen between 6.30 a.m. and 6.30 p.m. daily, except Sunday; cost of maintaining said watchmen be apportioned as follows: Two-thirds be borne by C.N.R. and one-third by city; payment be made monthly, or quarterly, as parties may agree; any dispute between parties to be settled by the Board.

19556—June 10—Authorizing C.P.R. to construct diveraion of roadway in Lot 6616, Kootenay District, B.C., at mileage 46.7, from Colvalli, on its Cranbrook Sub. Div., B.C., and construct tracks of said line across said diversion, by means of a grade crossing.

19557—June 11—Authorizing C.P.R. to construct diversion of road allowance in Sec. 35-19-19, W. 3 M., Sask., at mileage 38.44 from Swift Current, on Swift Current Northwesterly Branch; and construct, by means of grade crossing, tracks across said diversion (of said Swift Current Northwesterly Branch).

19558—June 11—Authorizing C.P.R. to divert and construct across diversion of road allowance in Sec. 36-19-19, W. 3 M., Sask., on its Swift Current Northwesterly Branch, by means of a bridge.

19559—June 12—Authorizing C.L.O. & W. Ry. (C.P.R.) to divert highway between Lots 24 and 25, Con. "A," Tp. Brighton, at mileage 94.15 from Glen Tay, so as to cross C.L.O. & W. Ry. and G.T.R. at mileage 94.41 from Glen Tay; and construct its tracks, by means of grade crossing, over new road at mileage 94.41.

19560—May 30—Authorizing C.P.R. to construct main line tracks and sidings of Island Sub. Div., B.C. Division, across Franklyn St., Lubock Square and Fitzwilliam St., city of Nanaimo, B.C.

19561—June 12—Amending Order No. 18927, dated March 27th, 1913, by striking out words "and future protection," in second last line of operative part of said Order.

19562—June 12—Extending, until July 19th, 1913, the time within which G.T.R. install electric bell at crossing of Clara St., near Glen Robertson Station, Ontario.

19563—June 12—Directing C.N.R. to reconstruct shelter building at Wroxton, Sask., so as to afford accommodation equal to standard third class station; work to be completed before Sept. 15th, 1913, and rescinding Order No. 19201, dated May 3rd, 1913.

19564—June 11—Directing G.T.R. to employ a night, as well as a day, watchman at crossing of Hurontario St., Port Credit, Ont., between 7 p.m. and 7 a.m.; expense of maintaining said watchman be apportioned as follows: 80 per cent. by G.T.P. and 20 per cent. by Tp. Toronto.

19565—June 12—Approving location C.N.O.R. station grounds at Galea, Tp. Field, Dist. Nipissing, at mileage 259.30 from Ottawa.

19566—June 12—Extending, until July 15th, 1913, time within which C.N.R. erect gates at crossing of Frederica and Edward Sts., city of Fort William, Ontario.

19567—June 11—Authorozing C.P.R. to construct spur for Massey-Harris Co., Calgary, Alta.

19568—June 12—Directing C.N.R. to install, within 60 days from date of this Order, an improved type of automatic electric bell at crossing of highway between Lots 2 and 3, Con. 4, at Station 2661, Tp. Scarboro, Co. York, Ontario; Railway Company to bear and pay expense of installing and maintaining said bell.

19569—June 11—Authorizing C.P.R. to construct, by means of a grade crossing, tracks of Johnville Ballast Pit spur across public road between E. ½ of Lot 27, Rge. 3 and Lot 27-D, Rge. 2, Tp. Eaton, Co. Compton, Quebec.

19570—June 13—Directing that where shippers furnish slats for floors of refrigerator cars not equipped with permanent slatted or double floors, for carriage of fresh fruits (apples excepted) under refrigeration, railway companies subject to jurisdiction of Parliament of Canada shall allow shipper $3 per car for said slatting; shipper be permitted to deduct said allowance from freight charges payable by him upon shipment in such car; shipper's receipt for amount so allowed be given railway company's agent at forwarding station, and be accepted by him as so much cash in prepayment of freight charges on such car.

19571—June 12—Directing C.P.R. to construct spur shown in red on plan on file with Board under file No. 22135, from point marked "B" to east boundary of Canada Tile & Fireproofing Co., Ltd., property; that C.N.R. construct spur from point marked "D" to southern boundary of said property; spurs to be completed within three months from date of this Order.

19572—June 14—Approving, subject to terms of agreement, plan showing proposed location of temporary chain hoist and raised rail, for purpose of unloading supplies in connection with St. Clair Ave. civic car lines near Davenport Station of G.T.R., Toronto, Ontario.

19573—June 16—Authorizing C.N.O.R. to construct across Kathleen St., town of Sudbury, within 60 days from date of this Order, C.N.O.R. install improved type of automatic electric bell at said crossing, and thereafter maintain bell at its own expense.

19574—June 16—Authorizing Algoma Eastern Ry. Co. to construct Goat Island Coal Handling Bridge, on Goat Island Docks, near Little Current, Ontario.

19575—June 16—Authorizing Esquimalt & Nanaimo Ry. Co. to construct Bridge No. 27.8 over Coal Creek, on Comox Extension, Dist. Newcastle, Vancouver Island, B.C.

19576—June 16—Approving change or altheration in C.L.O. & W. Ry. Co.'s line of railway; in Lots 23, 24 and 25, Con. A, Tp. Haldimand, Ont.

19577—June 12—Authorizing C.P.R., subject to conditions contained in by-law and agreement, to construct extension of railway across certain lands, streets and lanes in city of Edmonton, Alta.

19578—June 16—Authorizing C.P.R. to construct diversion of road allowance in N.E. ¼ of Sec. 19-17-24, W.P.M.; after such diversion company may close portion of road allowance between S.E. ¼ of Sec. 30 and N.E. ¼ of Sec. 19-17-24, W.P.M., within limits of right of way, mileage 44.47 at Kelloe, on its Bredenbury Sub. Div., Manitoba Division.

19579—June 16—Authorizing G.T.R. to reconstruct bridge No. 23, at Mile Post 47.28 on 21st District of its railway, 1¼ miles south of Hickson, Ont., over private roadway and stream.

19580—June 12—Authorizing G.T.R. to construct siding for A. Davis & Son, Ltd., Kingston, Ontario.

19581—June 12—Authorizing G.T.R. to construct siding, and spur therefrom, for the Dominion Tire Co., Ltd. (Canadian Consolidated Rubber Co.), city of Berlin, Ontario.

19582—June 12—Authorizing G.T.R. to construct two additional sidings to and into premises of C. A. Scott, on part Lot 2, south of Carlaw Ave., Toronto, Ontario.

19583—June 16—Approving and authorizing clearance as shown on G.T.R. plan showing clearance at its new bonded freight house on Wellington St., Montreal, Quebec.

19584—June 16—Authorizing C.N.R. to construct spur for city of Saskatoon, Sask., crossing Avenue "T" in said city.

19585—June 17—Recommending to the Governor-General in-Council for sanction an agreement, dated June 2nd, 1913, amalgamating the C.N.R. and Can. Nor. Branch Lines Co.

19586—June 16—Approving plans and specifications of Pennington Drain, under G.T.R., on line between Lots 2 and 3, Tp. South Norwich, Co. Oxford, Ont.; railway company to have option of doing work on its right of way.

19587—June 17—Approving location G.T.P. Branch Lines Co.'s station at Cando, Sec. 22-39-16, W. 3. M., Battleford Branch, Sask.; station to be in accordance with company's Standard Structural Plan No. 1, on file with the Board.

19588—June 17—Approving locations of G.T.P. Ry. stations as follows: No. 1, mileage 1155.6 west of Winnipeg, Cariboo District; and No. 2, mileage 1147.2 west of Winnipeg, Cariboo District, B.C.

19589—June 16—Approving location G.T.P. Branch Lines Co.'s station, at Fort, in Sec. 28-33-19, W. 3 M., on Biggar-Calgary Branch, Sask.; station to be in accordance with company's Standard Structural Plan No. 1 on file with the Board.

19590—June 17—Authorizing G.T.P. Branch Lines Co. to carry traffic on Biggar-Calgary Branch between Biggar (mileage 0.0) and Dodsland (mileage 48.0), Alta., provided speed of trains be limited to a rate not exceeding 20 miles an hour; and rescinding Order No. 17850, dated October 24th, 1912.

19591—June 16—Authorizing C.L.O. & W. Ry. (C.P.R.) to construct road diveraion in Lot 25, Con. 1, Tp. Clarke, Co. Durham, Ont., at mileage 142.05.

19592—June 16—Approving and authorizing clearances as shown on C.P.R. plan showing clearance of tracks of its coaling plant in North Tranacona Yards, Manitoba.

19593—June 17—Authorizing C.P.R. to construct bridge No. 103.7 (near Foster Station), on Sherbrooke Sub. Div., Eastern Div., P.Q.

19594—May 19—Authorizing C.P.R. to construct spur to Hastings Park, Vancouver, B.C.; spur to be constructed within three months from date of this Order.

19595—June 16—Authorizing C.P.R. to construct new trackage in railway yard, North Transcona, Man., across transmisaion line of city of Winnipeg, in Lot 58, Kildonan.

19596—June 17—Extending, until August 15th, 1913, time within which C.P.R. install gates at North Vancouver Ferry, Columbia Ave., and G.T.P.R. Co.'s team crossings, Vancouver, B.C.

19597—June 17—Authorizing C.P.R. to construct, by means of grade crossings, its Ballast Pit Spur across two (2) highways, namely, mileage 0.74 between Lot 8, Con. 1 and Lot 8, Con. 2, and at mileage 0.38, in Lot 9, Con. 2, Tp. Hinchinbrooke, Co. Frontenac, Ontario.

19598—June 16—Directing C.N.R. to erect a third-class station at Decker, Man., and construct two-car cattle pen at said point; work to be completed by Sept. 15th, 1913.

19599—June 16—Directing C.P.R. to move station off public road allowance, to a point 300 ft. west, and construct proper crossing along line of existing highway, municipality of Rosedale, to move grain elevators off highway, at Franklin, Man.; work to be completed within 60 days from date of this Order.

19600—June 17—Authorizing Dominion Atlantic Ry. Co. to construct siding for Markland Fruit Co., Ltd., across public road at Kingston, King's County, Province of Nova Scotia.

19601—June 17—Authorizing G.T.R. to construct certain spurs into premises of Pilkington Bros., Ltd., on Lots 71 and 72, Tp. Thorold, County of Welland, Ontario.

19602—June 17—Authorizing C.P.R. to construct spur for J. R. Johnston, Medicine Hat, Alta., to be completed within three months from date of this Order.

19603—June 17—Authorizing C.N.R. to construct spur along lane through Blocks 21 and 31, to cross Isabella St., Saskatoon, Sask., with said spur; and to construct spur along lane through Block 30, in said city.

19604—June 12—Directing that all wires at Yonge St. and Avenue Road, North Toronto, be placed underground, excepting long distance wires of Bell Telephone Co. Each company bear and pay cost of moving its wires on said streets.

19605—June 16—Authorizing C.L.O. & W. Ry. (C.P.R.) to operate work train service over crossing of its railway with C.N.O.R., for period of six months from date of this Order, pending completion of interlocking plant: provided that during such operation crossing be protected by flagman maintained at C.L.O. & W. Ry.'s expense.

19606—June 13—Relieving C.P.R. from providing further protection at crossing of first highway east of Berthier Jct., Que.

19607—June 16—Directing C.P.R. forthwith to remove trees south of track and west of crossing, at mileage 71.2, about three (3) miles west of Pointe du Lac Station, Quebec.

19608—June 12—Authorizing C.P.R. to construct spur adjoining Neebing Ave., city of Fort William, beginning at a point on its main line, at mileage 3.14, and extending to a point 100 feet south of main line of C.N.R. to a connection with industrial spur.

19609—June 13—Approving location G.T.R. station at Rideau, Ont., about 400 feet east of Kingston and Ottawa Road.

19610—June 11—Authorizing C.N.O.R. to construct across certain highways in town of Sudbury, Dist. Sudbury, Ontario.

19611—June 18—Approving location G.T.P. Branch Lines Co. station on Regina Boundary Branch, at "Boundary Line," in Sec. 6-1-2, W. 2 M, at mileage 154.8, Saskatchewan.

MACK

The Unit Type Body Which Can Be Discharged—

in sections for carrying coal, wood, cement or building material in different compartments is becoming popular in the building and contracting industries.

We show here a 4-ton Mack Truck of the unit type of body, each compartment of which holds a ton of material. These sections are operated individually which makes this type of dumping body especially adapted for use by coal dealers, building supply dealers, grain dealers, contractors, and all concerns delivering portions of a load to different places.

This view shows a 4-ton Mack Truck, each compartment of which holds a ton of material.

This truck has been delivering on an average of forty loads daily, within a radius of fifteen miles of the City of Hagerstown, Md., making approximately forty miles daily, and has displaced four teams and two men.

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"Leading Gasoline Truck of the World"

The owner advises us that his truck averages seven to eight miles per gallon of gasoline.

The operator was one of their factory hands, whom our expert instructor taught how to manipulate the car, he having had no previous experience in running motor trucks.

We shall be pleased to give you further information on this special kind of Dumping Device.

Mack Trucks are built in 1, 1½, 2, 3, 4, 5, and 7½ tons capacity, with any load distribution and any style of body.

Mack Trucks have proven their reliability, economy and long life by 12 years of real service in every line of transportation.

Send for literature and transportation data on your line of business.

The Canadian Fairbanks-Morse Company, Limited

ST. JOHN QUEBEC MONTREAL OTTAWA
TORONTO WINNIPEG SASKATOON CALGARY VANCOUVER

TENDERS CALLED FOR

PLANS AND SPECIFICATIONS ON FILE.

The following plans and specifications are on file for reference only, unless otherwise noted, at the office of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg, Man.:—

BIDS CLOSE	NOTED IN ISSUE OF
16-7—Construction of sewer and water-works, Prince Albert, Sask.	26-6

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

BEAUHARNOIS CANAL.

PROTECTION WORK FOR VALLEYFIELD GOVERNMENT DAM.

NOTICE TO CONTRACTORS.

Sealed tenders, addressed to the undersigned and marked "Tenders for works for protecting the Government dam at Valleyfield," will be received at this office until 16 o'clock on Friday, July 18th, 1913.

Plans, specifications and form of contract to be entered into can be seen in or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Quebec Canals, Montreal, Que.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque for the sum of $3,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 25th June, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—44229.

TENDERS FOR BRIDGE CONSTRUCTION.

Sealed tenders plainly marked as to contents will be received by the undersigned up to noon of Monday, July 7th, 1913, for the construction of a concrete beam bridge over the Humber River at Pine Grove, Township of Vaughan.

Plans and specifications and all necessary information may be seen at the office of the undersigned, 57, Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer.

Toronto, June 24th, 1913.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

TRENT CANAL.

Steel Pontoon Gate Lifter.

NOTICE TO CONTRACTORS.

Sealed tenders, addressed to the undersigned and marked "Tender for Steel Pontoon Gate Lifter, Trent Canal," will be received at this office until 16 o'clock on Tuesday, July 29th, 1913.

Plans, Specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Trent Canal, Peterborough, Ont.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the usual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque for the sum of $1,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Assistant Deputy-Minister and Secretary.

Department of Railways and Canals,
Ottawa, 25th June, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—44228.

CITY OF VICTORIA, B.C.

Sealed proposals will be received at the offices of the Water Commissioner, City Hall, until 12 noon, July 15th, 1913, for the fabrication and laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer, for such construction, pursuant to the provisions of By-law No. 814, and adopted by the Council.

Plans and Specifications can be seen, and Forms of Tender obtained, at the Sooke Water Supply Office, 1414 Douglas Street, Victoria, B.C.

The lowest or any Tender not necessarily accepted.

C. H. RUST,
Water Commissioner.

Victoria, B.C., June 14th, 1913.

(For further tenders see pages 86 and 88).

Insurance Engineering

We maintain a skilled force of engineers and inspectors to advise in regard to the insurance of industrial undertakings.

We offer our services as consultants to engineers and architects who have charge of industrial construction. We have a thorough knowledge of fire protection and the many matters which govern insurance rating.

Manufacturers are invited to permit us to make an inspection and to let us make suggestions regarding fire protection which will add security and also likely more than pay for themselves through reduced insurance rates.

Insurance may be placed through our firm in the same manner as it would be through other insurance brokerage firms. The service rendered—in most cases without cost to our clients—by our staff of inspectors and engineers, makes it profitable for owners who are placing insurance on industrial undertakings to place the insurance through our firm.

E. M. SELLON & CO.
LIMITED

INSURANCE ENGINEERS
and Insurance Brokers

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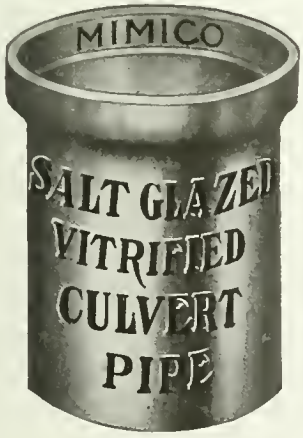

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If not, write now. Is it worth while? Well, see what the editor of The Canadian Engineer says about it on page 90 of the issue of June 26th.

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LIMITED
MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24".

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Total Issue, Fifteen Thousand

American Civil Engineers' POCKET BOOK

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A professor of Civil Engineering in a Western university was asked by a senior class for advice regarding the starting of a library after graduation, and he replied:

"Begin with Merriman's 'American Civil Engineers' Pocket Book.'"

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TENDERS CALLED FOR

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, July 8th, 1913, for the construction of the following sewers:—

Lane 1st N. Dale Avenue, Glen Road to East End.
Columbine Avenue, Rainsford Road to Kingston Road.
Columbine Avenue, Rainsford Road to Woodbine Avenue.
Jones Avenue, Danforth Avenue to 1,407-ft. North.
Braemore Gardens, Christie Street to Christie Street.
Lane 2nd N. King Street, Princess Street to West End.
Clara Street, Conduit Street to Quebec Avenue.
Beresford Avenue, Bloor Street to North End.
Wheeler Avenue, Queen Street to 1,350-ft. North.
Morley Avenue, 250-ft. S., Gerrard Street to Gerrard Street.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tenders obtained at the office of the Commissioner of Works, Toronto.

The tenderers shall submit with their tenders the names of two sureties (approved of by the City Treasurer, not members of the City Council, or officers of the Corporation of the City of Toronto) or in lieu of said securities, the Bond of a Guarantee Company approved of as aforesaid.

The usual conditions relating to tendering as prescribed by City By-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, June 26th, 1913.

TENDER FOR BRIDGE ABUTMENTS.

Sealed tenders addressed to R. W. Phillips, secretary of the York Highway Board, will be received up to 6 p.m., Monday, July 7th, 1913, for the construction of the abutments of the Eckardt Bridge, Lot 10, Con. VI., Markham Township.

Plans and specifications may be seen at the office of the Highway Board, or at the office of Frank Barber, Bridge Engineer, 57 Adelaide Street, East, Toronto.

E. A. JAMES,
Chief Engineer to the Board.

Toronto, June 26th, 1913.

CITY OF REGINA.

SIDEWALKS.

Sealed tenders addressed to the City Commissioners, Regina, will be received up until 12 o'clock noon, July 9th, 1913, for the following works:—

Construction of approximately 500,000 sq. ft. of concrete sidewalk.

All information regarding the above may be obtained on application to F. McArthur, City Engineer.

A marked cheque for 5 per cent. of the amount of the bid must accompany each tender.

The city reserves the right to divide the work into two or more contracts, and to reject any or all tenders.

J. MARTIN,
Mayor.
L. A. THORNTON,
J. A. REID.
City Commissioners.

Regina, Sask., June 19th, 1913.

CANADIAN PACIFIC RAILWAY COMPANY.

NORTH TORONTO GRADE SEPARATION.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the undersigned up to 12 o'clock noon on Saturday, July 12, for the construction of the substructure of a subway to be built at Yonge Street, at North Toronto.

Plans and specifications can be seen at the office of the Engineer of Grade Separation at No. 262 Avenue Road, Toronto, where proposal forms can also be obtained.

B. RIPLEY,
Engineer of Grade Separation.

Toronto, June 26th, 1913.

TENDERS.

CONCRETE BRIDGE AT SASKATOON.

Sealed tenders will be received up to 16.30 o'clock on Tuesday the 15th day of July, 1913, for the under-mentioned work:—

Construction of a concrete bridge over the South Saskatchewan River at Saskatoon.

Tenders for this work must be accompanied by accepted cheque on a chartered bank, or other satisfactory deposit for the sum of $15,000.00 Deposits of unsuccessful tenderers will be returned when contracts are signed.

The right to reject any or all tenders, or to waive any defects or irregularities therein is to be at the discretion of the Chairman of the Highway Commission.

Plans, specifications, forms of tender and all information may be obtained on application to the undersigned.

A deposit of $50 must accompany each request for copy of plans and specifications; this amount will be refunded on the return of plans.

A. J. McPHERSON,
Chairman, Board of Highway Commissioners.

Regina, Saskatchewan, June 20th, 1913.

(The unauthorized insertion of this advertisement will not be paid for.)

CITY OF PRINCE ALBERT, SASK.

Tenders will be received, addressed to the City Clerk, Prince Albert, Sask., until noon, Wednesday, July 16th, 1913, for the following contracts:—

13 D—Laying approximately 22,000 feet of steel water main.
13 E—Laying approximately 25,000 feet of steel water main.
13 F—Laying approximately 26,000 feet of sewers.
13 G—Laying approximately 25,000 feet of sewers.

Plans and specifications are on file at the office of *The Canadian Engineer*, Union Bank Building, Winnipeg, and at the office of the City Engineer, Prince Albert. Instructions to bidders and form of tender may be had on application to the City Engineer. Plans and specifications not to be sent out.

The lowest or any tender not necessarily accepted.

M. H. BAKER,
City Engineer.
N. W. MORTON.
H. E. M. KENSIT,
C. O. DAVIDSON,
City Commissioners.

Prince Albert, Sask., June 23rd, 1913.

(For further tenders see pages 84 and 88).

"STEELCRETE" CONCRETE REINFORCEMENT

for bridge floor slabs, culverts, retaining walls, etc.

Victoria Bridge, Elora, Ont. Messrs. Bowman & Connor (Toronto), Engineers. **"Steelcrete" Floor Reinforcement.**

Slabs of Concrete reinforced with "Steelcrete" Expanded Metal make a permanent bridge floor of the greatest strength, at the least cost, and with the least amount of superimposed dead load on the bridge. In all parts of the world "Steelcrete" is considered the best reinforcement by most bridge engineers. It possesses an absolutely mechanical bond against vibration. It lies flat. Once placed, disarrangement is impossible. The meshes are diamond shaped, the joints absolutely rigid. There are no corrugated or twisted strands. When the load is applied there is no straightening out to split the concrete before the reinforcement comes into tension.

Specify "Steelcrete" for

Floors	Sidewalks	Sewers
Roofs	Foundations	Bridges
Domes	Fortifications	Flumes
Tanks	Warehouses	Tunnels
Dams	Coal Bunkers	Cisterns
Piers	Storage Bins	Subways
Docks	Power Plants	Reservoirs
Vaults	Storage Houses	Conduits
Kilns	Retaining Walls	Factories

ENGINEERS ARE INVITED TO CORRESPOND WITH OUR DESIGNING DEPARTMENT CONCERNING ANY WORK ON HAND.

Made in Canada: Two Factories in Toronto, one in St. Catharines, Ont.

STEEL AND RADIATION, LIMITED

LARGEST MANUFACTURERS IN CANADA OF REINFORCING AND STEEL SASH

Head Office, Fraser Avenue
TORONTO

Burn & Langley
OTTAWA

138 Craig Street West
MONTREAL

CALGARY: Canadian Equipment & Supply Co.
VANCOUVER: E. G. Cullen, 418 Pacific Building
WINNIPEG: N. J. Dinnen, Canada Building

QUEBEC: 101 St. John Street
HALIFAX: F. S. Coombs
ST. JOHN: R. Max McCarty

Tenders Called For

CITY OF SASKATOON.

TENDERS WANTED.

Sealed tenders, addressed to the City Commissioners, Saskatoon, and endorsed "Tender for Boulevard Posts," will be received until 12 o'clock noon on **Monday the 21st day of July, 1913,** for sixty cutter's 5-light Boulevard Posts No. 1121.

Specifications and form of tender may be obtained on application to Mr. E. Hanson, City Electrical Engineer, Saskatoon.

The lowest or any tender not necessarily accepted.

F. E. HARRISON, Mayor,
Chairman of Commissioners.

Saskatoon, Sask., June 25th, 1913.

TO CONTRACTORS.

CONCRETE PAVING, OAKVILLE, ONT.

Sealed tenders addressed to the Chairman of Committee, will be received until noon on **Thursday, the 10th day of July, 1913,** for laying approximately 12,800 square yards of armoured, reinforced concrete pavement and 9,000 lineal feet of curbing.

Plans and specifications can be seen at the Star Office, Oakville, and at the office of J. A. Bell and Son, C.E., St. Thomas.

The committee do not bind themselves to accept the lowest or any tender.

C. H. CROSS.
Chairman Streets Committee, Oakville, Ont.

TENDERS FOR BRIDGE CONSTRUCTION.

Sealed tenders plainly marked as to contents will be received by the undersigned up to 6 p.m., of Monday, July 7th, 1913, for the construction of concrete abutments for concrete bridge over the Grand River, Lot 16, between Concession 5 and 6, Township of Amaranth.

Plans, specifications and all necessary information may be had at the office of the undersigned or seen at the residence of John Bryan, Esq., Laurel, Ont.

Lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer.

57 Adelaide Street East, Toronto, June 24th, 1913.

For further Tenders see pages 84 and 86.

NEW INCORPORATIONS.

Cap St. Martin, Que.—St. Laurent Quarry, $99,800. F. Dufresne, C. LePailleur, St. Laurent; J. A. LePailleur, Lachine.

Point Pelee, Ont.—Point Pelee Sand and Gravel Company, $20,000. J. W. Post, Chatham; W. A. Grubb, Sr., Mersea Township; A. T. Boles, Leamington.

Vancouver, B.C.—Standard Art Metal Company, $25,000. Bowena Copper Mines, $250,000. New Zealand Sulphur Company, $500,000. Crescent Sand and Gravel Company, $75,000.

Toronto, Ont.—Herbert Morris Crane & Hoist Company, $100,000. J. S. Lovell, W. Bain, R. Gowans. Gravel, Sand and Crushed Stone Company, $50,000. J. Kerr, L. V. McBrady, J. S. McLaughlin.

Second-Hand Machinery

Second Hand Contractors' Machinery

Why not use second hand equipment on the next job? We have a large stock of machinery ready for delivery

Nearly Good as New

Get the details on these items:—
1—24" x 24¼" x 30" "Ingersoll-Sergeant" compressor, Class A
1—20" x 20¼" x 24" "Ingersoll-Sergeant" compressor, Class A
1—14" x 14¼" x 18" "Ingersoll-Sergeant" compressor, Class A
1—No. 2½ "Smith" concrete mixer
1—No. 5 "Gates" gyratory crusher, style K
1—30" x 14" "Buchanan" crushing roll
1—35 H.P. "Farquhar" combined engine and boiler
2—No. 15 "Morris" centrifugal pumps with engines

L. F. SEYFERTS' SONS, Inc.
437 NORTH THIRD ST., PHILADELPHIA, U.S.A.

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

$400 WILL BUY a 30 H.P. gas engine and 30 H.P. gas producer; used less than two years on a chopping plant. Israel Brubacker, Elmira, Ont.

INSTRUMENT FACTORY AT MONTREAL.

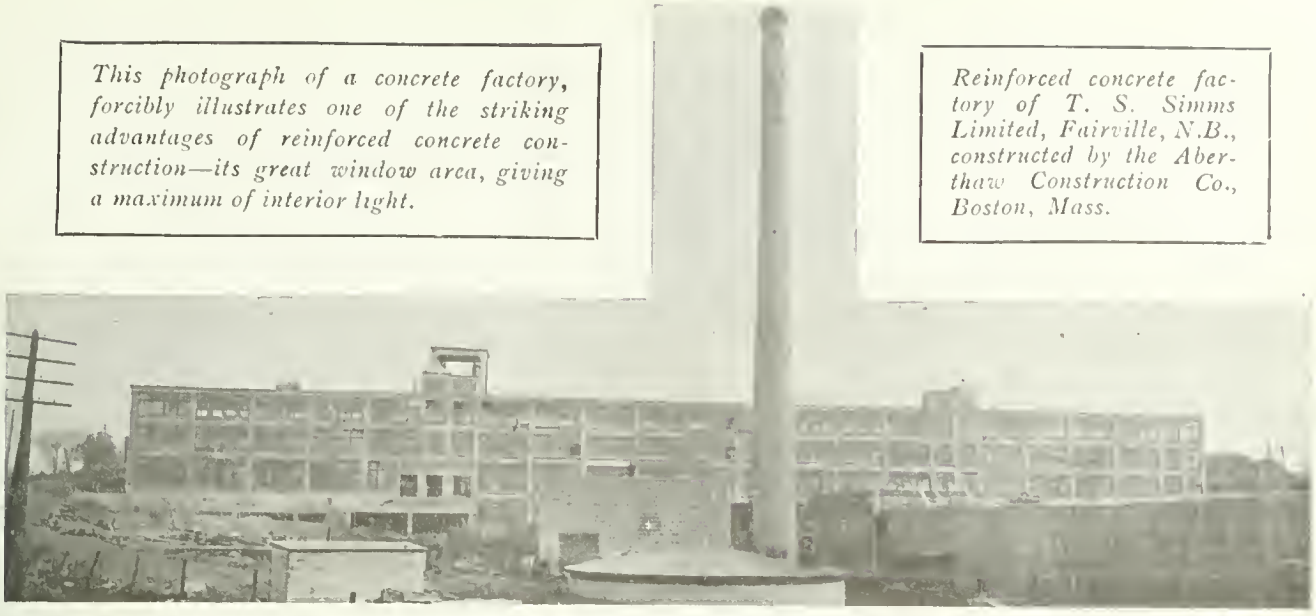
Announcement is made in this week's issue of *The Canadian Engineer* of the opening of a factory at Westmount, Montreal, for the manufacture of scientific instruments. The business has been organized under the name of The Gowlland Company, with Mr. Henry Gowlland as manager. Mr. Gowlland, who had some 30 years of experience in instrument manufacture in England, came to Canada three years ago, at the request of McGill University authorities. The disastrous fire at McGill, which practically ruined most of their instruments, made it imperative that an expert be secured to put the instruments in proper condition. Mr. Gowlland was secured and until comparatively recently was engaged almost solely on McGill's work. Within the past year he found time to do considerable repair work that came to him as a result of his McGill connections, and then he received various requests to build special instruments.

Business along these lines grew so rapidly that Mr. Gowlland decided to open an up-to-date factory devoted exclusively to the manufacture of transits, levels, microscopes, telescopes, heliographs, compasses, sextants and other scientific instruments.

A number of additions to the force at Oshawa headquarters of the Pedlar People, Limited, has recently been made which will further increase the efficiency of the organization. Mr. W. R. Geikie, formerly branch manager for the company in Toronto, will act in the capacity of managing director. Mr. Geikie's thorough knowledge of the business is reinforced by a number of years' experience as a manager of various branches of the Dominion Bank. The operating department has been strengthened by the addition of Mr. W. Loach, formerly connected with the management of Canada Foundries, Limited, Toronto, and with a wide and varied mechanical and manufacturing experience in the United States and Canada. A further addition has been made in the person of Mr. A. T. Enlow, in general charge of sales and advertizing. Mr. Enlow is a steel man of large experience, having been connected with the manufacture and sale of steel in the United States, for the last twenty years. He was plant manager for the United States Steel Corporation, at Cambridge, Ohio, and later sales manager of Berger Manufacturing Company, and general sales manager of the Stark Rolling Mills Company, both of Canton, Ohio.

This photograph of a concrete factory, forcibly illustrates one of the striking advantages of reinforced concrete construction—its great window area, giving a maximum of interior light.

Reinforced concrete factory of T. S. Simms Limited, Fairville, N.B., constructed by the Aberthaw Construction Co., Boston, Mass.



Concrete Factories are Most Efficient

The efficiency of a machine is the ratio of the amount of work a machine does, to the amount of work required to operate it. The output is equal to the input minus the work lost or wasted. The less wasted the greater the efficiency.
In the same way the efficiency of a factory may be defined as the ratio of output to input. Output, financially, is increased by reducing unnecessary expenses.

Concrete Stops Wastes

Concrete buildings are proof against fire, water and vermin. They give the maximum light and are sanitary. They resist vibration, and are permanent and durable.

Fire-proofness reduces insurance rates. Water or liquids used in certain processes will not leak through floors to destroy valuable goods below. Rats and other vermin find no place to live in a concrete building, thus eliminating losses from this cause. Maximum light and sanitary conditions increase efficiency of employees. Lack of vibration reduces wear and tear on machines. Permanency and durability reduce depreciation.

The way in which concrete stops these leaks is fully described in our handsomely illustrated 224 page book, "Factories and Warehouses of Concrete." It contains photographs and data of factories and warehouses for all classes of industries.

You can have a copy free if you will mention this advertisement.

CANADA CEMENT COMPANY
LIMITED
MONTREAL

POSITIONS VACANT

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.

By the city of Port Arthur, Ontario, **competent Ontario Land Surveyor** to act as Corporation Surveyor. Permanent position for the right man.

Apply giving experience, references and salary expected.

L. M. JONES,
City Engineer.

WANTED.—Experienced detailer and checker on highway bridge work. Applications, care of Box 56, *The Canadian Engineer*, Toronto.

POSITIONS WANTED

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

YOUNG CIVIL ENGINEER (26) desires position with engineering firm or contractor. Technical education; six years' experience in city, hydro-electric and railroad survey, highway and concrete construction. Good transitman and draftsman. Have had charge of field and office work for past three years. Excellent references. Have own instruments. Box 42, *The Canadian Engineer*, Toronto.

ELECTRICAL ENGINEER with two years' experience in design, construction and operation of electric light, power street and interurban railways; desires position as engineer, superintendent or foreman. Good references. Change personal reason. Single. Box 44, *The Canadian Engineer*, Toronto.

GRADUATE CIVIL ENGINEERS of long and varied experience in this country and United States, desire work for spare time. Designing, detailing and estimating. Reinforced concrete structural steel a speciality. Box 46, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER.—Experienced designer, cost estimator and salesman, works supervision, all kinds of steam engines. Boilers, hydraulic pumps, air machinery and mining plants, seeks position with consulting engineers, contractors, manufacturers or agency business. Highest references, some capital. Box 48, *The Canadian Engineer*, Toronto.

EXPERIENCED MUNICIPAL and sanitary engineer in sewers and sewage disposal works, reinforced concrete and constructional works, (19 years practical experience), desires position with contractor or municipality as superintendent or assistant engineer. Box 52, *The Canadian Engineer*, Toronto.

CIVIL ENGINEER, " '07," with broad experience in designing and detailing steel and reinforced concrete, now employed as designer in Montreal, wishes work during evenings and spare time. Box 54, *The Canadian Engineer*, 628 Transportation Building, Montreal, P.Q.

CIVIL ENGINEER, thoroughly experienced in reinforced concrete design, steel framed buildings, foundations; competent to take full charge of design, estimate, and supervise construction, desires responsible position. Moderate salary. Available on short notice. Box 58, *The Canadian Engineer*, Toronto.

CONDENSED ADVTS

Advertisements under this heading three cents per word per insertion Minimum charge fifty cents per insertion.

PATENTS FOR SALE Of the Canadian Patent No. 134013 and the United States Patent No. 1020197 for a very important improvement on **Link-Chains (Driving-Chains).**

Patented in 12 countries. Large success certain to be expected. Highest references from first-class firms.

ARNO GÜNZEL, Altenburg, S/A., GERMANY.

NEW INCORPORATIONS

Davidson, Sask.—Davidson Clay Products Co., $100,000.

Dunmore, Alta.—Canadian Manufacturing Co., $100,000.

Victoria, B.C.—Wilson and Miller, $25,000, (architects).

Broadview, Sask.—Broadview Brewing Company, $30,000.

Saskatoon, Sask.—Polar Aerated Water Company, $25,000.

Lethbridge, Alta.—Plunkett and Savage, Lethbridge, $50,000.

Craigmyle, Alta.—Craigmyle Farmers' Elevator Company, $10,000.

Ottawa, Ont.—Wapoose Mines, $100,000. A. W. MacMinn, P. J. Wood, S. J. Robson.

Fort William, Ont.—Dwyer Elevator Company, $250,000. J. W. Gauvreau, W. Grace, C. Hall.

Brighton, Ont.—D. J. Barker Foundry Co., $100,000. W. W. Porte, S. D. Ross, A. D. Bullock.

Quebec City, Que.—Donohue Construction, $50,000. J. T. Donohue, D. Gendron, G. Simard.

Ojibway, Ont.—Canadian Steel Corporation, $20,000,000. P. Davidson, G. A. Childs, M. Alexander.

Vancouver, B.C.—Vancouver Terminal Securities, $100,000. Coast Agencies Corporation, $10,000.

Saulte Ste. Marie, Ont.—Dudley Re-Action Engine Company, $100,000. J. Dudley, T. A. Hand, G. Carufel.

Hamilton, Ont.—Canadian Rector Gas Heating Co., $100,000. J. F. Leishman, J. S. Barnum, J. B. McNary.

Aylmer, Que.—Pilgrim Mineral Water Co., $50,000. F. M. Pilgrim, N. O. Kilpatrick, E. Edward, Brockville.

Ojibway, Ont.—Ontario Steel Products Co., $20,000,000. P. Davidson, G. A. Childs, M. Alexander, Montreal.

Woodstock, Ont.—Woodstock Brewing and Malting Co., $40,000. R. C. LeVesconte, V. J. Callen, H. Dreany.

Winnipeg, Man.—Universal Electric Company, Limited, $60,000. H. S. Simpson, J. H. Ferguson, W. M. Noble.

St. John, N.B.—British America Construction Company, $99,000. J. L. McAvity, A. E. Massie, W. M. Doherty.

St. John, N.B.—Oil Motor and Manufacturing Company, $150,000. E. J. Broderick, A. E. Massie, R. Sullivan.

Montreal, Que.—Windsor Strip and Supply Company, $50,000. H. W. Ellicott, H. Cutmore, A. H. Campbell.

Regina, Sask.—Union Gravel and Crushed Stone Company, $60,000. Western Fire Brick Company, $250,000.

Port Arthur, Ont.—Port Arthur Wagon and Implements, $500,000. H. Riley, W. R. Anderson, G. W. Morley, Toronto.

Kenora, Ont.—The Nestor Falls Timber Slide and Improvement Co., $30,000. J. W. Short, C. J. Short, Mrs. M. Short.

Cilmour, Ont.—Wandsworth Lake Mining Co., $60,000. C. C. Snedeker, J. A. Anderson, J. A. Pendergast, all of Syracuse, New York.

Edmonton, Alta.—Alberta Motor Boat Company, $15,000. Huff Gravel Company, $250,000. Whyte and Company, $10,000. Capital Coal Company, $50,000. Edmonton Cement Products, $10,000.

THE FOUNDATION COMPANY

LIMITED

MONTREAL
Bank of Ottawa Building

VANCOUVER
Dominion Trust Building

OUR SPHERE
IN CANADA

Foundations for

EIGHT BRIDGES, AND TWO LARGE BUILDINGS, BY OPEN AND PNEUMATIC METHODS

Construction of Algoma Eastern Terminal. A concrete mine shaft has been successfully sunk through 207 feet of treacherous ground.

MARKET CONDITIONS

Halifax, July 1st, 1913.

Axes.—Ordinary chopping axes, single bit, $6.50 per dozen; double bit, $11. Special brands, prices on application to jobbers.

Bar Iron.—The market for bar iron is open, but the situation is firm, and prices range as high as $2.35 base.

Black Sheet Iron.—This commodity is in good demand. We quote 24-gauge, $2.60.

Cast Steel.—The market is steady at 10 to 15c., according to makers.

Cement.—Stocks are low and market is steady, $2 per bbl.

Coil Chain.—The jobbing prices of English proof chain in Halifax are as follows:—3-16x4, $7.15; 3-16x3, $6.25; ¼, $5.35; 5-16, $4.60; ⅜, $4.35; 7-16, $4.20; ½, $4; ⅝, $3.65; ¾, $3.50; ⅞, $3.50; 1, $3.50; 1⅛, $3.50.

Fencing Wire.—We quote: plain twisted and galvanized at $3 per 100 lbs.; barb at $2.50 per 100 lbs.; bright staples in 100-lb. kegs at $2.65, and in 50-lb. lots, $3.15. Galvanized staples are 25c. extra.

Galvanized Sheet Iron.—The wholesale prices are as follows: 16 to 20-gauge, $3.85; 22 to 24, $4; 26, $4.50; 28, $4.75. These prices are for less than case lots.

Ingot Tin.—The tin market as usual is a fluctuating one, and the present price is about 60c. net cash.

Lead Pipe.—The price quoted to-day is about $6.65 for the ordinary jobbing quantities.

Linseed Oil.—Raw is fully worth $1.20 and boiled, $1.25 per gallon. Orders are small, the outlook firm, and higher prices looked for.

Nails.—Nails are firm. Wire nails, $2.45, and cut nails, $2.60. Business in this line is reported active.

Peavies.—There is a better enquiry than last year. Prices are unchanged at $11 to $13 per dozen, according to make, but we are advised that there will be an advance.

Pig Lead.—We quote $6.75 for English and $6.50 for Canadian.

Pipe.—Wrought iron, 1-in., $5.25.

Roofing Paper.—The demand is good Tarred paper, $1.70 per 100 lbs.; three-ply, roofing, 90c. per 100 lbs.; two-ply roofing, 65c.; sheathing paper, 30 cents per roll; tarred sheathing, 40 cents per roll.

Rope.—The price of cordage for next spring's supplies is unchanged. For large lots dealers should write jobbers for quotations. Small lots are as follows: Sisal, 9½c. base; lolster rope, 9¾c.; British manilla, 9½c. base; best manilla, 10¾c., base.

Sheet Lead.—The price of sheet lead is also very firm, 3 lbs., and heavier, $6.25 per cwt., in rolls, and $7.25 in smaller quantities.

Steel.—Tire, $2.55; spring, $2.70; machine, $3.25; toe caulk, $3.50; sleigh shoe steel, $2.50; the above are all base prices.

Tin Plates.—I. C. coke, $4.50-$4.75; I. C. charcoal, $5.00; I. X. charcoal, $6.00.

Turpentine.—Prices now quoted are as high as $0.85 in bbls., and $1.05 to $1.15 in smaller quantities. The market is open.

White Lead.—For Canadian pure, in 50 and 25-lb. irons, $7.20 is being asked. Brandram's B.B. genuine in 25, 50, and 100-lb. irons, $7.85, and B.B. No. 1, $6.60.

Zinc.—This commodity is very firm, $8.25 for casks and 9c. pound for smaller quantities. Spelter is 8c. pound.

Montreal, July 1st, 1913.

The market for pig iron in Canada is considerably disturbed by the action of both the American and English Market. Iron is now selling in Buffalo at $14.00 or the equivalent of about $18 20 laid down in Toronto. The result of this is that Canadian furnaces cannot continue to manufacture and meet prices at a profit, so it is claimed. As an evidence of this might be mentioned the fact that the Canada Iron Corporation is blowing out its big Midland furnace. This furnace has a capacity of 300 tons per day. The company will not cease to produce iron altogether, but will simply blow out the big furnace and keep the smaller one operating. The latter has a capacity of about 150 tons a day, and in order to fill contracts taken some time ago the company will require to keep this furnace operating.

Quite a little purchasing has been done of late by various interests which require iron, it being considered that it is very unlikely that prices will go much lower. In the United States, for instance, at least 20 blast furnaces have been blown out owing to the inability of the producers to meet prices at a profit. The situation is that several of the larger concerns own their own mines and their own boats and are in every way in a position to produce iron at a minimum cost, the result being, now that business is difficult to obtain, they are in a position to cut prices to a figure which cannot be met by a large number of their competitors. It is generally considered that this situation will mean that prices are now about the bottom, and this will have the effect of decreasing the production.

There has been a very severe break in prices of Iron in Great Britain. A few weeks ago, Middlesborough warrants were selling at 70s. 6d. This high price, no doubt was in the main due to a corner. In any case, during the past three or four weeks the price has broken and quotations are now 54s. 3d. At these prices it seems quite likely that a considerably larger import of English iron will take place. 10,000 tons is reaching port this week to fill orders taken from customers who require English iron for mixing purposes.

Prices hold very steady, being again unchanged, as follows:—

Antimony.—The market is firm at 10¼.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅛ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $2 per 100 pounds; carpet felt, $2.50 per 100 pounds; tar sheathing, 43c. per roll of 400 square feet; dry sheathing, 35c. per roll of 400 square feet; tarred fibre, 62c. per roll; dry fibre, 50c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Coal and Coke.—Anthracite, egg, $8.50; chestnut and stove, $8.50 per ton, net; furnace coal, $8.25, net. Bituminous or soft coal; Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b. cars, Montreal.

Copper.—Prices are 16¾c. Excellent demand.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c, and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are: Queen's Head, $4.35; Colborne Crown, $4.25; Apollo, 10¾ oz., $4.25. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lead.—Prices are firm at $5.35.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Nails.—Demand for nails is active and prices are: $2.50 per keg for cut, and, $2.45 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, $1 to $1.25 per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.45 to $1.55 per gallon, in barrels.

Pipe.—Cast Iron.—The market is active and strong:—$36 for 6 and 8-inch pipe and larger; $37 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 73⅗ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73⅗ per cent. for black and 63⅗ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, July 2nd, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Antimony.—Unchanged at $10.25 per 100 lbs., very firm.

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Building Paper.—Plain, 35c. per roll; tarred, 43c.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton. Schaw station, and a good deal moving. Broken granite is selling at $1 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

STRUCTURAL STEEL

ANGLES	BEAMS	PLATES
BARS	CHANNELS	TEES

LET US QUOTE ON YOUR SPECIFICATIONS

A. C. LESLIE & CO., Limited
MONTREAL

C. TENNANT SONS & CO.

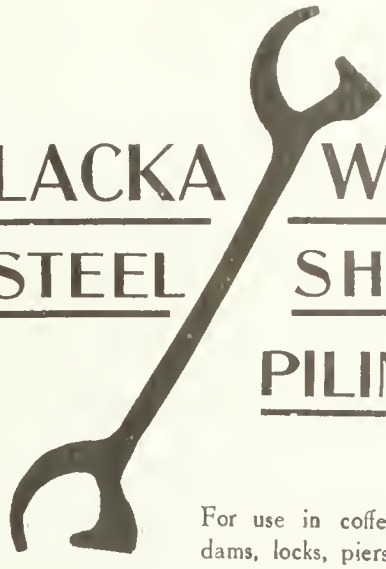
MONTREAL (LIMITED)
C.P.R. Telegraph Chambers, MONTREAL

Black and Galvanized Steel Sheets
TINPLATES and CANADA PLATES

BRASS and YELLOW METAL RODS
MANGANESE BRONZE,
PHOSPHOR BRONZE,
ALUMINUM BRONZE

German Silver Nickel Alloys

LACKAWANNA STEEL SHEET PILING



For use in cofferdams, caissons, dams, locks, piers, wharves, foundations, foundations for buildings and bridges, quick sand and retaining walls.

AGENTS:
H. A. DRURY CO., Limited
MONTREAL and TORONTO

J. H. NEW, President R. H. NEW, Vice-President.

THERE IS NOTHING MADE IN THE WORLD

THAT WILL COMPARE WITH

REAL VITRIFIED SALT GLAZED SEWER PIPE

For SEWERS DRAINS or CULVERTS.

The product of our factory we claim to be just as good as is made, and our system we feel excels our competitors. That's the reason we're so busy, and that's why we have such a big list of satisfied customers all over Canada.

ESTABLISHED 1860.

The Hamilton & Toronto Sewer Pipe Co., Limited
HAMILTON and TORONTO

NEW RAILS RELAYING

12 TO 80 POUND PER YARD

Switches, Turntables, Dump Cars, Etc.

CARRIED IN STOCK

JNO. J. GARTSHORE
TORONTO - ONT.

WALL PLASTER

"EMPIRE" Brand

Such as we manufacture is the kind YOU should buy. Has a larger sale than any other brand by reason of its superior quality.

Write for Specification Booklets

Wood Fibre Cement Wall Finish Plasters

MANITOBA GYPSUM CO. Limited
WINNIPEG - MANITOBA

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Coal.—Prices are quoted for this week as follows:—Youghiogheny lump, $3.85; river, $3.68; slack, $2.94; Solvey coke, $6.50; Connelsville coke, $5.45. Egg, stove and nut coke, $5.25. Pea, $6.75. Good market at these prices.

Copper Ingot.—The market is higher at 16 to 16½c., sheet copper case (16 oz. soft), 23½ to 25½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cent.

Felt Roofing.—Fairly active at $2.10 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $26 per 1,000. Fire clay, American, $8; scotch, $12. Market steady.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Lime.—Retail price in city 30c. per 100 lbs, f.o.b. car; in large lots at kilns outside city 25c. per 100 lbs. f.o.b. car without freight. Hydrated lime $10 per ton at warehouse; delivered, $10.60; 30c. per single bag at warehouse.

Lumber.—An active movement is going on ,of both timber and lumber, prices much the same as before. Pine is good value at $32 to $40 per M. for dressing, according to width required; common stock boards, $28 to $33; cull stocks, $22; cull sidings, $20. Southern pine dimension timber from $32 to $45, according to size and grade; finished Southern pine, according to thickness and width $34 to $48; spruce hemlock is in demand and held quite firmly, we quote $22 to $26; spruce flooring in car lots, $25 to $29; shingles, British Columbia, are steady, we quote $3.75; lath, No. 1, $4.60; white pine, 48-inch, No. 2, have gone up and are now held at $4.25; for 32-inch, $2.75 is asked.

Nails.—Wire, $2.30; cut, $2.70, spikes, $3.00 per keg of 100 lbs., base.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Putty.—In bladders, strictly pure, per 100 lbs., $2.60; in barrel lots, plaster is being used. Plasterer's, $2.15 per barrel of three bushels, at warehouse.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.50 per barrel.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, retail price, $3 per barrel, and but small stocks on hand at warehouse. New York hydrated lime $10 per ton at warehouse.

Ready Roofing.—Prices are as per catalogue.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Rope.—Sisal, 9½c. per lb.; pure manilla, 10¼c. per lb., base.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	0-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—23c. per lb

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.20; 22-24, $3.35; 26, $3.50; 28, $3.95; 29, $4.25; 10¾, $4.25 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 50 to 52c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60; Pan Canadian navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6.60 to $8 per cwt.

CAMP SUPPLIES

Evaporated Apples.—6c. per lb.

Butter.—Dairy prints are 23 to 25c. per lb.; creamery prints, 27 to 28c. per lb.

Canned Goods.—Peas, $1.35 to $1.75; tomatoes, 3s, $1.40 to $1.50; pumpkins, 3s, 85c.; corn, 97½c.; peaches, 2s, $1.50; strawberries, 2s, heavy syrup $2.40; raspberries 2s $2.15 with a tendency for lower prices on canned fruits.

Cheese.—New, large, 13¾ to 14c.; twins, 14¼c.

Coffee.—Rio, Green, 16c.; Mocha, 23 to 25c.; Java, 25 to 31c.; Santos, 17 to 18c.

Dried Fruits.—Raisins, Valencia, 8c.; seeded, 1-lb. packets, fancy, 8c.; Sultanas, choice, 10c.; fancy, 12c.; Filitras currants, cleaned, 7½ to 8c.; Vostizzas, 7½ to 10c.; uncleaned currants, 7 to 7½c.

Eggs.—New laid, 21 to 23c.

Flour.—Prices are maintained; thus, Manitoba flour, first patents, $5.40; second, $4.90; strong bakers', $4.70; Ontario flour, winter wheat patents, higher, at $4 to $4.25.

Feed.—Bran, $25 per ton; shorts, $27 per ton, scarce.

Lard.—Tierces, we quote 14½c.; tubs, 14¾ to 15¼c.; pails, 14¾ to 15¼c., tendency for higher prices.

Molasses.—Barbadoes, barrels, 35 to 50c.; West Indian, 27 to 30c.; New Orleans, 30 to 33c. for medium.

Pork.—Not much doing, short cut, $27 to $28 per barrel; mess, heavy, $22 to $23.

Rice.—B. grade, $3.33 per 100 lbs.; Patna, 6½ to 7c.; Japan, 6 to 7½c.

Salmon.—As before stated. We quote Fraser River, talls, $2.50; flats, $2.50; River Inlet, $2.35; cohoes, $2.20.

Smoked and Dried Salt Meats.—Long clear bacon, 15¾ to 16c. per lb. tuns and cases; hams, large, 18 to 18½c.; small, 20c.; rolls, 15½ to 16c.; breakfast bacon, 19 to 21c.; backs (plain), 23c.; backs (peameal), 24c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

Spices.—Allspice, 18 to 19c.; nutmeg, 30 to 50c.; cream tartar, 28 to 30c.; compound, 18 to 20c.; pepper, black, pure, Singapore, 19 to 20c.; pepper, white, 28 to 30c.

Sugar.—Granulated, $4.40 per 100 lbs. in bags; $4.45 in barrels, Acadia, $4.35; yellow, $4.30 per 100 in bags.

Syrup.—Corn syrup, special bright 3¾c. per lb.

Teas.—Japans, 22 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, 17 to 45c. per lb.

Vegetables.—Canadian potatoes, 75 to 80c.; Delawares, 85c. to 95c.; Egyptian, $2.75 bag; cabbages, 50c. dozen; apples, Winter, $2 to $3.25; turnips, 45c. bag; carrots, 65c.; parsnips, 75c. bag; beets, 75c. bag.

Winnipeg, July 1st, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c.; anvil and vise combined, each $5.50.

Axes.—Chopping axes, per doren, $6 to $10.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Building Paper.—Sheath, $1.10 per roll. Tarred felt, 8, 10 and 16 os., $2.35 per 100 pounds. No. 1 tarred, 88c. per roll; plain, 72c.

Copper Wire.—Coppered market wire, No. 7, $4 per 100 lbs., No. 6, $4; No. 10, $4.05; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Lumber.—No. 1 pine, spruce, tamarac, 2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, except 10 feet, $29; British Columbia fir and cedar, 2 x 4, 2 x 6, and 2 x 8, 12 to 16 feet, $32; 2 x 20, 4 x 20, up to 32 feet, $42.

Nails.—f.o.b. Fort William, $2.50; Winnipeg, $2.90; cut, f.o.b., Winnipeg, $3.35.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7 60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Roofing Paper.—60 to 67½c. per roll.

Shingles.—No. 1 British Columbia cedar, $4; No. 2, $3.50; No. 1, dimension, $5; No. 1, band saw, $6.

Spikes.—Basis as follows:—¼, 5 and 6, $4.25; 5-15 x and 5-16, $4; ⅜ x 6, 7 and 8, $3.80; ½ x 8, 9, 10, and 12, $3.65; ⅝, $3.55; ¾, $3.50.

Steel Plates, Rolled.—3-16-in., $3.25 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Staples.—Fence, $2.50.

Timber.—Rough, 8 x 2, to 14 x 16 up to 32 feet, $38; 6 x 20, 8 x 20, up to 32 feet, $42.

Tool Steel.—8½ to 15c. per pound

Volume 25 Toronto, July 10, 1913 Contents of this issue on page 149

The Canadian Engineer

An Engineering Weekly

THE COST OF GENERATING POWER WITH DIESEL OIL ENGINES

STATISTICS FROM PLANTS AT SHERMAN AND CLEBURNE, OPERATED BY THE TEXAS POWER AND LIGHT CO.—ACCEPTANCE TEST AND OPERATING COSTS.

By GORDON KRIBS,
Assistant Chief Engineer, Texas Power and Light Co.

THE Diesel oil engine was invented by Dr. Rudolf Diesel, the first working engine being produced in 1897. Since that time they have been gradually perfected until they have become a most reliable and efficient source of power. The demand for them has increased to such an extent that a large number of firms, including some of the largest and most reliable, both in America and abroad, are beginning their manufacture.

Up to the present time a considerable amount of information has been published relative to their operation and test, but accurate information as to the results to be accomplished by the use of Diesel engines over extended periods and under the varying conditions of actual practice, is mainly wanting. The Texas Power and Light Company are at present operating two Diesel oil engine plants, one at Sherman and the other at Cleburne, and it is the purpose of this article to set forth the actual operating results obtained under every-day operating conditions.

The Sherman plant consists of three 225-h.p., 3-cylinder, 4-stroke cycle engines, manufactured by the Busch-Sulzer Bros., Diesel Engine Company, of St. Louis, Mo., each engine being direct-connected to a 150-

Sherman Gas and Electric Company's 3—16—24 Diesel Engine No. 138.

Time	Volts	Amp.	Volts	Amp.	W-Mtr.	R.P.M.	Oil	O. Com. Gals	Air-P.	K.W.
5 p.m.	242	640	247	650	4876.0	162	—	—	72 a.t.m.	—
6 "	238	635	245	640	4891.3	164	3 0	—	72 "	153.3
7 "	242	635	243	650	4907.0	164	19.0	16.0	71 "	156.7
8 "	237	640	246	640	4922.4	164	34.5	15.5	71 "	154.0
9 "	240	655	243	665	4938.3	163	18.0	15.5	70 "	159.0
10 "	240	650	241	665	4954.2	163	14.5	14.5	70 "	159.0
11 "	243	620	240	675	4970 0	164	15.5	15.5	67 "	158.0
12 "	240	640	242	665	4985.8	163	14.5	14.5	69 "	158.0
1 a.m.	238	640	243	665	5001.7	104	13.0	13.0	—	159.0
2 "	240	640	242	662	5017.5	164	28.0	15.0	69 "	158.0
3 "	239	655	242	670	5033.2	163	14.0	14.0	69 "	157.0
4 "	240	650	242	670	5049.1	165	28.5	14.5	69 "	159.0
5 "	240	650	242	670	5065.2	164	14.5	14.5	69 "	161.0
6 "	240	655	242	675	5081.2	164	29 0	14.5	69 "	160.0
7 "	239	665	242	680	5097.2	164	14.0	14.0	69 "	160.0
8 "	238	670	241	690	5113.0	163	28.5	14.5	70 "	158.0
9 "	238	670	240	680	5129.0	163	14.0	14.0	70 "	160 0
10 "	239	665	241	680	5145.2	163.5	29.3	15.3	70 "	162.0
11 "	240	655	243	660	5161.25	164	13.5	13.5	70 "	160.5
12 "	238	665	241	675	5177.5	164	28 25	15.25	70 "	162.5
1 p.m.	238	665	241	675	5193.2	164	14.0	14.0	70 "	157.0
2 "	240	670	243	675	5209.5	162	29.5	15.5	70 "	163.0
3 "	242	660	244	665	5225.66	162	15.¾	15.75	70 "	161.6
4 "	246	655	250 251	655	5242.4	160 161	33.¼	19.5	72 "	167.4
5 "	243	675	245	685	5259.25	160	17.75	17.75	72 "	168.5
5.05	250	0	250	0	—	170	—	—	—	—

TOTAL KW. DEVELOPED DURING TEST.

Total hours run - - - - - - 24
Total K.W. developed - - - - 38325
Average K.W. developed per hour - - 159.6—232.4 H.P. at 92% Eff. of G.
Maximum K.W. developed in one hour - 168.5—245.0 " " "
Average air pressure - - - - - 70 atmospheres

(Oil consumption as shown averages 9.41 Gals. per 100 K.W. hours=6.46 Gals. per 100 B.H.P. hours.)

kw., 230-volt D.C. generator. These engines were installed January 1, 1905. They weigh about 100,000 lbs. and cost approximately $14,000 each.

The official acceptance test is given in the table shown on preceding page.

The oil consumption during the test averages 9.41 gallons per 100 kw. hours, which, with oil at 25 cents per gallon, is equivalent to 2.35 cents per kw.h.

During the year of 1910, 862,050 kw. hours were generated at a total fuel cost of $2,695.98, the fuel being the ordinary distillate as obtained from Texas crude oil, and costing $1.30 per barrel of 42 gallons, delivered. This oil has the following approximate characteristics:

Gravity, 37. Flash, 160. Fire, 190.

The operating expenses for the year were as follows:

Power plant wages	$3,014.00
Fuel for power	2,695.98
Water for cooling	37.07
Lubricants and waste	526.38
Miscellaneous supplies	63.78
Engine maintenance	411.12
Total	$6,748.33

Thus, for the year 1910, the cost per kw.h. for fuel was 3.1 mills, and the total cost per kw.h. was 7.1 mills. This, while not including interest on the investment, depreciation, or other so-called overhead expenses, is cer-

Diesel Engine—Operating Costs. 450 kw. Installation at Sherman, Texas. Cost of Production.

COST IN MILLS PER K.W.H. HR.

					Maintenance		Operation						
Month	Monthly Output K.W. Hours	K.W. Peak Load*	Load Factor Per Cent.	Engines	Total	Fuel Oil	Labor	Water	Lubricating Oil	All Other	Total	Total Cost Dollars per Month	Total Cost Cents Per K.W. Hr.
1912												$	
March	95,328	—	28.4%	None	—	2.20	2.80	0.02	0.39	—	5.31	—	—
April	77,915	—	24.0%	"	—	2.90	3.46	0.10	0.42	—	6.88	—	—
May	76,820	—	23.0%	"	—	2.50	3.51	0.06	0.63	—	6.70	—	—
June	70,230	—	21.7%	0.09	0.09	2.69	3.83	0.07	0.38	—	6.97	559.43	7.96
July	91,704	—	27.4%	0.03	0.03	2.53	2.94	0.06	0.32	—	5.85	738.20	8.05
August	85,105	—	25.4%	None	—	2.60	3.17	0.06	0.40	—	6.23	808.35	9.50
September	105,506	—	32.5%	0.03	0.03	2.71	2.56	0.08	0.36	—	5.71	621.48	5.83
October	117,360	—	34.7%	None	1.62	2.61	2.30	0.22	—	0.51	5.64	854.13	7.28
November	114,048	—	35.2%	"	0.81	2.46	2.00	0.24	—	0.44	5.14	733.92	6.43
December	117,499	—	35.1%	"	0.37	1.90	2.00	0.31	—	0.36	4.57	551.19	4.69
1913													
January	115,212	—	34.1%	"	0.40	3.00	2.10	0.17	—	0.37	5.64	717.26	6.22
February	101,300	—	33.5%	"	—	2.45	2.22	0.06	—	0.36	5.09	517.12	5.10
Total	1,168,027	—	—	—	—	—	—	—	—	—	—	—	—
Average	97,335	—	29.6%	0.05	0.478	2.54	2.74	0.12	0.40	0.41	5.81	—	6.78

* Total connected load, 1,553 k.w. No reliable record kept of peaks

PHYSICAL DATA.

H.P. Rating of Plant 675. No. of Engines 3. Size each 225 H.P.
Cost of Fuel Oil f.o.b. Plant per Bbl. $1.05. Per Gallon .025
B.T.U of Oil 18,000. Average Gal. Fuel Oil per K.W. Hr. .1020
Wages of men per day $9.00. 1 at $3.33. 1 at $2.17. 1 at $2.00. 1 at $1.50

Diesel Engine—Operating Costs. 450 kw. Installation at Cleburne, Texas. Cost of Production.

COST IN MILLS PER K.W. HR.

						Maintenance.		Operation						
Month	Monthly Output K.W. Hrs.	K.W. Peak Load*	Load Factor Per Cent.	Engines	All Other	Total	Fuel Oil	Labor	Water	Lubricating Oil	All Other	Total	Total Cost Dollars Per M'nth	Total Cost Cents Per K.W. Hr.
1912													$	
April	67,850	—	20.9%	None	None	—	3.08	4.79	0.40	0.38	0.07	8.72	—	—
May	74,330	—	22.2%	"	"	—	3.29	4.37	0.38	0.64	0.06	8.74	—	—
June	73,410	—	22.7%	0.14	"	0.14	3.19	4.42	0.46	0.50	0.07	8.64	587.57	8.00
July	80,020	—	23.9%	2.33	"	2.23	3.20	4.06	0.44	0.46	0.06	8.22	800.13	10.00
August	86,860	—	24.9%	0.47	"	0.47	3.09	3.74	0.49	0.72	0.06	8.10	650.20	7.48
September	89,130	—	27.5%	0.08	"	0.08	3.14	3.64	0.36	0.32	0.05	7.71	673.18	7.55
October	100,580	—	30.0%	1.32	0.16	1.48	3.03	3.11	0.30	0.43	0.05	6.92	878.55	8.73
November	107,379	—	30.9%	0.22	0.31	0.53	2.99	2.72	0.16	0.42	0.05	6.34	746.31	6.95
December	123,030	—	36.7%	2.03	0.03	2.06	3.03	2.59	0.42	0.38	0.04	6.46	951.53	7.73
1913														
January	127,170	—	37.9%	0.72	0.72	1.44	2.96	2.23	0.72	0.22	0.04	6.17	1102.97	8.67
February	98,430	—	32.5%	1.64	0.01	1.65	3.00	3.20	0.28	0.56	0.05	7.09	1010.52	10.26
March	106,270	—	31.7%	1.30	0.24	1.54	2.98	2.91	0.24	0.30	0.05	6.48	—	—
Total	1,134,459	—	—	—	—	—	—	—	—	—	—	—	—	—
Average	94,538	—	28.8%	1.02	0.24	1.17	3.08	3.47	0.39	0.44	0.05	7.46	—	8.37

* No record of peak loads available

PHYSICAL DATA.

H.P. Rating of Plant 675. Number of Engines 3. Size of each 225 H.P.
Cost of Fuel Oil f.o.b. Plant per Bbl. $1.25 to $1.64. Per Gal. .03 to .039
B.T.U. of Oil 18,000. Ave. Gal. Fuel Oil per K.W. Hr. .1020
Wages of men per day $10.83. 1 at $4.16. 2 at $2.50. 1 at $1.66.

tainly exceptionally low in cost per kw.h. for a plant of this size.

In the accompanying Table II. are given the results for the 12 months' period from March, 1912, to February, 1913. It will be noted that the total cost of production per kw.h. was 6.78 mills with fuel oil at $1.05 per barrel of 42 gallons.

The plant at Cleburne consists of three 225-h.p. units similar to those at Sherman, with the exception that each engine is direct connected to a three-phase, 2,300-volt, 60-cycle alternating current generator. It is worthy of note that no trouble whatever has been experienced in paralleling these machines.

In the accompanying Table III. we give the results of 12 months' operation at this plant.

In conclusion, the writer wishes to state that for small and medium sized plants, he believes the Diesel oil engine to be the most efficient prime mover available, and while the engine is now built only in comparatively small sized units, there is no doubt in the future it will be developed in large sizes and made available where a large quantity of power is desired. The first cost of the engine is high, and in some cases this may be a drawback.

It is also essential to have a good mechanic as head plant engineer, as the engine requires intelligent handling. They are, however, far from being the trouble-makers internal combustion engines are supposed to be, and are giving excellent service in both of the plants above mentioned.

SUITABLE ROAD SURFACES FOR VARIOUS KINDS OF TRAFFIC.

THE study of the effect of different kinds of traffic on roads and of the most suitable surfaces to withstand them, as carried on by the Massachusetts Highway Commission, was the subject of a paper entitled "Traffic Census of Roads in Massachusetts," by Mr. William B. Sohier, chairman of the commission, and presented at the convention of the American Road Builders' Association last December. The commission has come to the popular conclusion that roads used by large numbers of swiftly moving vehicles require special attention to prevent disintegration and rutting, and that such traffic cannot be carried on successfully over gravel or water-bound macadam roads unless amply protected. The results of the investigation in Massachusetts show that the use of some dust layer or binder is an absolute necessity. Where a road is subjected to traffic varying from light, swiftly moving vehicles to heavily laden trucks, the adoption of a surface to prevent excessive wear is arrived at by re-surfacing with some form of bituminous mixture to a depth of several inches of the road.

Motor-Vehicle Traffic.—Some oiled gravel roads are satisfactory and very economical, if they are constantly and properly maintained, even where there are large numbers of swiftly moving automobiles a day, at least, in the summer months, but where there are not many heavily loaded wagons. Some of these roads have 500 automobiles or more a day, and yet they are cheaply built and cheaply maintained. Roads built of sand and asphaltic oil also stand up well under heavy motor-vehicle traffic, but these roads have very little heavy teaming on them. Heavy wagons and many heavy motor trucks rut such roads quickly and soon wear them out.

Maintenance Costs.—When the motor vehicle appeared in fair numbers upon the roads Massachusetts had 600 to 700 miles of state highways (now over 900), and they were mostly water-bound macadam, with some few miles of gravel road.

These highways had been built from 1 to 14 years previously, very few miles had been resurfaced, and the Highway Commission had only $100 a mile a year to spend for maintenance and resurfacing, and not that much except for the last few years. The maintenance of these old roads was our problem in 1908, and has been ever since.

Automobile travel has increased 40% and the total traffic 14% a year, and these roads must be maintained, or the state's money, borrowed on long-time bonds, would be lost and wasted; the good roads would be gone, but the bonds would still remain to be paid.

The state doubled its appropriation for maintenance in 1908, giving the Highway Commission $200,000 a year instead of $100,000. The motor-vehicle fee was also increased, and the right to use the net fees for the maintenance of roads was obtained. These two sources of revenue for the last three years have provided about $500,000 a year, for maintenance; an average of $450 a mile a year, and we are at least holding our own.

Bituminous Binders and Dust Layers for Old Roads.—Many miles of old roads have been saved by spreading a coat of asphaltic oil, light or heavy, or tar over them. To-day some asphaltic binder or dust layer has been used on over 80% of our state highways. The only roads on which it has not been used are those located in the country districts where there is very light traffic.

During the year 1912 we used nearly 2,000,000 gal. of bituminous material in construction or maintenance. Over 800 of the 930 miles of our state highways received some form of bituminous treatment. We have resurfaced as many miles of road every year as we could; using, where the traffic was heavy, a bituminous macadam on the top 3 in.

Effect of Traffic on Bituminous Surfaces.—Massachusetts has four division engineers, on its highway work. They were asked the same questions relating to different tars, oils, asphalts, etc., and for their opinions of the relative merits or demerits of each.

The answers were all different. One had used tar on the surface successfully, another had not. One liked tar for penetration or mixing; another preferred an asphaltic compound. The same was true of the use of various asphaltic oils as a blanket coat, or as a dust-layer. One preferred a heavy cold oil, another a heavier hot oil. There was, however, if the traffic and other conditions in each case were carefully studied, a real agreement in all essentials.

Where Heavy Oils Fail.—We have a good many miles of old macadam road which have been saved and maintained by ½ gal. of hot asphaltic oil spread upon each square yard of surface and properly covered with sand and pea stone or gravel. Many of these roads have worn three years, and in their fourth year are still in good condition. A few miles have worn four years and are now on their fifth year. The patching has cost but little, from 1 to 3c. per sq. yd. a year.

These roads often have very heavy automobile travel, possibly over 1,000 cars a day. They often have large numbers of teams daily. One has over 500 teams and 1,000 automobiles, and a heavy blanket oil surface has worn reasonably well for three years, and will for a fourth

year except in a few places. This same road also has an average of 55 motor trucks a day.

Near two traffic taking stations, where the teaming was heavy, for one-quarter of a mile in each place (out of four miles), the blanket oil failed. It crumbled, went into mud, developed holes and was disappearing. We have replaced the top 3 in. with an asphaltic bituminous macadam.

Heavy Horse-Drawn Wagons Cause Failure.—The traffic study shows that it is not the number of wagons, but heavy wagons—two or more horses and heavy loads on narrow tires—that cause the failure. The failure of roads treated with heavy oil has occurred on a few miles of road at certain places where it was clear that heavy horse-drawn wagons were responsible.

In two instances it was 50 to 75 ice-wagons a day, together with other wagons, carrying 3 tons or more each on 2½ to 3-in. tires which did the damage. In a month the oil surface began to crumble and break up on the side of the road on which the loaded teams travelled. The surface lasted three months on the other side of the road where these wagons came back empty. The same road, treated with the same oil, is still in good condition beyond the ice-houses. In one case for 3 miles, in the other for 15 or 16 miles, the oil surface is three years old and still needs only patching. Light cold oil has been substituted as a dust-layer and has proved reasonably satisfactory, though the stone of course is wearing out, and a bituminous macadam would probably prove economical.

In 1909 another important road, which had been covered with a hot oil blanket, was rutting and wearing out rapidly. A coal team was passing to some hotels three or four times a day during the summer (carrying 6 or 7 tons of coal on narrow tires). When a motor truck was substituted for the coal team the surface of the road, which had been oiled, was again in good condition. It has worn three years and now needs only patching.

Hot Oil Blanket Surface.—A hot oil blanket surface, made of a good asphaltic oil, will be economical and will carry large numbers of automobiles at high speeds (over 1,000 a day in summer) for several years, will carry large numbers of light wagons (500 a day), and quite a number of motor trucks (50 or so a day), but will be destroyed by a large number of heavy wagons, especially those with narrow tires. Fifty or more such vehicles daily, farm wagons, wood wagons, etc., will rapidly destroy the road surface. A surface coat of a good quality of tar will last satisfactorily under a large amount of automobile travel, but usually it has to be renewed more often than a good quality of oil.

In all cases it is assumed that holes and depressions will be filled before tar or oil is used, that the bituminous material is evenly distributed and is sufficiently covered and kept so that it will not be picked up on tires, and that all holes that develop are patched at once as soon as they appear.

Constant repairs, at a cost of 1 to 2c. a sq. yd. a year will save an expenditure of from 40c. to $1 a sq. yd. for the resurfacing of these bituminous surfaces if they are allowed to go to pieces; and they will do it in a year or two at the most, if not cared for properly.

When these surface treatments fail, as they will where the traffic is extremely heavy (heavy in weight of vehicles, not numbers of vehicles), then some more permanent form of construction must be selected and the road reconstructed as soon as possible. It will prove to be true economy in the end, and the end is not far off.

Light cold oils, water-gas tar, etc., used as dust-layers help to prevent the ravelling of roads. These materials may be economical and work satisfactorily for small wagon traffic (30 to 50 a day) and medium automobile traffic (50 to 100 a day), provided the road is not one where high speeds are usual.

They may also help to preserve the road from the effect of automobile traffic where the team traffic is too heavy, or the loads are carried on such narrow tires that a hot oil blanket surface will not wear satisfactorily, until money becomes available to resurface the top 3 in. with some form of bituminous macadam.

Conclusions Summarized.—The accompanying table shows as nearly as possible the results observed after four years of experience with bituminous materials, comparing these results with the traffic going over the road in 1909 and again in 1912.

It is fully realized that more experience will undoubtedly cause changes or modifications in some of the present opinions.

Table Showing Kinds of Road Surfacing Best Adapted to Different Classes of Traffic for a Standard Road 15 Ft. in Width, With a 3-Ft. Gravel Shoulder on Each Side.

	Average Daily Traffic			
	Light wagons	Heavy wagons one horse	Heavy wagons 2 or more horses	Automobiles a day
A GOOD GRAVEL ROAD will wear reasonably well and be economical with	50 to 75	25 to 30	10 to 12	100 to 150
Needs to be oiled with				over 150
OILED GRAVEL fairly good either hot or heavy cold oil ½ gal. coating (cold oil must be used yearly)	75 to 100	30 to 50	20	500 to 700
WATER-BOUND MACADAM will stand with	100 to 150	175 to 200	60 to 80 perhaps more	Not over 75 at high speed
Dust-layer will prove serviceable on such macadam with				50 to 100
Macadam will then stand (but the stone wears, of course), with				300 to 500
WATER-BOUND MACADAM WITH HOT OIL BLANKET COAT will be economical with	250 to 300	75 to 100	25 to 30	Up to 1400 and more with fewer teams
Will stand at least	50 motor trucks		probably more	
But will crumble and perhaps fail with over		100 on narrow tires	50	
	(loaded farm wagons, ice and wood wagons, etc.)			
WATER-BOUND MACADAM WITH A GOOD SURFACE COATING OF TAR will stand with	30 to 50	25 to 30	10 to 15	1800

The quality of gravel or other material and the speed of motor vehicles in particular localities are important factors and account for the above minimum and maximum variations.

It has not yet been satisfactorily determined when the weight of traffic makes it more economical to use a bituminous macadam, either tar or asphaltic products by penetration with a sealing coat of tar or asphalt, or by the mixing method, but it is believed that some such method would be economical and desirable where the team traffic is so heavy (75 to 100 heavy wagons on narrow tires with two or more horses), that a heavy, hot oil blanket surface will not carry the traffic but fails within the year.

We have several such bituminous macadam roads which have stood for three or four years very well indeed, but time alone will determine the ultimate economy. In surfacing with a 3-in. bituminous macadam top the extra cost for such top has varied from 30 to 60c. a sq. yd., depending on material and methods used.

ARTIFICIAL ICE MANUFACTURE IN OTTAWA.

By Gerald L. Kirwan, B.A.Sc.
Topographical Surveys Branch, Department of the Interior, Ottawa.

THE provision of pure water and pure ice is a problem that has reached an acute stage in municipal affairs, and the satisfactory solution of it, at a popular price, will be heartily welcomed in numerous Canadian municipalities. Ottawa, Ontario, is trying out a system that promises to give the maximum of satisfaction, in so far as the purity of products and their price is concerned. The company (The Artificial Ice Company of Ottawa) has strong co-operation and support, and claim that they are in a position to meet any competitive selling price on the part of natural ice dealers, and still produce a much superior product. They have just started the production of about 5,000 gallons of double-distilled, re-oxidized water, in addition to the demands of their daily ice market. The plant is designed to turn out fifty tons of ice per day with provision for 75 to 80 tons in emergency weather. About 15 men comprise the working staff. Mr. P. D. Lyons, as manager, and Mr. R. W. James, mechanical engineer, had charge of the construction of the plant.

Briefly, the system may be outlined as follows:—

Evaporation.—City water is taken from the hydrant, and evaporated to steam in a boiler 54 ft. long by 6 ft. in diameter. The company (The Artificial Ice Company of Ottawa) owns, however, two wells, each sunk on their own property to a depth of 360 feet, forty feet of which are through clay, and the remainder through solid limestone—a formation that obtains largely under Ottawa. Hence, the water is a reasonably pure product at the beginning of the process. A small air compressor will be used to pump the water from the wells to the boiler, the pipe lines of which are being laid with all possible caution against the introduction of scale from the pipe itself, or of foreign materials from any source.

Condensation.—The steam from evaporation is introduced at 110 pounds working pressure into the first of eight Reilly multicoil evaporators—boilers about 7 ft. high by 2 to 3 ft. in diameter, and each one containing a vertical coil of pipe. Passing through this pipe-way from top to bottom, and thence to the next boiler, the steam condenses, each boiler providing steam at lower pressure for the next until finally the pressure has dropped to a 28-inch vacuum. This vacuum serves the beneficial purpose of removing most of the contained air from the condensed steam, air, in the finished product giving the ice a snowy, cloudy appearance which, in the popular mind, robs it of the purity associated with crystal ice. It also causes the ice to melt and check much more readily than the properly finished product.

As the condensed water from the boilers concentrates in a pump nearby it opens a steam valve on assuming at a certain head (about 12 inches). The pump, thus automatically opened or shut, accordingly as the head of water rises above or falls below the height required, pumps the doubly distilled water through a system of pipes automatically cooled by contact pipes containing running city water at about 55 or 60 degrees F.

Filtration.—The cooled, distilled product is pumped from bottom to top through four strongly riveted galvanized-iron boilers. Inside the true bottom of each, and a few inches above it, is a perforated false bottom. The space between each perforated pair of bottoms and tops is filled with finely divided, well-washed, hard maple charcoal, the function of which is to catch any possible sediment in the water that might get through from the distilling part of the process, (although the pipes and valves have been specially made and assembled with caution against such an occurrence). Each boiler is about 6 ft. high and 3 ft. in diameter, and the four will easily handle all the water the plant has capacity for, on account of the freedom from sediment of the distilled product.

Leaving the boilers, the water is pumped to a 3-ton storage tank, about 20 feet above the level of the floor. Here it is pre-cooled to about 35 degrees F., in order, by condensing its volume, to drive out the last remnant of air. It is now ready to be turned into ice in the "freezer"—the portion of the process which deserves special and continual attention, as it is the important phase of the operation. The details, however, have been so well attended to that it is doubtful if a shut-down of any considerable importance would ever be involved.

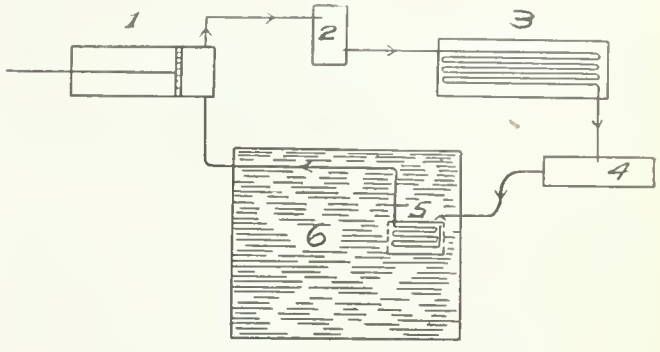


Fig. 1.—Details of Freezing System.
(1) Compressor; (2) de-oiler; (3) water-coolers; (4) condenser; (5) "shell" cooler; (6) "brine" tank.

The "Shell" Freezer.—In one compartment of the building is a tank 65 ft. long, 30 ft. wide, and standing 5 feet above the level of the machinery floor. Its floor and walls are of concrete, and its roof is a wooden structure possessing small trap-doors, each opening being about 2 feet by 1 foot—large enough to admit a can containing water from the storage tank to be frozen in the "brine" solution below this floor level. "Brine" is, properly speaking, a misnomer, as instead of common salt, calcium chloride, which has a more effective freezing action, is used, in the proportion of about 20 pounds to a cubic foot of water. The solution, kept in circulation by an electrically driven paddle, comes in proximity to ammonia in a cooling tank for the purpose of extracting its heat. This cooler is a boiler 15 feet long, 44 inches in diameter, and is situated in one end of the freezing brine tank, being equipped with an interior end-to-end series of pipes, very much like an ordinary steam boiler. Through these pipes ammonia flows, and they are surrounded by the brine solution in much the same manner as a furnace flame sweeps in and around the boiler-pipes. The purpose of the ammonia, as stated, is to extract heat from the brine, to reduce the temperature of the latter sufficiently low to freeze the distilled water in large cans placed in it.

To produce this freezing action, the following explanation and compression cycle is utilized: Gaseous ammonia, compressed to 150 pounds, ultimate working pressure, is discharged into an oil-settling tank, from which it flows through a condensing system of water-cooled

pipes into a gathering tank. From here it passes through an expansion valve directly into the "shell" cooler, where it suddenly expands until its pressure drops from 150 to 15 pounds per sq. in. It proceeds at once in this state to draw heat from the surrounding brine in order to make up as much heat per unit volume of ammonia as it had before. Thus its temperature of vaporization is again attained, and in passing from the liquid to the gaseous state its excessive heat of vaporization is derived from the "brine," as it passes through the "shell" cooler and back again, to the compressor as a vapor. The ultimate result is that in the compressor the ammonia temperature may be well over 100 degrees F. and that of the "brine" in the tank approximately zero. Eight above zero is a good working temperature. Eight below, while producing ice much more rapidly than eight above, checks it, however, making it more brittle and cloudy. If, by any chance the "brine" reaches eight below, the compressor is generally stopped long enough to enable the system to rise fifteen degrees or so.

As the ammonia returns to the compressor, the cycle is repeated and, being continuous, the fresh ammonia running through the "shell" cooler, does its work much more quickly than would be possible with an intermittent cycle. The pipes themselves are good indicators, (i.e., those in connection with the freezing system), since they

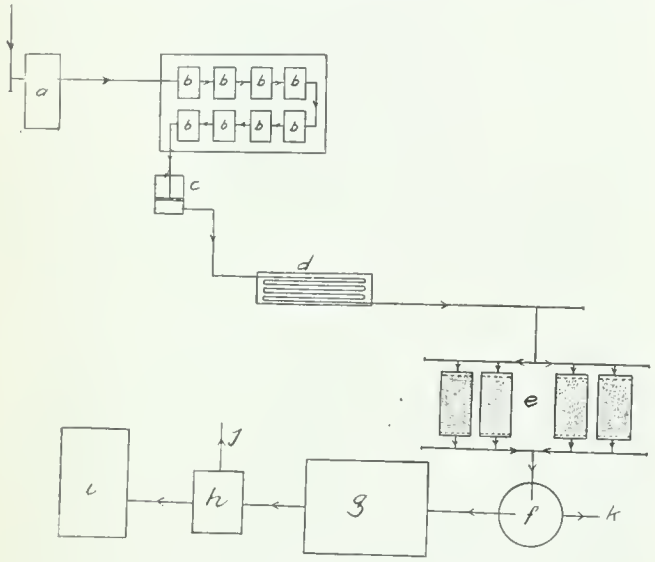


Fig. 2.—Flow-Sheet of System.

Well-water to: (a) Evaporating boiler; (b) 8 Reilly multicoil condensers; (c) automatic steam-pump; (d) water-coolers; (e) 4 mechanical filters; (f) 3-ton storage tank; (g) freezing system; (h) distributing room for ice; (i) store-room; (j) to city delivery; (k) pure water supply.

show frost on the outside at the level of the frozen ammonia liquor in the "shell" cooler, and of "brine" in the tank. It may be remarked in passing that the loss in ammonia is exceedingly small, very little replenishing being necessary in years.

The advantages claimed for this freezing system over the old systems are as follows: It costs, for a 50-ton-a-day plant, $1,000 less, saved chiefly in pipe installation. Also, the wear and tear is very small compared with the old system—as, for instance, the cans containing the freezing water lie in "brine" solution, without having to be jammed down among these old-fashioned coils of piping. It is also claimed that 33% more production is obtained, That advantages like these cannot be overlooked is obvious.

The actual freezing is carried out as follows: The water is led from the storage tank through rubber piping to the freezing-cans. These are 510 in number, and are each 8 ft. by 4 ft. by 1 ft. They are made of riveted galvanized iron, and are guaranteed for four years. When full, a can weighs 400 pounds. A patented automatic nozzle is attached to the feed-hose, and the operation of filling is as follows: The workman opens the feed valve, the water pours into the can; as the level rises, it pushes up a hood on the nozzle till, at a certain height, this hood catches a spring, releasing it, and closing the feed-valve. A can takes about 36 hours to freeze, and as fast as one is removed full of ice, a water-filled can takes its place in the brine. The ice-can is lowered into warm water a minute to loosen up the block of ice inside; then raised by compressed air and tilted on a shaft, opened, and the cake of crystal ice slid along a trough to a drained concrete chamber for cartage to customers, or for storing in a 350-ton store-room.

UTILIZING WOOD WASTE.

Perhaps the most interesting development in the manufacture of wood products has arisen in the increasing variety of uses to which wood-waste can be put. Beginning in the forest the closer utilization of the various wood-products can be traced through the saw-mills and large wood-working industries, right down to the firms working only on small specialized lines.

It is now commercially possible to reduce the fifty to sixty per cent. waste formerly left in the woods by the lumberman to no more than five per cent., by a combination of three well-developed chemical industries, namely, paper-making, wood-distillation (in a modified form) and the manufacture of resin oils. Practically all the valuable constituents from the stump, tops, branches and defective stems which would otherwise be left to rot in the forest are thus converted into useful commodities.

The utilization of mill waste is being made increasingly possible by the developing markets for odd and short lengths in lumber instead of a few assorted sizes. Many saw-mills use their waste products in the manufacture of laths, mouldings, pickets, roller-blinds and paving blocks. The manufacture of wood-pulp from the small waste-wood now being fed to the burner is also a commercial possibility. Even sawdust has its uses, and in countries where more intensive utilization prevails it is being successfully manufactured into a variety of products. Several plants have been erected in this country for its manufacture into ethyl (or grain) alcohol, sugar and briquets for fuel.

The bulletin now being issued by the Forestry Branch, Ottawa, on "The Wood-Using Industries of Ontario," throws considerable light on the utilization of wood-waste. Sash and door factories sell or use their short ends and trimmings for the manufacture of boxes, baskets, bobbins, butter-moulds, insulator pins, novelties, skewers, spindles, spools, stakes and woodenware. They bale their common sawdust and sell it for covering for the manufacture of composition novelties, and for cleaning screws. They sell shavings for bedding, packing and for drying wet land. Hickory and other hardwood dust is sold for smoking meats. In fact, wood manufacturers will soon be able to boast of using all the wood but the bark—and even that, in the case of some woods, such as hemlock, is of considerable value.

THE GENERATION OF ELECTRICAL ENERGY FOR SMALLER TOWNS

DATA CONCERNING CONSUMPTION OF LIGHT AND POWER — PLANT DUPLICATION FOR RELIABILITY OF SERVICE — FEATURES GOVERNING PLANT DESIGN AND EQUIPMENT.

By M. M. INGLIS,
Electrical Engineer, Yorkton, Saskatchewan.

IN a paper read at the eighth annual convention of the Union of Saskatchewan Municipalities, and entitled "The Generation and Distribution of Electrical Energy for Light and Power Purposes in Medium and Small Sized Towns," Mr. Inglis began by citing a few statistics covering a number of towns having generating units installed, and the degree of patronage extended to them, but his remarks were based largely upon the comparative suitability of the various types of prime movers, for small installations.

In towns of 1,000 to 1,500 population the average number of consumers is approximately fourteen per hundred.

In towns of 1,500 to 2,500 population the average number of consumers is approximately sixteen per hundred.

In towns of 2,500 to 3,000 population the average number of consumers is approximately thirteen per hundred.

The average consumption per capita in towns from 1,000 to 5,000 remains fairly constant, and from data collected that consumption is approximately 60 watts.

Thus in a town of 1,000 inhabitants the output required of the generating unit would be 60 kw., or taking the efficiency of the generator as being 90%, then the output of the prime mover would be approximately 90 b.h.p. Similarly with a population of 5,000 the output of the electrical equipment would require to be 300 kw., or with a generator efficiency of 92% the output of the prime mover would be approximately 440 b.h.p.

In order to maintain a thoroughly reliable service during the 24 hours of the day, it is absolutely necessary to duplicate the plant. Consequently, for a town of a thousand population the total generating capacity ought to consist of two units of 90 b.h.p. capacity. However, as most towns only run their plant during the lighting period, or approximately ten hours per day out of the twenty-four, on a yearly average, the question crops up as to whether it is necessary to install this duplicate unit. This question is usually decided by the financial position of the municipality and whether there is sufficient demand for power during the remaining fourteen hours of the day. In most cases only one unit is installed.

Salient Points Governing Installations.—The most important items to be considered in locating small central stations are:—

(1) The method of driving the generators.

(2) The proximity of fuel supply.

(3) Pure water supply.

(4) Railroad facilities and the possibilities of later expansion.

Although I have numbered these items, I have by no means attempted to place them in their order of importance, because they will each affect to a more or less degree the different type of plant which it is proposed to install. The first mentioned, namely, the method of driving the generators, from an engineering point of view, seems of primary importance. Considering the two types of drive universally used, namely, the belt drive and the direct connected drive, experience has shown that the belt-driven plants are less efficient and much less reliable than the direct connected unit. This is due principally to belt troubles. Much more floor space is also required for the belt-driven type of plant, consequently a larger building is required in which to house them. As important as any of these drawbacks is the inferior regulation which is very apparent when no automatic regulator is connected in the electrical circuit, especially if the load is at all variable. The only advantage the belt-driven type has over the direct connected type is a lower first cost, but this is hardly worth considering when compared with the advantages which accrue from the direct connected type.

The second item: The proximity of fuel supply. This is an item of considerable importance in these parts where freight rates are so high, and the municipality which has close at hand a good source of fuel supply is extremely fortunate, in so far as it will materially reduce the cost of production of energy. It will also be one of the deciding factors in arriving at the type of plant to be installed.

The third item, namely, pure water supply, will also be a deciding factor, as all the prime movers in use to-day use water to a more or less degree, either in the direct process of generation or as a cooling medium.

The last item, but none the less important, is that of railroad facilities and the possibility of later expansion. The railroad facilities we are all familiar with for the handling of the fuel supply, but the possibility of later expansion is one that cannot be given too much consideration, as not a few instances can be seen where inadequate provision has been made for future extensions. If the proper precautions were taken in deciding upon the best type of plant for each individual case, and provision made for future extensions, then a great deal of time and money would be saved as well as greater possibilities obtained of supplying energy at a lower rate in the future.

Taking the case of one unit being installed, and for instance, say, a 100 b.h.p. unit, this is equivalent to an electrical output of approximately 68 kw., taking the efficiency of the generator at 91%. Assuming the plant to run on an average ten hours per day during the period of one year or, say, three thousand hours, then the maximum number of units generated would be 204,000. This is only true if the plant is run on full load during the entire period. In actual experience, however, the total units generated approximate a yearly average 15% of the maximum, which is equal to 30,600 units. Assuming the cost of energy to be 15 cents per unit with no allowance for distribution loss, then the yearly revenue would be equal to $4,600. Knowing the principal and interest payable yearly on the debenture issue, as well as the fuel and operating expenses, with a liberal allowance for depreciation, it is an easy matter to determine whether or not the cost per unit, namely, 15 cents, is sufficient to

meet this expenditure. In this manner it is possible to figure out a rate at which the undertaking will be self-supporting. With small plants the biggest items of expenditure are usually the fuel bill and wages. In order to keep these to a minimum it is necessary that the most efficient and reliable plant be installed combined with simplicity in operation.

Steam, Gas and Oil Engines.—The steam engine in favor to-day for small central station work is the vertical compound high-speed engine, fitted with piston valve, automatic governor and having forced lubrication throughout. This type has proved itself very suitable in so far as reliability and speed regulation are concerned. The operation of the same is simplicity in itself. There are, however, other items to contend with in a steam installation just as important as the engine itself. One of these I have previously mentioned, namely, pure water supply. In connection with this, all are familiar with the difficulties attending an impure or shortage of supply. These call for proper and costly treatment on the one hand, and an unreliable service is the result on the other hand, attended with loss of revenue from the sale of energy. There are also injectors, pumps and boilers, which are often more troublesome than the actual prime mover itself. The whole of these difficulties may not be met with, but there is one difficulty attending all small steam installations and, to my mind, a very important one, that is *the stand-by losses*. These ought to be given due consideration when it is intended to install a generating plant. Take the case of a plant running only ten hours out of the twenty-four; for the other fourteen hours there is quite an appreciable loss for which there is absolutely no return, besides there is also the cost of labor looking after the boiler equipment during the non-working hours. Taking this loss of fuel, in addition to the actual fuel consumed during the generating period and with a load factor of 15 per cent., the consumption of coal will be approximately six to seven pounds per unit generated at the switch-board. Taking this lower consumption and coal at the price of $7 per ton, this is a generating cost of 2.1 cents per unit.

Of the gas engine plants the suction gas producer equipment seems to hold the field. These plants are proving themselves more and more reliable and are very suitable for small stations. They are, however, less reliable, although more economical than the steam engine. The greatest difficulty in connection with these plants is usually met with in the gas producers, and in spite of the statements to the contrary, it requires an experienced man to care for the producers, to obtain the best results and keep the plant in first-rate condition. The principal troubles are the keeping of the combustion zone within the proper limits, the removal of ashes and clinkers, and the effects of impurities in the gas. This first trouble is usually caused by the fuel not being kept consolidated during operation. The second due to improper regulation of steam which causes high combustion temperatures, if there is sufficient steam with consequent fusing of incombustible matter. When the ashes and clinker are being removed, and especially in the smaller sizes of producer, little or no provision is made to exclude the air from entering, thus causing an irregularity in the quality of the gas produced. This, you can understand, will naturally affect the running of the engine.

Let us consider the cycle of operation in the engine. During the first stroke, a mixture of air and gas is drawn into the cylinder. On the second stroke this mixture is compressed. At the end of the compression stroke the mixture is ignited by means of an electric spark from a magneto or some such apparatus, thus we have explosion and subsequent expansion during the third stroke. During the fourth or exhaust stroke the products of combustion are set free to the atmosphere. This completes the cycle of operation. The combustion of the gases is accompanied by the formation of a carbon deposit in the cylinder and it sometimes happens even though due precautions are taken, that this carbon, which is at a high temperature, is sufficient to prematurely ignite the fresh mixture during the next cycle of operation. This premature ignition sets up undue strains in the mechanical parts of the engine, which are liable to cause trouble. It is thus found necessary to withdraw the piston in this type of engine at approximate intervals of three months, in order that the carbon deposit does not interfere with the working of the engine. There are also the stand-by losses to be considered, but these are not of the same magnitude as with a steam equipment. In a suction gas plant of the same capacity as that quoted in connection with the steam plant, and under the same conditions, the consumption of coal would be approximately four pounds per kw. generated at the switch-board. Taking coal at $8 per ton, this would mean a cost of approximately 1.6 cents per unit.

In considering the oil-burning engines, I might just mention that it has been a recognized fact both theoretically and practically, that the higher the compression in the internal combustion engine the more efficient would it become. One reason for the keeping of this compression at a moderately low figure has been due to the excessive temperature caused by the compression and the likelihood of this high temperature igniting an explosive mixture such as is compressed in the ordinary gas engine. This difficulty, however, has been overcome in one type of internal combustion engine which is considered one of the foremost prime movers on the market to-day, that is the Diesel crude oil engine. The cycle of operation may be described as follows: During the first or suction stroke, air only is drawn into the cylinder. On the second stroke this air is compressed, and at the end of the compression stroke the fuel oil is sprayed in finely divided particles into the cylinder. The air temperature, being high, as the result of compression, the finely divided oil burns as it enters the cylinder. This spraying of oil is continued during a considerable portion of the outward stroke, and during the remainder of this the third stroke, the products of combustion and the surplus air expand. During the fourth or exhaust stroke the products of combustion are driven off to the atmosphere. This completes the cycle. It will thus be noticed that air only is compressed and not a mixture of air and combustible vapor or gas: consequently, whatever the pressure of compression and whatever the temperature, premature ignition cannot occur, there being no fuel to ignite. Therefore the greatest economical advantages of high compression can be utilized. There is, however, the disadvantages of high compression, which are all more or less of a mechanical nature, but these difficulties of a recent development are being largely eliminated. The Diesel engine, like all other prime movers, is not immune from trouble. It may be the sticking of a fuel valve, the hanging up of a compressor valve, or a leaky exhaust valve. All of these defects may be of little or no importance, and may cause a shut-down of only a few minutes, yet there is that interruption in the service which always means a loss of revenue. To my mind the only great disadvantage in connection with the Diesel oil engine is a possible short-

age of fuel supply. So far as I know there is no decrease in the actual production of oil, yet there is that ever-decreasing demand for the finer and crude oils. Up till the present there has been no difficulty in obtaining fuel oil, but the price has increased almost fifty per cent. during the past twenty months. It might also be interesting to know that the freight on fuel oil to Saskatchewan is approximately equal to the cost of oil in its home market. Under the same conditions as that of the steam and gas producer plants before mentioned, the oil consumption is approximately .12 of a gallon per unit generated at the switch-board. Taking the price of fuel oil at 12 cents per gallon, this gives a cost of 1.44 cents per unit.

Comparing the three types of prime movers discussed we have:—

Steam, with coal at $7 per ton, 2.1 cents per unit.

Gas, with coal at $8 per ton, 1.8 cents per unit.

Diesel, with oil at 12 cents per gallon, or approximately $27.60 per ton, 1.44 cents per unit.

In concluding the generating part of this paper, I might say that the labor costs are highest for gas engines and lowest for Diesel engines, with steam plant taking a position about midway between the two.

ENGLAND'S EXPORT TRADE.

According to the Board of Trade the following are the values of produce and manufactures exported by the United Kingdom to the leading countries and self-governing dominions:—

Germany	£40,362,767
Australia	34,840,701
United States	30,065,806
France	25,585,681
Canada	23,531,311
South Africa	21,420,912
Holland	14,281,668
Belgium	12,193,306
New Zealand	10,390,334

GRANITE AND TRAP-ROCK IN CANADA.

The production of granite and trap-rock in 1911, according to returns from forty-seven active firms reporting, and contained in the statistics given in the annual report on the mineral production in Canada, by John McLeish, B.A., was valued at $1,119,865, as compared with a production by thirty-three firms, valued at $739,516, in 1910; showing an increase of $380,349, or 51.4 per cent. There was a particularly large increase in the value of granite used for building purposes and in the production of crushed stone.

Quebec province was again the largest producer, the value of sales in 1911 being $462,678, as compared with $356,257 in 1910. The value of sales in British Columbia in 1911, however, approached very closely to that of Quebec, being $460,851, as against $244,767 in 1910. Ontario produced granite to the value of $131,816 in 1911, as compared with $109,678 in 1910. Both New Brunswick and Nova Scotia showed an increased production, the value of the New Brunswick output being $37,994. Much of the rough stone quarried in New Brunswick, as well as stone imported from Redbeach, Maine, and Mt. Johnston, Que., is worked up into finished monumental and ornamental stone at mills at St. George, the value of the finished product here in 1911 being $86,658.

BRIDGE FLOORS REPLACED WITH CONCRETE

MR. L. C. Smith, engineer for the Michigan State Highway Commission, in the fourth biennial report of the commissioners, advises the use of concrete wherever possible in the replacing of floors on old steel or wrought iron bridges, even though this may necessitate the laying of new steel stringers.

This plan has been followed for assumed load specifications and computing stress in truss:

(1) Concentrated wheel load of five tons on area 12 inches by 28 inches on floor slab.

(2) Concentrated wheel load plus weight of slab on two stringers spaced not more than 28 inches apart.

(3) Distributed ten-ton load plus dead floor load on floor beams.

(4) Ten-ton concentrated load tried on each panel joint plus dead load of whole bridge for the trusses.

In no case have concrete floors been recommended where the stress in the steel would be above 17,000 pounds, and in wrought iron above 13,000 pounds.

The following general specifications are used:

Steel.—Steel stringers shall be spaced not more than 28 inches nor less than 24 inches centres.

For panel lengths, from 12½ feet to 14 feet and width of roadway 16 to 18 feet. Eight-inch 18-pound I-beams shall be used for three centre stringers. On each side of these, two 7-inch, 15-pound I-beams, and, in place of side channels, 6-inch 12¼-pound I-beams shall be used at each edge. All stringers shall be long enough to reach two panel lengths, and be laid so as to break joints. Stringers shall be bolted to floor beams securely with one-half inch bolts at each intersection. Stringers shall be connected at ends with two three-eighths inch fish plates 14 inches long and wide enough to fit snugly between flanges. Fish plates shall be bolted with eight one-half inch bolts in each plate. Not more than one-quarter inch, nor less than one-eighth inch shall be allowed between ends of stringers.

All abutment and pier ends of stringers shall be bedded in Portland cement mortar mixed 1:3.

All floor beams, sway bracing stringers and connections shall be coated with two coats of linseed oil paint. Tops of stringers must not be painted.

Forms.—Forms shall be placed between stringers tight up under top flange. Tar or builders' paper must be used on forms to make them tight.

Curb forms shall be securely fastened in place before any concrete is placed.

Reinforcing.—Expanded metal No. 40—3-inch U.S. or Kahn rib metal No. 3 wire reinforcement, having the same area of cross-section per foot width, shall be used. Reinforcing shall be laid with main members, running at right angles to stringers. Ends of reinforcing shall be bent up three inches into curb. Strips shall be securely wired or clipped together. Reinforcing shall rest on top flange of stringers and be not more than one-half inch nor less than one-quarter inch from forms.

Concrete.—Gravel shall be from forty to sixty per cent. pebbles by weight, no stones larger than one-inch. An approved brand of Portland cement shall be used. Concrete shall be mixed in the proportion of one part cement to three parts gravel, wet mix. A batch mixer or very careful hand mixing shall be used.

Concrete shall be spread uniformly 3½ inches thick over tops of stringers. On account of stringers being of

different depths, finished roadway will be crowned two inches.

Concrete must not be trowelled, but smoothed off with a template. Curbs must be poured at same time as roadway.

Expansion Joints.—On top of every other floor beam an expansion joint shall be placed. This joint shall consist of two thicknesses of heavy tar paper.

Work shall not stop in laying the floor at any place except at an expansion joint.

Surface shall be covered with sand or sawdust and be kept wet during first five days of drying.

Forms shall not be removed in less than three weeks. No traffic shall be allowed on floor until four weeks after completion of concrete work.

Tar Top.—A skin coat of bituminous binder, mixed with sand, shall be spread on the concrete surface not to exceed one-quarter inch in thickness.

A bridge floor was replaced at Montrose, Michigan, following the above plan. The cost of doing that work, without any allowance for superstructure, was as follows:

Cost of Montrose Bridge 150-Foot Span, 16-Foot Roadway.

New 8-inch steel stringers	$ 595.00
Removing old floor	15.00
Punching and erecting new steel	60.00
Lumber for concrete forms	65.13
Labor placing forms	10.00
Cement on the job	90.00
Gravel on the job, ½-mile haul	18.00
Mixing and laying concrete	70.00
2,400 square ft. expanded metal	112.90
	$1,035.03

Itemized Cost of Concrete Per Cubic Yard.

Form lumber	$1.19 per cu. yd.
Labor on forms	.34 per cu. yd.
Cement 1:3 mix	3.03 per cu. yd.
Gravel	.60 per cu. yd.
Mixing and laying	2.36 per cu. yd.
Total	$8.52 per cu. yd.

New oak floor would cost $50 per thousand, including laying, or for a wood floor 3 inches thick, the cost would have been 15 cents per square foot, or $360. To this must be added the steel stringers needed in either floor, which makes $360 plus $595 or $955. The difference in cost of the two floors would only be $80, without any consideration of the most important item, namely: How long will it last? The concrete floor will continue to grow stronger with age, and on the other hand, the wooden floor would need repairs in five years. The concrete would tend to stiffen the whole bridge and distribute the concentrated loads over a larger area, and the wood floor is at best a springy, shaky, rough-riding and expensive proposition. An ordinary plank bridge floor weighs about 30 pounds per square foot, while the concrete floor weighs 60 pounds per square foot, both weights including steel stringers.

"When a new bridge floor for an all-steel or wrought iron bridge is needed," says Mr. Smith, "a competent bridge engineer should inspect the trusses and abutments and determine whether or not the bridge is sufficiently strong to carry a concrete floor. If the bridge is worth it or can be reinforced to make it sufficient to carry a reinforced concrete floor, it is by far the best."

THE APPLICATION OF OZONE TO WATER PURIFICATION.

IN a recent report by Russell Spaulding, consulting ozone engineer for the State Department of Health, New York, the application of ozone to water purification is treated as a process that is quite feasible commercially. The report, just issued by the Department, is very enthusiastic about the ozone process as compared with filtration which it pronounces efficient, but more or less cumbersome and not always practical; and with rapid filtration for dirt and subsequent treatment with chemicals, of which the most promising is chloride of lime.

The use of ozone as a purifying agent has received such varied publicity that the history and development of the gas needs but brief attention.

A Dutch physicist, Van Marum, in 1783, while studying the behavior of gases in the path of electrical discharges, noted that oxygen gave a decided odor. But not until 1840 was this peculiar form of oxygen recognized as a distinct gas. In that year Friedrich Schoenbein, a German chemist and professor at the University of Basel, Switzerland, showed that oxygen, after being subjected to electrical stress, possessed peculiar chemical properties. To this gas he gave the name "ozone."

The gas remained more or less of a scientific curiosity for a number of years, and the study of its properties seems not to have been attempted for practical ends until Berthelot took it up in 1890. He was followed by a long line of experimenters, most of them Europeans.

Only a few of the army of experimenters made definite contributions to the advancement of the art of producing ozone in large quantities on a commercial scale and with a minimum expenditure of power.

Ozone is a form of oxygen in which the atoms of the molecule have a different arrangement from that of ordinary oxygen. It is very unstable and will revert to oxygen in a very short time if left to itself. When, therefore, it is put into water it will speedily assume the condition of oxygen and be quite beyond the possibility of polluting water. Consequently its use is beyond any criticism which may be directed at the chemical treatment which may remain as an impurity. Ozone could not be an impurity in water, for it changes instantaneously. It owes its efficiency in acting on bacteria to the fact that it cannot remain in the condition of ozone, but breaks up and forms free oxygen, which is an extremely powerful oxidizing agent. This oxidization destroys bacteria with incredible rapidity in the purification of water by ozone, which in turn leaves no trace of itself.

The utility of ozone as a bactericide, through its marked oxidizing properties, was pointed out by de Meritens in 1886 and Froelich about 1890.

To-day there is little question of the efficacy of ozone as a commercial chemical and sterilizing agent but there are questions of practicability, related mostly to the cost of production and utilization, and to the ease of maintenance of generating apparatus. By the improvement and refinement of the generators, the cost of production has become a small part of the cost of any complete process for using ozone for purifying or bleaching. This condition arises largely through the expense of forcing contact between the ozonized air and the material to be treated.

The process about which most interest centres, naturally, is the purification of water. There are elements in the proposition to kill all bacteria and to get rid

of organic contamination by introducing "electrified air" that appeal to the popular imagination as no proposal to filter or chemically sterilize water can. It has been demonstrated that ozone is a simple and effective sterilizing agent and leaves no residue in the water repugnant to the public mind as use of chemicals would. Whether or not an ozone plant is the best thing for a given location often simmers down to a question of the costs, and these depend to a very large extent on local conditions, so that results obtained in one place are to be applied with caution to another place and only under the advice of competent engineers.

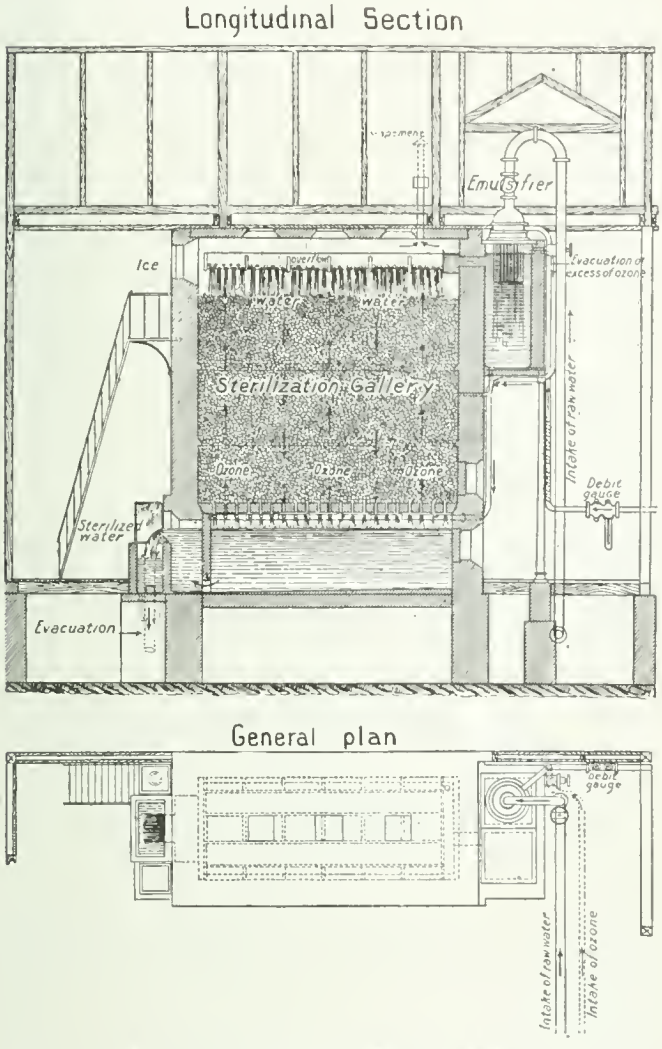


Fig. 1.—Plan of Plant at Saint Maur; Capacity 1,012,500 Gallons Per Hour.

The earliest attempt to produce and utilize ozone on a commercial scale was that of Baron Tindal at Oudshoorn in Holland, in 1893. Since then great improvements have been made in ozone-generating apparatus, both from the point of view of reliability and of economy. Baron Tindal's first apparatus yielded about 2 grammes of ozone per kilowatt hour, whereas the plants now in use in Europe produce from 40 to 50 grammes per kilowatt hour. Even this efficiency can be improved on, and the United States may soon redeem itself for its slowness in adopting a system already so well developed in Europe by outstripping the old world in the production of economical apparatus. Baron Tindal was followed by such men as De Frise, Schneller, Vandersleen, Vosmaer, Otto, Abraham, Marmier, Siemens, Gerard, each contributing to the improvement of apparatus and application. Among the European installations the systems of Otto and Siemens are giving very satisfactory service and are mentioned in the report as the best so far attained.

The list of European plants contains 26 plants in France, 4 in Roumania, 7 in Germany, 5 in Italy, 3 in Russia and 1 in Spain. Three South American plants are also mentioned. These plants range in daily capacity from 32,400 gals. for the Ravenna, Italy, plant, to 24,300,000 gals. for the St. Maur, France, plant. A brief description of several plants follows:—

Saint Maur (Paris), France.—This plant is the largest one in France, and is diagrammatically shown in Fig. 1. It was enlarged in 1910 to its present capacity of 24,300,000 gals. per 24 hours. This plant is situated near Paris on the River Marne. The water pumped from the river is first filtered through sand and then sterilized by means of ozone.

This ozone is drawn into the water by Otto aspirators. The water then trickles down through gravel contained in a sterilizing tower, meeting an ascending current of ozone which further sterilizes it. From this tower the sterilized water runs into a large reservoir, from which it is pumped into the city of Paris proper.

Nice, France.—Early in 1904 the municipality of Nice, in southern France, entered into a contract with the French Ozone Company for the erection of an ozone sterilization plant near the reservoir of Bon-Voyage. This plant, with a capacity of 6,480,000 gals. daily, was completed in 1905. The general arrangement is shown in Fig. 2.

Following are some of the requirements made by the city, translated from the official contract: 1. Capacity of sterilization, regular and continuous, 6,480,000 gals. per 24 hours. 2. Maximum allowance for upkeep $5,000 per annum. 3. The city will furnish free hydraulic power—13,157 kilogrammes on the axis of the turbines. 4. The Ozone Company guarantees that the treated water will not contain any pathogenic bacteria. 5. The maximum harmless bacteria not to exceed 10 per c.c., exception being made for B. Subtilis. 7. The Ozone Company guarantees that the chemical qualities of the water will not be altered except they be improved, that they will not introduce in the water any harmful foreign substance, and that no trace of ozone will remain in the treated water as it emits from the reservoir of Bon-Voyage. 8. The Ozone Company further guarantees the absolute innocuousness of the process. 9. The Ozone Company will be responsible for any abnormal corrosion of the conduits. 10. Price of entire installation to be $48,167.

The success of this installation is evidenced by the fact that in 1909 the community of Nice ordered installed a second plant at Rimiez with a capacity of 3,700,000 gals. per 24 hours.

Paderborn, Germany.—As a result of the experimental plants installed at Berlin in 1896 and at Martinikenfeld in 1898, it was decided to build an ozone water-purification plant on a large scale, in order to determine whether or not it would prove reliable, efficient and economical in a municipal plant.

The town of Paderborn in Germany was chosen for the initial plant. The plant was erected and officially turned over to the municipal authorities in the month of August, 1902.

The plant has a capacity of 500,000 gals. of sterilized water per 24 hours. It has been operating uninterrupt-

edly since 1902, never once failing to perform its duties in an entirely satisfactory manner. Bacteriological examinations are made regularly and at frequent intervals each day. Since the day the plant started, in 1902, these examinations have shown an entire absence of pathogenic bacteria. A duplicate of the Paderborn plant was erected in 1903 to supply the town of Wiesbaden. The plant is located near the River Rhine at Schierstein, and the sterilized water is pumped over to Wiesbaden.

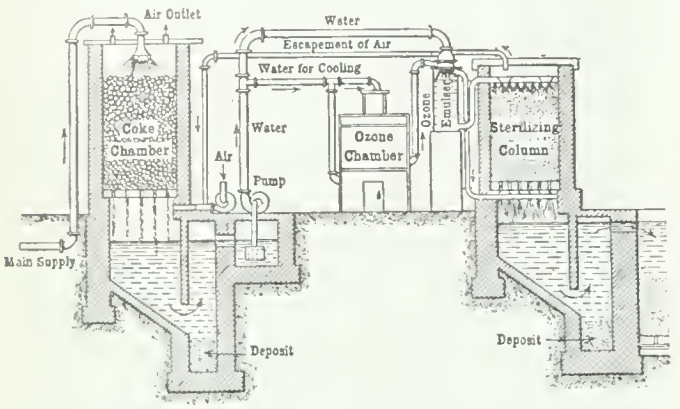


Fig. 2.—Arrangement of Plant at Nice, France; Capacity 27,000 Gallons Per Hour.

St. Petersburg, Russia.—The city of Saint Petersburg in Russia is dependent on the River Neva for the major portion of its municipal water supply. These waters were contaminated by typhoid and cholera bacteria.

After a thorough investigation of all available means for the purification of water, investigations which extended over a considerable period of time, the authorities of the city of Saint Petersburg decided that the most reliable and effective agent was ozone. Researches made at the Pasteur Institute in Paris were made the final basis of the Russian authorities.

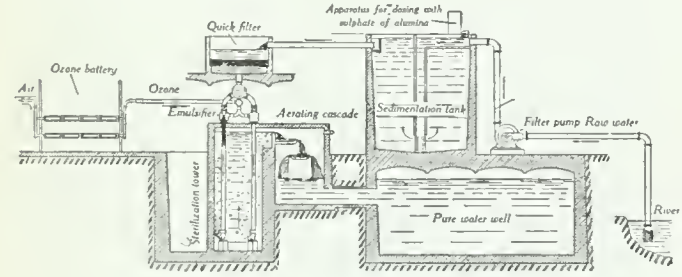


Fig. 3.—Plant at Saint Petersburg.

Work on the plant was started in 1910 and was completed in November, 1910. The water after being pumped from the river is first treated with sulphate of alumina as a coagulant; it is then filtered through rapid filters. Careful bacteriological examinations show that both before and after filtration the water contains an abundance of typhoid and cholera bacteria, whereas after ozonization there is invariably a total absence of these and all other pathogenic bacteria. The gross cost of purification, including filtration, is $15 per 1,000,000 gals. The net cost of ozone sterilization is $7.50 per 1,000,000 gals. Fig. 3 is descriptive of the installation.

In concluding his report Mr. Spaulding states that the most desirable mechanical factors to be used in connection with the generation of ozone are: 1. A supply of alternating electric current at low cost. 2. An efficient transformer to obtain high tension. 3. Ozone electrodes that do not generate enough heat to—(a) Disrupt the dielectrics; (b) Cause reversion of ozone to oxygen; (c) Require external means for cooling. 4. Ozone electrodes that will approach the theoretical efficiency much more closely than the various systems now in use.

The only failures in ozone water purification plants that have so far occurred have been due to a failure in breaking up the water in sufficiently fine particles and in properly contacting these small particles with ozone. The two failures which he mentions are those at Ann Arbor, Mich., and at Lindsay, Ont. He refers to failures in the technical sense, that is, failure to produce odorless, tasteless, colorless water, entirely free from pathogenic germs, by means of ozone. Failures might occur from a commercial point of view, because of excessive overhead charges or too high a cost of maintenance due to low efficiency or unreliability of apparatus.

The report urges upon the authorities of the State of New York the advisability of giving to ozone, as a means of purifying potable waters, their most earnest consideration, stating that there is no means known to science more reliable or absolute than ozone, with which to overcome pollution and protect public health. The latest developments of the art have brought ozone water purification well within the boundaries of economical municipal administration.

TENSILE TESTS OF CONCRETE.

A series of tests on concrete specimens measuring 18 in. long by 6 in. square has recently been made in the engineering laboratory at Cornell University.

The specimens were of three different mixtures, the first a 1:2:4 mixture containing limestone crushed to pass a 1½-in. ring, the second a 1:2:4 mixture containing sandstone, crushed to pass a 2½-in. ring, and the third a 1:2½:5 mixture containing crushed sandstone similar to that of the second mixture.

In six tests the 1:2:4 limestone concrete showed an average tensile strength of 278 lb. per square inch, the highest being 308 lb. per square inch, and the lowest 253 lb. per square inch.

In nine tests, the 1:2:4 sandstone concrete showed an average tensile strength of 150 lb. per square inch, the highest being 178 lb. per square inch, and the lowest 128 lb. per square inch.

In nine tests, the 1:2½:5 sandstone concrete showed an average tensile strength of 129 lb. per square inch, the highest being 179 lb. per square inch, and the lowest being 97 lb. per square inch.

It is worthy to note that in many instances particles of sandstone were split in two in the plane of the fracture instead of breaking the bond with the mortar; this was particularly so in the case of red sandstone, and illustrates the importance attaching to the selection of aggregates for employment in concrete work.

Boring for oil in Sicily has been vigorously prosecuted for the last 18 months, according to "Daily Consular and Trade Reports," of recent issue. It appears that there are large quantities of oil near Nicosia in Catania, containing considerable quantities of bitumen, about 40 to 55 per cent. of petroleum, and free from sulphur.

WHY SOME MUNICIPAL ASPHALT PLANTS FAIL.

By H. B. Pullar, Assoc. Am. Soc. C.E., of Pullar & Enzenroth, Engineering Chemists, Detroit, Mich.

Many cities throughout the United States and Canada now own and operate their paving plants. A majority of these paving plants have proven a success, but a number of them have been unsuccessful. It is not the intention in this paper to discuss the advisability of municipal paving plant ownership, but to show, in a manner, why some municipal paving plants fail to accomplish their purpose and prove to be a losing venture for the city that owns them. As facts are more interesting than theory, a short description of the methods used by one city owning a municipal paving plant may prove interesting.

This city, of about 50,000 inhabitants, situated in the middle eastern States, purchased a municipal paving plant and the necessary equipment for laying its own pavements, the initial capital expense amounting to about $10,000. According to the usual custom, the plant manufacturers offered the services of a so-called expert to get the plant in running order and demonstrate its economical qualities. This so-called expert, as is too often the case, was not familiar with the paving industry, and was absolutely incapable of organizing and properly running a paving plant. The city engineer, whose paving experience had been largely that of supervising the laying of brick pavements, justly became disgusted with the methods of this so-called expert and decided to operate the paving plant according to his own ideas.

Without intending to unjustly criticize the engineer and other officials in charge of this municipal asphalt plant (for without question they were running it to the best of their ability), the operation of this plant under the conditions was bound to result in a failure for the municipal plant, which eventually would disgust the taxpayers with municipal plant ownership.

The concrete foundation was laid according to the same grades and profiles used for laying brick pavements, and was in most places rough and uneven. The laying of the foundation to such grades naturally made it necessary to put down a bituminous pavement consisting of a binder and wearing surface of between 5½ and 7 inches, which, of course, was contrary to all correct and recognized principles of sheet asphalt construction. The engineer gave as his excuse for laying the foundation in such a manner that, should the sheet asphalt prove a failure, then it could be easily torn up and replaced by a brick pavement.

The paving plant was in charge of an employee who had had some previous experience in plant work, but who was not familiar with the present-day methods, and who was certainly not running the plant in an economical way. The plant site was too small, and was carelessly laid out, making it impossible to run the plant efficiently.

On account of there not being any satisfactory stone in the near vicinity, gravel was used for binder. It was used just as it came from the pit, and contained a considerable percentage of round, smooth boulders, varying in size from ½ to 2 inches in diameter. Of course, it was absolutely impossible for the binding material to hold and bind these boulders together in any satisfactory way. While this unsuitable gravel was run into the mixer from one side of the plant the asphalt cement was run into the mixer from the opposite side, the melting and mixing going on simultaneously. This is contrary to the best practice, and much better results could have been accomplished at a very small expense by having a separate kettle for melting the asphalt cement. After the mix had been running for what the foreman considered a satisfactory period it was dumped into wagons. By the time the last of the mix was out of the mixer the temperature was about fifty degrees higher than the first that came out, the result being that there was usually a part of the load that was either too cold or else overheated.

The binder was then taken to the street and laid by inexperienced men (as will later be described), to a thickness of between 3 and 4 inches. After there had been laid what was considered a sufficient amount of binder, the plant was stopped and changes made in order to run the surface mixture. No system was used in making these changes from running binder to surface mixture, and there were many useless and expensive delays.

The surface mixture consisted of sand, marble dust and asphalt cement, the sand and marble dust analyzing as follows:—

Sand.

		Per cent.
Passing mesh	200	0.0
" "	100	0.0
" "	80	0.5
" "	50	12.5
" "	40	14.0
" "	30	28.0
" "	20	11.5
" "	10	13.5
" "	4	20

Marble Dust.

		Per cent.
Passing mesh	200	80.6
" "	100	12.4
" "	80	6.0
" "	50	1.0

The marble dust was of good quality and satisfactory for filler. The sand, which was to comprise 80 per cent. of the pavement, and which is too often considered of little importance, was poor and very unsatisfactory for high-grade sheet asphalt work. As will be noted by the grading, it was entirely too coarse, and especially so when the heavy traffic of the street was taken into consideration. Sometimes it is necessary to make the best possible mix out of the available materials, but in this instance a suitable sand could have been obtained at a very small increase in cost. This poor quality of sand, mixed with too low a percentage of marble dust, was run into the mixer at the same time as asphalt cement, and, as was the case with the binder, all the materials were heated and mixed simultaneously. After the mixture had been heated for what was considered a satisfactory length of time it was dumped into wagons, the same deviation of temperature occurring during the discharge. The wearing surface after having received this improper treatment at the plant was taken to the street and carelessly laid and rolled to a thickness of between 2½ and 3½ inches.

The inefficiency exhibited by the street crew was even worse than at the plant. This crew did not contain a single man who was experienced in the laying of sheet asphalt pavements. The rakers, tampers and smoothers were merely laborers picked up in the city and knew nothing whatever about paving construction. The rollerman was inexperienced in paving work. He knew nothing at all about proper compression or the proper time to start

rolling the hot material, and he considered the pavement sufficiently rolled when it looked fairly smooth. Even a good rollerman would have had difficulty in rolling and getting the proper surface and compression to a bituminous pavement of this thickness.

Two samples taken from the pavement laid under these conditions analyzed as follows:—

		Sample 1. Per cent.	Sample 2. Per cent.
Bitumen		8.62	7.04
Passing mesh	200	4.1	5.0
" "	100	1.4	2.0
" "	80	1.5	1.0
" "	50	14.0	14.4
" "	40	29.4	27.0
" "	30	14.6	10.6
" "	20	12.3	11.2
" "	10	10.0	9.8
" "	4	12.7	19.0

It might also be interesting to note that this pavement was being laid on one of the heavy traffic streets of the city, and also on a street containing car tracks.

Just before the paving season closed this condition of affairs was brought to the attention of the city officials in charge, and after some considerable discussion, in which there was an attempted defense of the methods used, it was decided to allow an experiment to be made in laying a strip of pavement under better conditions.

The first thing that was done was to put the work under the supervision of an experienced man thoroughly familiar with the proper laying of sheet asphalt pavements. He secured a few experienced men from a nearby city and carefully watched the rest of the men, and instilled into them a little pride in the work which they were doing. On account of being very near to the end of the paving season, and the fact that it would have delayed the work considerably to get in more suitable materials for the binder and wearing surface, he took the materials which were on hand and proceeded to get the best results with them. The first thing that was done was to obtain an inch screen and screen out all the big stones contained in the gravel which was used for binder. This cost amounted to about 30 cents per cubic yard. More dust was added to the mix to stiffen it up, and the per cent. of bitumen increased to properly coat and bind the mineral aggregate. Careful attention was given to the details at the plant and on the street, temperatures were controlled as much as possible, and a fairly uniform mix obtained. A sample taken from the pavement laid under these new but improved condition analyzed as follows:—

		Per cent.
Bitumen		10.0
Passing mesh	200	6.4
" "	100	1.0
" "	80	2.3
" "	50	16.8
" "	40	14.0
" "	30	26.3
" "	20	8.7
" "	10	10.2
" "	4	14.3

The foundation was laid to a satisfactory grade, so that the pavement consisted of 1½ inches of binder and 2 inches of wearing surface. The mix was taken from the plant to the street in covered wagons, where it was handled by experienced rakers, and the rollerman was made to continue rolling both lengthwise and diagonally until the surface had the required compression and was free from marks and imperfections. Under these very adverse conditions a saving of a little over 25 cents per square yard was made in the wearing surface and a little over 24½ cents per square yard in the binder, or a total of practically 50 cents per square yard saved on the bituminous part of the pavement alone. Besides this, there was a considerable saving made on the foundation and on the grading, the details of which were not kept.

The following table gives a comparison of the amount of material and costs of construction between the work which was laid under the poor conditions existing at the municipal plant and under the adverse but improved conditions of expert supervision:—

Binder Mix.

	Weight of mix per sq. yd.	Cost per sq. yd., complete.
Old conditions	400 lbs.	$0.52
Expert supervision	188 lbs.	.2718

Top Mix.

	Sand per sq. yd.	Dust per sq. yd.	A. C. per sq. yd.	Mix per sq. yd.
Old conditions	250 lbs.	26.3 lbs.	39 lbs.	315.5 lbs.
Expert supervision	169 lbs.	21.3 lbs.	18.7 lbs.	209 lbs.

Old conditions, cost per sq. yd., complete..... $ .75
Expert supervision, cost per sq. yd., complete.. .4987

While the above example of inefficiency in running a municipal plant is, of course, unusual, and, in fact, ludicrous to those familiar with the industry, it is an accurate account of the exact condition existing in this particular city. If this poorly managed department had continued to operate their plant with their inefficient organization, tax-payers would be amply justified in condemning municipal plant ownership.

While the above example is one instance where a municipal plant will eventually become an absolute failure, there are many other municipal plants throughout the country that are not proving to be a good investment to the city, and are not being run to their maximum efficiency. There are many ways that savings could be accomplished, and if these plants were put under efficient management or someone well versed in the paving business, they would be very valuable assets for the city. For instance, a municipal plant in one of the Western cities saved over $1 per car on every carload of sand that came into their plant by merely rearranging their material and storage space, and by putting in about 50 feet extension on the side track. There are many details connected with paving plants by which much money can be uselessly expended. Cramped quarters and insufficient storage room for crude materials are an expensvie handicap, and cities desiring to install municipal plants should be careful to give proper consideration to the location.

The most common form of municipal plant failure is the one well recognized by those connected with the industry, i.e., where the city appropriates and expends sufficient money for plant and equipment to take care of all its paving, and then, on account of the laws or on account of the policy of the administration, can only run it a small part of each year for repair work. It is a waste of money for a city to invest in a plant having a capacity of from 1,000 to 2,000 yards of completed pavement per day and have only, say, 10,000 yards of repair work to be done during the entire season, and yet there are many cities owning their municipal asphalt plants where this condition prevails. In the writer's opinion no city should contemplate putting in a large municipal plant unless it

expects to use that plant for at least 50,000 square yards per year. The maintenance and cost of operation for large plants are too great, and the result is usually a failure. There are numerous small mixers on the market to-day which are satisfactory for cities who wish to do their own repair work, amounting to only a few thousand yards per year. The initial and operating costs are small, and when not in use they require practically no expense. The maintenance and depreciation are also very low.

There are many other causes for municipal paving plant failures which require long explanations, but it is at least encouraging to note that the cities owning municipal paving plants are waking up to the fact that sometimes failures can be turned into success, and are putting their municipal plants under proper conditions to do the work for which they were intended.

CLASSIFICATION OF ONTARIO ROADS.

The roads of Ontario may, for a consideration of construction, be broadly divided into three classes, states Mr. W. A. McLean, in the annual report on highway improvement, one grade merging into another, however, at the arbitrary dividing line. It is estimated that in the organized counties of old Ontario there are 50,000 miles of road, and a classification would be approximately as follows:—

1.	Trunk roads connecting the large towns and cities	5%	or 2,500 miles
2.	County or leading market roads	12%	or 6,000 miles
3.	(a) Main township roads	50%	or 25,000 miles
	(b) Secondary township roads	33%	or 16,500 miles
	Total	100%	or 50,000 miles

In the foregoing classification, the roads described as trunk roads are, with the exception of a few connecting links, among the most important of the county roads, and are heavily travelled for local market purposes, but they carry as well an increasing amount of through inter-urban traffic. The heavy and complex nature of this traffic requires, as a rule, construction of the most durable type varying from a concrete, brick, or other durable pavement to first-class macadam. The classes one and two, including trunk roads and leading market roads, thus include two divisions of what what would be the main county roads of the province. These comprise 17 per cent. or 8,500 miles in all. which if properly selected and constructed should carry 80 per cent. of the traffic of the province.

The main township roads comprise principally the concession roads on which numerous farms front and which converge into and create the traffic of trunk or county roads. The more important of these should be metalled with gravel or broken stone, if available. Secondary township roads include the little travelled connecting roads which should be graded and given such further treatment as circumstances may permit. The first need for the roads classified as township roads is thorough grading, draining and bridging, and systematic maintenance with the log drag.

Gradients adopted, amount of camber or crown, width and depth of metal, foundation if any, drainage, binding material, and other details, should, as suggested, be largely dictated by the degree of traffic. A good road attracts and creates traffic so that the construction of any one road is very likely to raise it from one class to a higher grade, a matter which should not be lost sight of in planning improvement. Methods of construction should be as simple and direct as proper results will permit. There should, for true economy, be a well adjusted average between maximum service and minimum cost.

NEW YORK CITY A VAST BRICK MARKET.

It is difficult to realize the enormous quantities of brick used annually in greater New York. During 1912 the consumption was more than 1,000,000,000. The principal source of this vast quantity is the Hudson River region, which extends along both sides of the river from New York to Cohoes and embraces ten counties, nine in New York and one in New Jersey. Other sources of supply are the Raritan River region of New Jersey and the Connecticut region.

The year 1912 was one of unusual interest in the Hudson region. It opened with an increasing demand and the price of common brick was $7 per thousand compared with $4.25 in 1911. For several years the use of cement or concrete in construction appeared to be displacing brick to some extent, but owing to the strong "back to brick" movement the year 1912 saw in the New York market a change favoring brick as the best building material for many purposes. Influences that have contributed to this change are the failure of some concrete buildings, the advertising campaign carried on by the brickmakers and the improved quality of the Hudson River brick. The average price was the highest since 1906.

The marketed product of 1912 was larger than that of 1911 and would probably have been still greater but for the scarcity of labor, especially at Haverstraw, and the strike among the brickmakers in the Newburg district. The strike was of short duration, but the scarcity of labor drawn away by large construction enterprises, such as the Catskill aqueduct, railroad extensions and subway operations, was a serious drawback to the Hudson River brickmakers in 1912. This condition was so serious that the operators resorted to night work and rainy-day work in loading barges and imported laborers from the South.

An important development during the year was a large increase in the use of Raritan River brick in New York city, which has for some years been drawing on the Raritan River region. In 1912 the demand for this brick was very much greater than ever before.

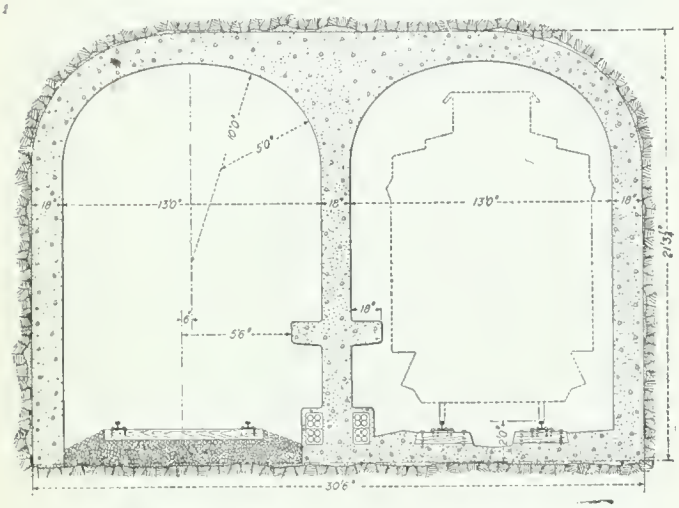
On the whole, the year may be regarded as one of prosperity. The demand was good, prices were high, the mild weather toward the end of the year permitted shipments to its close, and while the marketed product was not the largest recorded, it was considerably larger than that of 1911.

The statistics gathered by Jefferson Middleton, of the United States Geological Survey, show that the number of brick marketed in the Hudson River region in 1912 was 1,019,259,000, valued at $5,850,770, or $5.74 per thousand, compared with 926,072,000 brick in 1911, valued at $4,717,633, or $5.09 per thousand. This was an increase in 1912 of 93,187,000 brick and of $1,133,137 in value. The number of operating firms reporting in 1912 was 126.

During ten months ending May 1st Canada exported 3,250,272 tons of bituminous coal to the United States and imported in return 19,353,252 tons of anthracite and 22,356,868 tons of bituminous, according to the latest monthly summary of the United States Bureau of Foreign and Domestic Commerce.

THE CROSS-SECTION OF THE MOUNT ROYAL TUNNEL.

Various phases of preliminary and construction work in connection with the Mount Royal tunnel, to provide an entrance into the city of Montreal for the Canadian Northern Railway, have been described in previous issues of *The Canadian Engineer*. The first article, which dealt with the difficult problem encountered by the Canadian Northern Railway in arranging terminal facilities in Montreal, as the eastern distributing point for its transcontinental system, due to the location of the older and most congested part of the city lying between Mount Royal and the St. Lawrence River, appeared in the issue of January 16th, 1913. The tunnel was chosen to dispense with the necessity of making an extended detour of the city, including the possibility of two separate stations for west-bound and east-bound traffic. The location of the tunnel as then proposed was described, together with the system of tracking which it was designed to accommodate. A description of the plant to be used in this construction was also given.



Cross-Section of Mount Royal Tunnel.

In *The Canadian Engineer* for February 6th a description was given of the progress of the work upon each of the four headings which were being driven simultaneously, and general information concerning the character of earth and rocks encountered, and the methods of excavation, was included. The article illustrated the site of the tunnel, and various views of the machinery and equipment were given. An article appearing in February 27th issue dealt with the general survey work connected with the tunnel, and the methods used in precise measurements, while from time to time items of interest concerning the progress of the undertaking have appeared. The reader is requested to refer to the issues mentioned for full details pertaining to the gigantic piece of work.

It has recently developed that a twin tunnel cross-section has been adopted, of the design shown in the accompanying figure, which we reproduce from the Engineering Record. The adoption of this type is due to three especial reasons, viz., safety in case of accident or derailment, economy in excavation and construction, and economy and efficiency in ventilation. It will be noted that the new structure is similar to the tunnel work of other projects with which readers are familiar. The outside wall clearance is coincident with the clearance for the new structures in the New York Central Terminal work in New York, and exceeds the clearance of the Pennsylvania lines east of Pittsburg.

A high headroom, almost the same as that of the Detroit River tunnel, was adopted on account of the probability of a high-voltage overhead contact circuit. The flattened three-centered arch was adopted to allow for the sway of the pantograph and on account of the stratification of the rock where much of the lining will occur.

The walkway is made narrow, so that people will be forced to pass along it in single file, thus avoiding the danger of crushing and panic. The normal clearance at the walkway edge is 2 in. greater than that of the normal high passenger platform adopted in the terminal, which is somewhat greater than that allowed on the New York Central and Pennsylvania lines about New York. The walkway edge also coincides with clearance lines (outside of the platform) of the Pennsylvania lines east of Pittsburgh, including the through lines between New York and Pittsburgh.

Underneath the walkway is a continuous refuge niche, except at splicing chambers, where trackmen may sit on the duct bench at the bottom of the dividing wall and be absolutely protected from passing trains.

The work is being done by the Canadian Northern Montreal Tunnel and Terminal Company, Limited, of which Mr. S. P. Brown is chief engineer, and Mr. H. T. Fisher, tunnel engineer. This journal referred recently to 810 feet of heading having been driven in 31 days, beginning May 1st, as a tunnelling record for America. Ahead of it is a Switzerland record of 1,013 feet of 6½-ft. by 10-ft. heading accomplished in the same amount of time. The Mount Royal excavation is an 8-ft. by 12-ft. heading through Trenton limestone, which exceeds in hardness the soft triassic limestone encountered in the Loetschberg tunnel in Switzerland.

UNITED STATES PRODUCTION OF PIG IRON IN 1912.

According to a bulletin issued by the American Iron and Steel Institute, the production of pig iron in the United States in 1912 was as follows; the figures for 1911 and 1910 being given for comparison:

	1910 Tons.	1911 Tons.	1912 Tons.
Bessemer and low phosphorus	11,245,642	9,409,303	11,667,656
Basic	9,084,608	8,520,020	11,394,477
Charcoal	396,507	278,676	347,025
Ferro-manganese	71,376	74,482	125,379
Spiegeleisen	153,055	110,236	96,346
Foundry ferro-silicon, etc.	6,352,379	5,256,830	6,096,254
	27,303,567	23,649,547	29,727,137

With the development of long-distance electric-power transmission, the line voltage has increased steadily in spite of difficulties which increase at the same time. When the first 110,000-volt transmission line was put in operation, a few years ago, many considered that the maximum commercial voltage had been reached. But last year, the first 140,000-volt line was put in operation in the state of Michigan, covering a distance of 125 miles, which was soon increased to 235. The line is in regular service and is reported to be giving entire success.

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CONTENTS OF THIS ISSUE.

	PAGE
Editorial:	
Exhibition of British Goods in Canada	149
An Institution for Municipal Engineers	149
Leading Articles:	
The Cost of Generating Power With Diesel Oil Engines	133
Suitable Road Surfaces for Various Kinds of Traffic	135
Artificial Ice Manufacture in Ottawa	137
The Generation of Electrical Energy for Smaller Towns	139
Bridge Floors Replaced With Concrete	141
The Application of Ozone to Water Purification	142
Why Some Municipal Asphalt Plants Fail	145
Classification of Ontario Roads	147
New York City a Vast Brick Market	147
The Cross-Section of the Mount Royal Tunnel	148
Letters to the Editor	151
Scientific Utilization of Natural Resources	154
Reinforced Concrete Pontoons for a Modern Floating Boathouse	156
Macadamized Roads Constructed With Tarry, Bituminous or Asphaltic Binders	157
The Railway Tie Situation in Eastern Canada	160
Coast to Coast	161
Personals	163
Market Conditions	92-94
Construction News	75
Railway Orders	82

EXHIBITIONS OF BRITISH GOODS IN CANADA.

The established success of the "Made-in-Canada" exhibition trains of this year and last, and the growing popularity of the enterprise throughout the provinces, is responsible for a good deal of industrial activity in many western towns and cities. The tour of the 1913 train, which terminated in Montreal a few days ago, covered some 125 points on the lines of the Canadian Pacific, Canadian Northern, and Grand Trunk Pacific roads west of Winnipeg. To practically all these places, with the exception of the larger cities, the exhibition was a new feature, having been much more comprehensive in its make-up, and having touched other points than those visited last year.

The project has aroused a lively interest outside the Dominion, especially among manufacturers in Great Britain. British Chambers of Commerce are taking up the suggestion that the best way to place British goods before Canadian customers is by the provision in Canada of a British manufacturers' exhibition train. Various chambers and associations are working upon it, in conjunction with an endeavor to urge the establishment in Canada of permanent exhibitions of manufactures from the United Kingdom.

Although of the opinion that permanent exhibitions of machinery and engineering supplies are never a success, except in so far as a unit, satisfactorily installed and efficiently operated, may and should be regarded as an exhibit, its successful operation continued under working conditions, showing the desired result, we are inclined to believe that an exhibition of British manufactures, by train, would be a good thing for Canada and Canadian industry. For instance, cars representing such manufacturing centres of Great Britain as one might mention by the score, furnished with British machinery and equipment, pertaining to municipal and public works, would create, in municipalities, conceptions not born of catalogue illustrations or literature. At the same time, Canadian manufacturers would profit by the incentive to install equipment, which these exhibitions would arouse, in the direction of electric light and power, water-supply, sanitation, and general municipal development. Besides, the spur to industry which towns have experienced as a result of the Canadian trains would, in all probability, be forthcoming from the visit of a British train, providing the tours were properly executed and the idea not overworked.

AN INSTITUTION FOR MUNICIPAL ENGINEERS.

An organization to serve the needs of Canadian municipal engineers is advocated by letter in another column of this issue. We hope its appearance will arouse a discussion of the subject. Men following this branch of the profession are peculiarly situated with regard to each other and are segregated, in fact, from engineers in general, living more or less in a sphere of their own.

A municipal engineer enjoys the distinction, however, of acquiring by necessity a general all-round engineering experience—problems electrical, mechanical, geological, of transportation, waterworks, sewage disposal, costs, estimates, etc., are all within the category of the average municipal engineer's duties. Naturally, the benefits which he would derive from social and professional intercourse with others in this work are many, tending to result in

greater efficiency of service, the elucidation of methods whereby other municipalities, in like or varied conditions, are served, and a general strengthening of the status of the municipal engineer.

Owing to the peculiar distribution of municipal engineers throughout the country—in special instances only can a few of them meet frequently—the working-up to the establishment of such an organization would be a long and arduous task, liable to prolonged lapses of inactivity. In short, although we believe that the municipal engineer would benefit greatly by such an association, it seems certain that his geographical position with respect to others in his field, together with his preoccupation with the particular needs of his own municipality, would afford him little opportunity for supporting an organizing committee in its work.

In the Canadian Society of Civil Engineers all branches of the profession in Canada should have ample representation. The society consists at present of four sections, namely, electrical, mechanical, mining, and general. A vast majority of municipal engineers throughout the country is enrolled in the membership of the society, and the well-established, coast-to-coast institution that it is, its sub-committees dealing with all engineering problems, including those pertaining to municipal work, its membership should include the entire body of three to five hundred municipal engineers estimated by Mr. Wynne-Roberts in his letter.

The establishment in the society of a section for municipal engineers would afford them the advantage of having behind it a strong, internationally recognized society, that has been serving for years all phases of the profession akin to municipal work. On the other hand, the society would be materially strengthened by having incorporated into it a section whose membership is carrying the work of the engineer into all parts of Canada, and is performing the service of connecting link between the profession and the community everywhere.

Mr. Wynne-Roberts' suggestion is good, provided the proposed association is formed as a section of the Canadian Society of Civil Engineers.

EDITORIAL COMMENT.

The Canadian Pacific Railway Company is contemplating a large extension of double track throughout Ontario, on lines both east and west of Toronto. Work is being started at once on a continuation to Guelph Junction of the double track line in use from Toronto to Islington. An extension to Detroit, 189 miles in length, is scheduled for next spring. The company also proposes double-tracking eastward to Smith Falls to link with the line from there to Montreal already in use.

* * * *

The proposed commission to investigate Ontario roads with a view to outlining a government policy for their improvement will not get an early start this season. No names have been disclosed, but Mr. W. A. Maclean, provincial engineer of highways, will likely be a member of the commission, if one may form an opinion from a recent report to the effect that Hon. J. O. Reaume, Minister of Public Works, has stated that no move would be made in this direction by the government until Mr. Maclean returns from Europe, where he is attending the International Roads Congress.

The twelfth annual meeting of the International Geological Congress, which will open shortly, should be attended by mining engineers in great numbers. The chief feature of the congress will be the numerous excursions to the principal mining districts of Canada, and to her many localities of geologic interest. The Geological Survey of Canada, the Canadian Mining Institute, and the Government are putting forth every effort to afford profitable papers and suitable accommodation at its meetings and on the numerous excursions. Cobalt, Porcupine, Sudbury, Nova Scotia, and the Yukon are among the localities which will be visited. It goes without saying that the convention will rank as the best ever held in Canada for mining men. The session in Toronto opens August 7th.

* * * *

The University of Toronto's venture in discarding separate heating and lighting units in favor of a central plant for all buildings appears to have achieved vindication at last. Better service and lower cost of operation are prominent features of the report for the 1912-13 season. With the temperature 4.70 degrees above the average, for the entire season, the cost per square foot of radiation was as low as 24.153 cents, as against 38.27 cents for the previous year and 41.32 cents for 1908-09, under old conditions of separate heating units. During last year light and heat was supplied to twenty-six buildings, including Wycliffe and Victoria Colleges, containing 170,221 square feet of radiation surface, at a cost of $41,183. The report states further that by centralizing its heating systems, the University has evaded the expenditure of a large sum in the necessary renewal of individual plants, and in the installation of new systems into buildings erected during the past three years. It has, at the same time, redeemed for other urgent needs, the space previously occupied by boilers and coal bunkers.

* * * *

The International Joint Commission has before it the consideration of a proposed lease in which the Michigan-Lake Superior Power Company and the United States are the contracting parties. The power company desires to divert, for power development purposes, a flow of water from the St. Mary's River, to the extent of 25,000 to 30,000 cubic feet per second, and proposes to construct compensating works opposite Sault Ste. Marie, Mich. Under the new conservation policy adopted by the United States, the Government proposes to lease the water for power with a view to ultimately owning the development works constructed by the company. In the lease at present under consideration the latter offers to pay a yearly rate of $2.50 per cubic foot per second up to a flow of 25,000 cubic feet, in excess of which $1 per cubic foot per second is the charge it offers to meet. The question being of boundary water, and therefore of international concern, the finding of the International Joint Commission will govern the situation, and its report will be awaited with interest.

CALCUTTA SECTION, THE INSTITUTION OF MECHANICAL ENGINEERS.

The fifth annual report of the Calcutta and district section of the Institution of Mechanical Engineers has just been received. The report shows an increasing membership and a healthy contribution of interesting papers read during the past year. The membership on March 31, 1913, consisted of eighty names.

LETTERS TO THE EDITOR.

[Note.—Opinions are solicited from readers concerning subjects opened for discussion in these letters.—Ed.]

Previous Conventions in Canada of Am. Soc. C.E.

Sir,—I was much interested in reading your account of the proceedings of the recent convention of the American Society of Civil Engineers in your issue of June 26th. It recalled to my mind the first time the society met in Canada, as you rightly state, in 1881. I have very vivid recollections of that meeting—one of the most successful, socially and scientifically, ever held up to that time, and for many years thereafter.

I recall with considerable pleasure the entertainments provided the visitors and their guests—the reception at the residence of Col. C. S. Gzowski, in Toronto; the trips to Ottawa; shooting the rapids on logs at Chaudiere Falls; Rideau Hall; Parliament Buildings; Quebec; Falls of Montmorency, etc.—in charge of the Montreal local committee, headed by Mr. John Kennedy, chief engineer of harbor commissioners, chairman, with his associates, E. P. Hannaford, chief engineer of the Grand Trunk; P. Alex. Peterson, chief engineer, Intercolonial Railway: Louis Lesage, chief engineer of waterworks; Geo. Doane Ansley, city engineer, and not forgetting the noble veterans, Messrs. Thomas C. Keefer and Sandford Fleming. How many of these gentlemen are now living! The writer at that time, and for some years before and after, was chief clerk, assistant secretary and auditor of the society under Hon. John Bogart, who for many years was its most efficient and accomplished secretary.

The recent meeting in Ottawa was the third held in Canada. The convention of 1897 was held at Quebec.

THOMAS B. LEE.

Montreal, July 1st, 1913.

* * * *

A Plea for a Canadian Institution of Municipal Engineers.

Sir,—Out of about 70 societies, Canadian technical societies, 16 are associated with general engineering; 3 represent electric engineers, etc.; architects have 7 societies; land surveyors have 6; mining engineers, 3; gas engineers,. 1; railway engineers, 3; chemists, 1, and the remainder are associated with builders, astronomers, stationary engineers, good roads, smoke abatement, peat, forestry, cement, and miscellaneous, numbering in all about 18. The mayors, aldermen, councillors, and town clerks have 10 societies, organized to represent their views and wants. It is also worthy to note that there is one Public Health Association in Canada, and this is said to consist largely of medical men.

Canada is a large country, with a population of about eight million people. The health of the communities, where human activities are so pronounced, is of vital importance, yet, the last named association is the only one which has been established in this country, primarily in the interest of public health. The municipal engineers, however, as an organized, coherent body of officials, do not exist at all. In Canada, therefore, at the present time, so far as I am able to ascertain, there is no organization which has specially the right to represent and voice the views of the important profession of municipal engineers.

Why is this so? Is there a good sound reason for the absence of such a representative society? Is the immensity of Canadian territory a deterent to a prosperous institution?

After studying the situation, the writer was forced to the conclusion that it was because each municipal engineer had as much as he could do to carry on his own professional duties, and consequently, had but little time or occasion to think of such an organization. Furthermore, they dwell and work at distances, more or less great from each other, with the result that the engineer in British Columbia, for instance, rarely meets his confreres in the Prairie Provinces, much less have many opportunities of conferring with those in the East. If this applies to engineers working in the West, but whose native home is in the East, then it is still less probable that those living and working in the East get frequent opportunities for visiting works in the West. There is no inducement, at present, for them to make the trips. This, however, is not a strong reason for the absence of a Canadian Institution of Municipal Engineers, but is a powerful argument in favor of its immediate formation. The vastness of this country renders it even more desirable that engineers should combine and by means of an organized effort, eradicate the present tendency to insularity caused by their isolation from engineers in other cities and provinces.

Many of these engineers have occasion at one time or another, however infrequent, to visit other towns and cities, and to inspect various works of interest to themselves, and by making the most of their individual opportunities, they are able to secure valuable information which tends to show them that different engineers have different ways of achieving similar results. But if an insitution was formed and meetings were held at different centres, the benefits would be collective and not individual.

In the field of general engineering, there is probably an ample number of societies, and for almost every phase of engineering in Canada—except municipal engineering—there is a representative organization.

According to the Dominion census of 1911, there were 107 cities and towns in Canada having a population of 4,000 and over. This was an increase of 45 per cent. over 1901. The increase in population has been much greater during the last five years than in any other similar period, and it is safe to reckon that the number of towns and cities of 4,000 inhabitants and over will by 1921 be about 200.

Most of these towns employ an engineer, some of them also have departmental engineers, and the writer ventures to estimate that there are at present from 300 to 500 engineers engaged on municipal works in Canada, who, owing to the non-existence of a distinctively representative society, common to practically every other class of men, are left to their own resources and initiative.

A Canadian association representative of these men might include city engineers, municipal, electric, water, drainage, road, street, railway, gas, and other engineers. Perhaps consulting engineers engaged on municipal undertakings would be allowed to join. The only qualification, which would probably be needed (especially at the commencement) would be that the applicants either hold principal civic appointments or are engaged on municipal works. The members could, of course, be divided into classes according to their individual qualifications and occupations, if it was thought desirable.

Such an institution would meet in different cities, at least once a year (the oftener the better) where papers would be read by the engineers, describing the works undertaken by the city. These works would be inspected and explained, questions would be invited and answered, and a general discussion would take place.

It is ofter the case, in other societies, that a free discussion affords more useful and comparative information than is to be found in the paper itself. Such discussions are good, the weak and strong points of any scheme are brought out prominently, for in the multitude of counsel there is often much wisdom. Discussion also broadens the mind, enlarges the horizon of thought and developes the reasoning faculty; it is also educational to both the speaker and audience alike, it creates a healthy and generous rivalry, and establishes a standard of excellence which by mutual accord becomes higher each year and which will inevitably reflect credit on the profession generally, and give greater satisfaction to the public for whom we work. Such discussion would be of immense advantage to the engineers and to the authorities; the latter would not only secure an excellent advertisement, by virtue of the official visit of the society, but what is of even greater value, the town authority would hear criticisms and obtain information useful for future operations.

Later on, the institution could, if it was deemed desirable, organize examinations in the theory and practice of municipal engineering and in municipal law.

Such an institution would tend to weld together the band of municipal engineers to their own direct benefit, and the town authorities, by sending their engineers to the meetings, would in every way reap great advantages, because the educational and social aspects of such meetings would be conducive to mutual interest, efficiency, confidence, progress and *esprit-de-corps* among the officials.

Considering that enormous sums of money are annually spent by municipal engineers, of various classes, and that so much depends on the efficiency of their works in the direction of public health, public utilities, and public amenities, it might seem strange that active steps to combine had not long since been taken. An official who is perforce to follow solely his own ideas—ploughing his lonely furrow—without seeing what has been done by others in the same sphere of operations, is apt to fall behind and develop the spirit and sentiment of the proverbial cobbler who never went beyond the confines of his own little village.

Whilst in the early stages, it might perhaps, be found possible to form only provincial institutions, the formation of a powerful Dominion institution should be advocated, for in union there is strength and in co-operation there is prosperity. The aim and object of the promotion should be to force it to become a power in the land and that the opinions, transactions and developments of the institution should carry weight and tend to create an appreciative public opinion of the inobstrusive work carried on by engineers in the Dominion. Such an institution, if rightly directed and loyally supported in its initial stages, would soon reach the position when its power and influence would be felt outside the circle of engineers.

At present if any Canadian engineer desires to meet in conference, men of similar vocation, he has to cross the international boundary where, of course, he will see much to his advantage, and though he will certainly receive a warm welcome and a great hospitality, he cannot help but feel a sense of lonliness in the crowd. If, however, a representative society were to make an official visit to the same town the members would not only receive even greater welcome and more bountiful hospitality, but they would also feel far from being lost in the multitude but rather as if they were members of a great family.

From a national point of view, moreover, we should be patriotic enough to be in a position to announce that we have similar societies in Canada, for certainly we have much to be proud of in the number of municipal works, which we can visit.

The suggested Canadian Institution of Municipal Engineers, if formed, could occasionally pay an official visit to a city across the line, just as the gas engineers visited Toronto last year, and the American Society of Civil Engineers visited Ottawa recently. This is a graceful manner of recognizing the internationality of the engineering profession.

The writer does not know what are the views of the municipal engineers on this subject. He has spoken to a few and they appear to be favorable to the suggestion of forming the institution, but it will be advisable to have a free discussion before anything is done in the matter. Perhaps the editor will throw open the columns of this journal for such purpose.

R. O. WYNNE-ROBERTS.

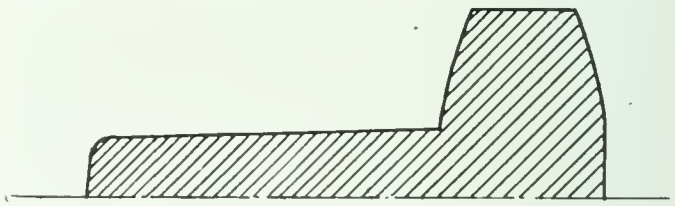
Regina, June 27th, 1913.

* * * *

The City of Toronto and the Acquisition of the Toronto Railway.

Sir,—There are several matters which it will apparently be well for the city council of Toronto to take into consideration in estimating the expenditure that will be necessary within the coming year or two, in order to bring the street railway and its equipment into such a condition that will provide a better service than is at present afforded to the citizens.

Gauge.—It must be remembered that the present gauge of the tracks is a special one, and one to which it will never pay any radial railway to construct its tracks. The gauge of four feet, ten and seven-eighths inches, was adopted in the first instance to permit vehicles of ordinary gauge to run inside the elevated portion of the rail. Even at the outset this was a mistake, because it was always a difficult matter for a wheel running upon the lower portion of the rail to be lifted out over the elevated portion, and many a wheel tire was torn off in endeavoring to get away from the track. The accompanying figure shows the form of the original rail.



It is necessary, therefore, for the city council to bear in mind that the gauge should be changed now that there is an opportunity. It should never have been permitted to remain in use when the railway discontinued horse in favor of electric traction.

This change necessarily requires a certain amount of alteration in the tracks, and while this is being done is a most opportune time for widening the space between them, i.e., the devil strip. The necessity of this change has been so self-evident that new tracks and new diamond crossings have already been laid to a greater width than previously, in readiness for this contingency.

Wide Devil-Strip Necessary to Accommodate Cars of Radial Railway.—The actual width between new tracks at present is not known to the writer, but from observa-

tion it appears to be too small. He found, when constructing an interurban railway, the cars of which were to be run through the streets of the City of Rochester, N.Y., that the devil-strip there, of four feet in width, was too narrow to admit of cars of suitable width for longer journeys than are usually taken on the street railway. As far as possible, therefore, the cars for radial railways which must be constructed sufficiently wide for comfortable seating, will be run over streets that have only a single track laid upon them, unless there is a suitably wide devil-strip on double-tracked streets.

After much consideration the City of Chicago decided, last year, that in streets with double tracking, the distance of the tracks from centre to centre should be ten feet two inches, leaving a clear space of twenty inches between two cars, each eight feet six inches in width, so that all classes of cars could be safely moved upon them.

In order to have a suitable width in the seating of the Rochester Street Railway cars, when there was a central aisle there was a double seat on one side and a single seat on the other—a very poor arrangement, but one occasioned by a devil-strip only four feet in width.

Naturally these changes will require considerable expenditure on capital account, there being, of course, items of labor and new materials required in the alteration of the track gauge.

Central Aisles in Cars.—The trucks of existing cars will likewise require alteration and many cars should now be scrapped, the annoying "wet curtain" cars first of all, and others of modern standard construction provided to replace them. The very undesirable system of longitudinal seats should be done away with in any cars, such as those of the convertible type, that are sufficiently wide to admit of a central gangway.

Low Floor Cars.—A number of Pittsburgh low floor cars should at once be put into commission, to obviate the unnecessary climb which now exists in Toronto cars, and which is so trying to many ladies, to children, and to infirm persons of both sexes.

P. A. Y. E. Cars.—There is no reason why all cars should not be prepared for the pay-as-you-enter system, so as to be ready as soon as the system is adopted on all routes.

The above items are only a few which suggest themselves as points of engineering importance. There are many more which will naturally occur to those familiar with the operation of a city service. Existing methods show abundance of room for improvement.

It would not be surprising if, after acquiring the properties now under consideration, at a cost of $29,000,000, a further outlay of $11,000,000 were required for the lines which are already in commission, and for the necessary alterations to existing track and equipment. It would seem prudent, therefore, for the city council to provide for a total outlay of $40,000,000 accordingly, when making the requisite financial arrangements.

EDMUND WRAGGE.

Toronto, June 24th, 1913.

* * * *

Sir,—According to the Calgary newspapers, I note that the city of Calgary is considering piping water from a point forty-five miles distant.

Calgary is growing greatly and I presume that they would not install less than a 50-inch main. This would make the cost great. It is surprising, particularly in view of the financial conditions in Western Canada, that this proposition would be considered seriously, in view of the fact that a twenty-million-gallon filtration plant, sufficient to supply the city of Calgary for several years to come, could be installed complete at a cost not exceeding $400,000.

The operating cost of such a filter plant would not be as great as the interest on the difference in cost between the filter plant and the pipe line. Furthermore, there is the large item of patrolling this line and keeping it in shape, and the possibility of the source of supply not being sufficient or becoming contaminated and subject to a period of turbidity in future years. The city officials of Calgary will do well to consider this matter thoroughly before going ahead with it, and should certainly secure the best possible engineering advice.

WATERWORKS ENGINEER.

Winnipeg, June 26th, 1913.

ROAD INSPECTORS IN NEW ZEALAND.

Judging from the schedule of duties, with a copy of which a correspondent, resident in New Zealand, has recently favored us, and which appears below, the position of road clerk, or overseer, in some municipalities of this antipodal sister colony, is not without a full course of obligations.

(1) The clerk and overseer to give all his working time, i.e., eight hours per day on six days of the week, to the service of the board, excepting statutory holidays, or holidays given by the board or its chairman for the time being; such working time to be spent in such manner as the board shall instruct in connection with the carrying out of office work and the inspection of roads, etc., and other necessary work.

(2) To do all the clerical work in connection with the business of the board, i.e., to carry out all necessary correspondence, keep all accounts, and prepare all necessary specifications and estimates.

(3) To do all surveying and measuring in connection with, and superintend all works and contracts carried on or let by the board, also to inspect frequently and report upon, monthly at least, all roads, etc., under the control of the board, and to carry out to the satisfaction of the board all the usual duties of a clerk and overseer to a road board.

(4) When on his rounds of inspection of roads and supervising the work of the board's employees, or contractors, the clerk to carry with him suitable tools for effecting small repairs to roads, fords, etc., such work to be carried out by him as the time at his disposal will permit.

(5) The clerk to provide his own horse or horses, vehicles, harness, necessary for carrying out the above duties.

(6) The clerk shall not undertake any work or duty of whatsoever kind other than that of the board, without its consent

(7) The clerk shall, beside his other duties, perform the duties of poundkeeper.

(8) The clerk to be paid by the board a salary of £200 (two hundred pounds) per annum, with free use of house, outbuildings, stables, garden and balance of five acres of land.

(9) The clerk to enter into a fidelity bond in the sum of £300. The premium of such bond to be paid by the board.

(10) One month's notice to terminate the appointment to be given by either side.

THE SCIENTIFIC UTILIZATION OF NATURAL RESOURCES.*

By Dr. W. W. Andrews.

In these days of modern development conservation has come to be a great work. As a people, we have marched across this continent, skimming its resources in most wasteful ways. This has been called "the White Peril" of the world, for we are found under every sky, wastefully exploiting nature's gifts to the race. A method of agriculture which over large areas has robbed the soil of its fertility, and a method of lumbering which has taken no care of the younger trees, with frequent forest fires destroying millions of dollars worth of timber, have hardly troubled our consciences.

During the last few years, however, a more enlightened sense of values has been making itself felt. In some businesses the dump heaps of former years have become the great sources of profit. We have further begun to realize how enormous are the resources lying unused and wasted around us, and the best powers of science are being devoted to the task of finding the best means of putting these to human use.

So rapidly are we laying under contribution the forces of nature, increasing human efficiency by millions of horse-power and lifting burdens from human muscles, that we may hope very soberly for the time when the manufactured wealth of the world will be so great that drudgery will be almost totally eliminated from human life, and the wealth produced through these borrowed powers be so abundant that poverty will be practically unknown. All that remains after physical science has done its work is that social science shall lead us to a condition of society in which wealth will be more evenly distributed than it is at present. The promise of this is already above the horizon.

The physical resources of a country are limited and unrenewable. Such are coals, our gold, iron and all other mineral deposits. The more rapidly we exploit these the sooner they are used up, never to be at the service of the world again. The ancient bituminous and anthracite coals, and the modern lignites can never be restored. Why should we be in so feverish a haste to use up these assets of the world which belong to future ages as well as to ourselves?

The second class of resources are those which are perennial and exhaustless, because they are perpetually renewed, such as growths of our fields and our forests, the flow of our waters, and the force of our winds. All these depend upon the force of the sun, and from year to year they are reproduced. Emerson said: "Hitch your wagon to a star," and that nation which builds its prosperity on a wise utilization and conservation of these resources may keep its population and its prosperity as long as the sun shines.

Utilization of the Wind.—The first of these of which I shall speak is the force of the wind. The difficulty in using this force is found in the fact that it is a widely diffused force, and is fitful in its operation. If we can economically capture it and store its energy so that it will be at our call whenever we wish to use it, it may be made of immense service.

The winds of Saskatchewan are nearly equal to a nine-mile breeze blowing day and night from June to June. The total force of this is equal to a thousand Niagaras. Can it be utilized? It is interesting to note in these days of the supremacy of steam power that of the forty thousand vessels which comprise England's merchant marine, thirty thousand are yet wind-propelled. It was the wind power which carried the Anglo-Saxon Celt around the world, and it is seen that he is depending in a large measure upon it still. I call your attention to the following recent developments. It has been found that a comparatively slight change in the shape of the fans in a wind motor will give almost double the power. It has further been shown that the wheel of a hydroplane working in the air is more efficient than a wheel working in the water. If, therefore, these two discoveries are made good use of, we may expect to find very much more efficient wind motors than we have known heretofore.

The development of the storage battery is being rapidly promoted, and the increasing efficiency of dynamos points to a time when the energy of the wind will be economically stored. We have all heard of the Edison storage battery, which may be charged and discharged at any rate without injury to the battery. In the common lead battery Prof. Hannover, of Copenhagen, has discovered a method of making what he calls "pore" lead, which increases the capacity of a battery about four times. On the basis of such advances as these we may look for the time when the electric automobile will be the common automobile throughout the country, and wind stations, with their installation of windmills, will be as marked features of the prairies as the grain elevator is at present.

Clay Resources.—The next great asset of this country of which I shall speak are our practically omnipresent clays. These clays have been produced from the original granites of the earth, through the action of water, rain, and moving ice, and by streams they have been deposited in their present beds. They are thus produced indirectly by sun power throughout millions of years of the earth's past history, and are being produced and laid down today. They therefore belong to the exhaustless resources of the world, even though their quality was not as great as it is. The clays of these prairie provinces will yet prove to be, after the fertility of the soil, the most useful asset of the people. Their variety is so great, the new methods of manipulating them is so efficient, that there are but few of them which cannot be put to commercial use. Structural material, such as wood and iron and stone, will always be dear in these prairie provinces. In the clays we must find our substitutes. Leaving out of account the Portland cement, which requires lime, in addition to the clay, we need only speak of the use of the clay for building purposes, in the form of bricks, tile, pillars, decorative panels and pottery, and for road-making purposes.

I could show you some specimens of bricks and pieces of pottery, which have been made out of clays which were deemed to be almost hopeless. When this much can be realized with these, we may speak hopefully of all other clays. In China the clay-workers of one generation dig the clay for the next. Modern methods enable us to produce an equal amelioration of the clay in ten days, instead of thirty years. Each clay-bed, however, needs to be subjected to careful experimental tests, and this should give results definite enough for wise investment.

We all know what a trial our clay is when wet, to those who try to haul loads along our roads. It has been

* Read at the 8th Annual Convention of the Union of Saskatchewan Municipalities, June 26th, 1913.

found that if we subject the clay, which has been compacted somewhat by road traffic, that if it be piled up in beehive shape kiln, and well burned, we get a material devoid of all stickiness and in its smaller particles very hard, and quite porous to water. This substance will grind under traffic into a dust. But this may be counteracted by a judicious mixture of raw clay.

The experimental road which was laid down for the government was built in this manner. A narrow trench was dug along the centre of the road. In this a tile drain was laid, and then covered in with burnt clay, hammered down. Then a layer of straw was laid over the clay of the road, and over that eight inches of burnt clay containing 25 per cent. of raw clay was laid over the surface as the road metal. The whole was then well rolled with a heavy roller. This portion of road is standing up well under traffic, dries quickly, does not load the wheels, and is showing the same properties which most of you are familiar with in many parts of the country where sand and clay have been mixed by nature in such proportion that bad roads are seldom found. All such a road needs is that it shall be dragged after every rain with a split-log drag. It looks as if it could be depended upon to give a clean, satisfactory road at all seasons of the year. It is very easy also to treat such a road when it is wet, by hauling over it either the split-log drag or the lap-drag backwards.

Another suggestion which I have made has not yet been put to experimental test. I have thought that the marble-like hardness which our gumbo acquires, when it dries under traffic, could be made use of to give us a firm foundation for asphalt roads, in place of the costly concrete. Certain it is that if water be kept out of it, it will stand the heaviest kind of traffic, even without the protection of an asphalt sheet. To conserve the hardness of the gumbo base, I suggest the laying of a central underdrain with cut-offs to the side ditches, so placed that whichever way the wind blows they may cause a movement of dry air through the heart of the road. I am in hopes that some form of this road will make the asphalt road cheap enough to become a country road proposition, at least on those roads which are subjected to the heaviest traffic.

The burnt clay, when properly prepared, is found to have the properties of good sharp sand. It may, therefore, replace sand in ordinary mortar. Word has come that the British Government specify this for some of the work done in India. A homesteader, therefore, may out of the clay dug from his cellar find a substitute for sand. This ought to prove of great value to homesteaders who are miles away from a good sand-pit.

A little special treatment will also produce a very fine material which can take the place of costly broken stone in asphalt and concrete work.

Fuel Production.—The last subject before you is that of the possible utilization of the great stores of fuel which we have in the straws which are burned in so immense quantities each year on the prairie.

Various authorities state that the amount of combustible gas in straw amounts to twelve thousand cubic feet per ton. The writer's measurement, without being made very exact, supports this estimate. Personal analysis of the straw shows the following:—

Volatile hydrocarbons, 64 to 72 per cent.
Moisture, 6 to 10 per cent.
Fixed carbon, 21 to 24 per cent.
Ash, 6.5 to 8.2 per cent.

If 25 to 30 per cent. of the volatile matter be driven off, that is, the moisture and the hydrocarbons, we have a slightly charred mass, which is very brittle, is very similar in composition to good dried lignite, and has a calorific value of eight thousand seven hundred B.t.u. This I have named "Lignite Char." If 70 per cent. of the weight be driven off, in the form of volatile matter, then a char similar to anthracite in many of its qualities, and of very similar chemical composition, is left as a residue. This I call "Anthracite Char." Both of these residues can be readily made into briquettes, named respectively "straw lignite briquettes" and "straw anthracite briquettes." It is possible to manufacture any grade between these two extremes.

The purpose of this study was to find whether it is possible to make a portable machine which would go from farm to farm, after the manner of a threshing machine, and using the materials on the farm, manufacture a farmer's fuel. It is found that the slight charring of straw solves the problem of reducing the straw to a powder fine enough for briquetting, and also that pulped potatoes forms an excellent material for binder. Beet sugar waste also is a very satisfactory binder. One ton of straw will produce 1,400 pounds of briquettes. If we allow 400 pounds to be used up in producing the charring of a ton, then one ton of straw will yield a thousand pounds of fuel. If we count the yield of straw as one ton per acre, then one-half section of wheat or other grain will yield 160 tons of fuel, equal to the best lignite. Three acres of potatoes will supply sufficient binder for this quantity. It will thus be seen that the farm may not only produce all the fuel necessary for household and power purposes, but the small towns or villages may be supplied with fuel from the neighboring farms. As the fuel may be cheaply produced, it opens up the possibility of cheap fuel, and therefore of small manufactures through the province. Wherever the homesteader goes, there can be found his fuel without haulage and freight charges.

How enormous the possibilities are will be shown from the following: Suppose we think of a square forty miles each way, with Regina as the centre. If 24,000 acres be left out for the city and vacant places, and supposing that one-half the remaining area is given to grain crops, 250,000 tons of this fuel may be produced every year for all time, nearly all of this coming a distance of less than twenty miles from the city.

The importance of this kind of work must be evident to all. If it is done, it must be thoroughly done, and with fully adequate equipment. I need scarcely appeal to the members of this influential body to heartily support the government to carry on this kind of work, whether it be directly under government auspices, or by the university. In the work that I have done, the discovery that our clay would make a substitute for sand at a cost of 50 cents per cubic yard, as against $1.80 to $2 for natural sand, when it comes to be used as largely as it may, will repay many times over every year all that these initial researches have cost. All future development must depend first of all on the application of scientific research and scientific principles to the problems which arise in connection with the development of the enormous resources of a province such as this. No investment of money can pay as well.

More durable and elastic than ordinary macadam is said to be a new pavement laid in Paris with a bottom layer of concrete, an intermediate one of concrete mortar reinforced with iron rods and a surfacing of crushed stone and mortar.

REINFORCED CONCRETE PONTOONS FOR A MODERN FLOATING BOATHOUSE.

By D. C. Findlay, B.Sc., A. M. Can. Soc. C.E.

The universal presence of the "teredo" in the salt water of the ocean renders very short the life of wood used for supporting floating boathouses, etc. Likewise, steel pontoons require special surface coating and frequent inspection to ensure against their being corroded by the salt water.

In the design of the modern boathouse described below, concrete was used for the novel purpose of building the pontoons, as it is unaffected by either, if properly constructed. Fig. 1 shows the outside form assembled and the reinforcing in position. The walls and floor are only 2½ inches thick and consequently the design and installation of the reinforcing required great accuracy and care. Half-inch square bars were carefully bent to the shape of the shell, carried along the bottom and up the sides. These bars were spaced about 18 inches centres, and the ends of longitudinal ½-inch bars were carefully looped to accurately fit the ½-inch vertical bars. One of these bars was driven down with a sledge until it was 1 inch from the bottom on each side. A second bar was placed on the top on either side and across the ends. This

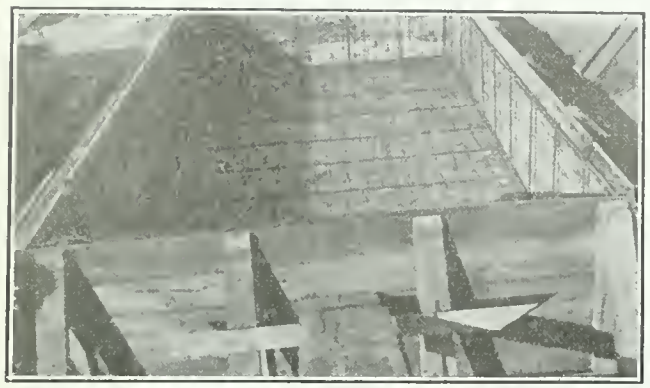


Fig. 1.—Pontoon Form Showing Reinforcing.

formed a very rigid skeleton steel frame of interlocked bars which could not be displaced, and which afforded ample support for fastening the intermediate bars in position. On this framework was carefully spread triangle wire mesh, style No. 26. The lengths were cut and formed so as to extend along the bottom longitudinally and up the two ends, and the sides were treated likewise. The wire mesh was carefully wired to ½-inch bars at every intersection. At about 20 inches from each end a special reinforcing bar had an eye welded to it, projecting above the top of the finished side wall. This enabled chain blocks to be applied for launching, and furnished means of attaching ropes for towing to the site of the boathouse.

This building is 100 feet long by 27 feet wide with a clear height of 17 feet 6 inches to the bottom of the roof truss. Calculations to ascertain its weight determined the most economical size of pontoon to be 16 feet long by 7 feet 6 inches wide and 30 feet deep.

Fig. 2 shows one of the finished pontoons in the water after launching. A centre partition was built into the side walls and floor and consisted of "ferro-dovetail" sheets with their ends projecting 1½ inches into the walls and plastered with concrete on both sides. This stiffened the walls and made two separate water-tight compartments.

For attaching the sills of the boathouse ¾-inch bolts, threaded at the ends, were set into the concrete about 3 inches off the centre of the pontoon, to which the 6-inch by 8-inch sills of the boathouse were bolted. This offset was calculated sufficient to withstand the extra weight of the roof slab and to cause the pontoon to float properly in the water.

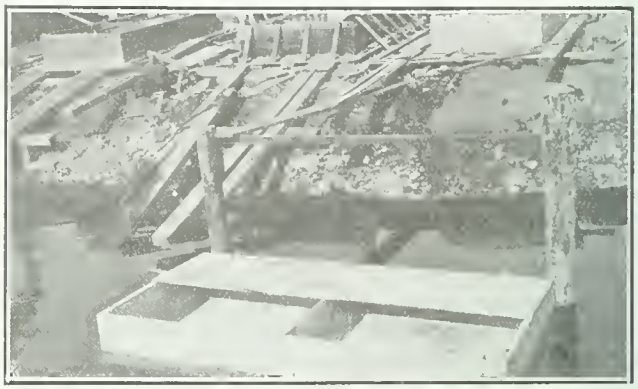


Fig. 2.—Finished Pontoon.

It may be noticed that the roof slab extends on one side only. Further, the end walls were cast with a 2-inch fall from the centre. This portion of the pontoon is outside the building line and the roof sheds the rain. The roof is made of "ferro-dovetail" sheets ⅝-inch in depth of groove, resting on the centre partition wall, and fastened to the ends and side by ⅜-inch carriage bolts placed in the green concrete. Both top and bottom of the sheets were then plastered with a 1:2 mixture. The finished roof slab was only 1¼ inches thick, but possessed remarkable strength and absolute watertightness.

In order to get all the buoyancy possible, every pound of unnecessary weight had to be eliminated. As constructed, the pontoons weighed about 8,000 lbs. and, on launching, floated to within ¼ inch of calculated water line. Each pontoon supports a live load of about 7,800 pounds.

The boathouse under description has 11 pontoons under it, five on each side and one on the forward end, while the other end of the building, containing the large swinging doors, as shown in Fig. 3, was tied together by a 1½-inch iron bar attached by galvanized bolts to the top of the pontoon, and passing between guide bolts set in the bottom, so as to distribute the load in a vertical plane. The horizontal part of the tie rod was 6 feet below water, allowing a yacht to pass over it in entering the boathouse.

The building is rigidly built, and the roof supported by trusses, both roof and walls being covered with a special V crimp, galvanized iron, with a panelled lattice running around the entire building. Manholes in the floor allow for inspection of the inside of the pontoons, which are used for storing light material used about the yacht. At one end it is held in position by a reinforced concrete pile 24 inches square, and by a floating boom attached to the shore at the other. A floating fender attached by spreaders to the sill was installed to prevent the yacht ramming the pontoons in making a landing alongside the boathouse.

In constructing the pontoons, 3 casting floors of shiplap were built on the beach and carefully levelled up. These served as forms for the bottom of the pontoon and two sets of collapsible wood forms were then made up, which were used 15 times in all. The outside forms were first set up and the reinforcing carefully placed and supported from the bottom by small concrete blocks which were cast into the floor. The floor was then poured, using a wet mixture of 1 part cement and 2 parts sand. This covered the steel completely, and was very thoroughly tamped to fill all the voids.

A mixture of 1 part cement, 2 parts sand and one part screened gravel of ½ inch maximum size was then poured on the top and brought to a depth of 2½ inches. The collapsible inside form was then quickly set in place, and braced into alignment, and the concreting of the walls continued without a break. Very great care was used in the mixing, and especially in tamping the thin walls, to insure the steel being thoroughly enclosed and all air expelled. Very gratifying results were obtained, as of the 15 pontoons built, not one of them showed any indications of dampness of any sort when launched. They have been in the water now for nearly nine months.

Fig. 3.—Showing Pontoons in Place.

Forms were stripped in about 36 hours and allowed to season until thoroughly set, when a frame was placed over each end. Chain blocks were used to lift the pontoon clear of the floor, when launching timbers 10 by 14 inches were placed under on rollers. At high tide the pontoon was about 6 feet above the water. An incline runway was built, extending into the water, and a temporary roof built over the open side of the pontoon to prevent shipping water on launching. Two men with bars easily pushed it off the floor and it took the water very easily. A motor boat then took it in tow for about a mile to the site of the boathouse.

Accurate account was kept of the cost, which amounted to $78 including launching, for each pontoon.

Considering their indestructibility, they are far superior to anything else in use, and prove conclusively that concrete itself, if well placed, is a sufficient waterproofing agent, as no waterproofing was used in the concrete.

The pontoons and boathouse were designed and built under the direction of Mr. D. C. Findlay, A. M. Can. Soc. C.E., chief engineer of the Vancouver Portland Cement Company, Limited, of Victoria, B.C., for Mr. R. P. Butchart, managing director of the company.

MACADAMIZED ROADS CONSTRUCTED WITH TARRY, BITUMINOUS OR ASPHALTIC BINDERS.

At the third International Road Congress the third question, "Construction of Macadamized Roads Bound With Tarry, Bituminous or Asphaltic Materials," was discussed by representatives from twelve different countries. Interests on this side of the Atlantic were looked after by Professor A. H. Blanchard, of Columbia University, and consulting engineer of New York; Major W. W. Crosby, chief engineer to the Maryland Geological Survey, and consulting engineer of Baltimore, and Prevost Hubbard, Department of Roads and Pavements, the Institute of Industrial Research, Washington. The following is taken from Professor Blanchard's paper, which dealt with bituminous surfaces and bituminous pavements constructed by the mixing methods, and refers to progress made during the past three years:

In order to avoid continual explanations and the use of long expressions, the following definitions are given:

Bituminous surfaces consist of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character.

Bituminous concrete pavements are those having a wearing surface (crust) composed of stone, gravel, sand, shell or slag or combination thereof, incorporated together by mixing methods.

Bituminous concrete pavements which have been used in the United States during the past three years and of which broken stone forms an integral part may be grouped in three classes dependent upon the character of the mineral aggregate.

Type A consists of so-called one size crusher run broken stone mixed with bituminous material. This description of broken stone refers to the product obtained at a crushing plant which passes over a screen having holes of one size and through a section of screen having the next larger size holes or which passes through a screen of one size of holes and is retained upon a screen having smaller holes.

Type B consists of one size crusher run broken stone as defined above and sand or other fine mineral matter mixed with bituminous material.

Type C consists of a predetermined graded aggregate usually composed of broken stone and sand with or without other mineral matter mixed with bituminous material.

Foundations and Drainage.—The following statements contained in the 1912 Report of the Special Committee on "Bituminous Materials for Road Construction" of the American Society of Civil Engineers embody the underlying principles of the best current practice relative to foundations, subdrainage and surface drainage.

Sub-Grades and Foundations.—Your Committee believes that the use of any form of a bituminous wearing surface does not preclude the necessity for the construction of a well-drained, thoroughly compacted and adequate sub-grade. In fact, such improvement of the road surface frequently attracts heavier traffic, and thus increases the stresses in the sub-grade.

Crown.—The investigations and observations of the Committee to date have convinced it that the crown generally used in construction of macadam roads is excessive when bituminous materials are used, and that a crown of even ½ in. to the foot should be avoided when a lesser

crown can be secured without detriment to the surface drainage.

The above report will hereinafter be designated as the "Am. Soc. C.E. 1912 Report."

Sizes and Shapes of Broken Stone for Bituminous Bound Surface Crust.—Bituminous surfaces have proved more efficacious when constructed on macadam roads composed of well compacted and thoroughly bonded broken stone ranging from ¾ in. to 2 ins. in the wearing surface than when the stone is of smaller dimensions. This size of stone is usually obtained by passing over a screen having 1¼-in. holes and through a screen having 2¼-in. holes.

Bituminous concrete pavements. Type A.: The best results have been secured by using a mineral aggregate composed of broken stone varying in size from stone passing a 1¼-in. laboratory screen to a small amount passing a ¼-in. screen. This product is usually obtained from the ordinary type of crushing plant from stone passing over a ½ or ⅝-in. screen and through a section of a screen having holes 1¼-in. in diameter. A typical analysis of such a product follows:

Per cent. passing ¼-in. screen	5.4
Per cent. passing ½-in. screen	34.7
Per cent. passing ¾-in. screen	40.6
Per cent. passing 1 -in. screen	17.3
Per cent. passing 1¼-in. screen	2.0

The following excerpt from the "Am. Soc. C.E. 1912 Report" bears especially upon the construction of Type A.:

Your Committee recommends that trap rock in sizes greater than that passing a 2-in. screen should be used with caution in the construction of the upper course, unless the voids of the same are properly reduced, because of the liability of the individual stones to rock under traffic.

Type B.: The mineral aggregate has been composed of a combination of one size crusher run broken stone and one or more grades of sand or stone screenings. The mechanical analysis of a typical combination covered by the description, two parts trap rock passing a 1¼-in. ring with a maximum of 5 per cent. dust and one part sand, follows:

Per cent. passing 200-mesh screen	3.3
Per cent. passing 80-mesh screen	6.9
Per cent. passing 10-mesh screen	29.7
Per cent. passing ¼-in. screen	25.1
Per cent. passing ½-in. screen	24.3
Per cent. passing ¾-in. screen	10.7

Type C.: One class of mineral aggregate which has been used to a considerable extent during 1911 and 1912 is known as the "Topeka" grading and is usually composed of broken stone and sand with or without a filler of fine material. The grading for this mixture is covered by the following limitations in the mechanical analysis:

Per cent. passing 200-mesh screen	from 5 to 11
Per cent. passing 40-mesh screen	from 18 to 30
Per cent. passing 10-mesh screen	from 25 to 55
Per cent. passing 4-mesh screen	from 8 to 22
Per cent. passing 2-mesh screen	less than 10

Many bituminous pavements of Type C with proprietary names are laid in the United States. Among these may be mentioned "Bitulithic" and "Warrenite."

Use of Partially Worn Materials in Bituminous Bound Surface Crust.—The universal practice has been to condemn the use of materials, which have been previously employed, for the mineral aggregate in the construction of bituminous concrete pavements.

Thickness and Composition of the Strength Crust and of the Super or Wearing Crust Under Different Conditions.—Bituminous surfaces: A thin coat of the proper kind of bituminous material has given better satisfaction than the formation of a comparatively thick carpet, especially when the surface is subjected to excessive horse-drawn vehicle traffic.

Bituminous Concrete Pavements: Type A is usually laid upon a foundation course of broken stone having a thickness varying from 4 to 8 ins. Type B is laid on a broken stone foundation course as indicated for Type A or a cement concrete foundation, 5 to 6 ins. in thickness. Type C is laid on a broken stone or a cement concrete foundation as mentioned for Type B. It is being recognized as a fundamental principle that where Type C is used under conditions which render it economical and suitable, only the cement concrete foundation should be employed. The necessity for constructing strong foundation courses due especially to the rapid development of motor truck traffic is apparent. For Types A and B the thickness of the wearing surface has varied from 1½ ins. to 3 ins., the average being 2 ins. For Type C, when a fine mineral aggregate is employed, 1½ to 2 ins. has been used, the best practice favoring 2 ins. Pavements with mineral aggregates having larger broken stone are generally laid 2 ins. in thickness, although 3 ins. has been used in some cases.

Life of Surface Crust Under Different Conditions of Traffic, Weather, Subsoil, etc.—Bituminous surfaces: The life depends primarily upon the character of the material and the amount and kind of traffic. Bituminous surfaces on macadam roads have a life of from one to three years and on bituminous concrete pavements from one to five years.

Bituminous Concrete Pavements: As with all types of bituminous pavements, the life of the wearing surface depends, to a large extent, upon the character of maintenance. Granted proper construction, including adequate foundations and drainage, and continual maintenance, which includes the use of seal coats applied periodically, the life of bituminous concrete pavements, based upon such information as is at hand, may be estimated at from 20 to 35 years. This estimate is based upon the supposition that the various types of bituminous concrete pavements are used under conditions for which each is suitable. More definite information is at hand covering the life of pavements which have not been maintained. The following estimates cover average life without maintenance: Type A, 4 to 10 years; Types B and C, 7 to 15 years.

Relative Importance of Patching, Repairs and Periodical Renewals of Surface Crust. Extent of Wear Permissible Before Renewal of Surface Coating.—All types of bituminous surfaces and pavements are liable to develop weak spots. Patching in these cases is found to be economical and practical as it is comparatively simple to replace a portion of a bituminous concrete pavement or a macadam road. Likewise periodical renewals of bituminous surfaces are efficacious. This method of repairing will be economical until such time as the pavement begins to generally wear out or disintegrate.

Measurement of Wear and Appliances Used for This Purpose.—Work of this character on bituminous concrete pavements has been limited to that of a few investigators,

all of whom have used the method of periodically taking accurate elevations in order to determine the amount of wear.

Various Methods of Bituminous Treatment. (a) Mixing Methods.—(1) in Factories; (2) on the Spot.—Type A.: In 1910 practically all of the bituminous pavements of this type were constructed by hand mixing methods. In very few cases was the broken stone heated. During 1911 and 1912 there has been a general abandonment of hand mixing methods and a substitution therefor of various machines especially designed for the heating of the mineral aggregate and the mixing of it with bituminous materials. The introduction of these machines has made possible the use of the most suitable types of bituminous materials. Generally this type of mineral aggregate is mixed in portable mixing plants at the roadside.

Types B and C.: The mineral aggregate of these types of pavement has during 1911 and 1912 been universally mixed in a special machine designed to heat the mineral aggregate and mix with it the bituminous material. The location of the machine depends upon local conditions. In some cases the mixing plant is located at a railroad siding at which both the broken stone and the bituminous material are available and in other cases, near the road to be constructed. In some instances large mixing plants have been installed in municipal yards. Type C is also manufactured in the form of asphalt blocks at factories. The following reference to heated aggregates in the "Am. Soc. C.E. 1912 Report" is pertinent:

Your committee recommends that in the use of a heated aggregate for the construction of a bituminous pavement, non-uniformity or excess in the heating of stone, such as usually occurs with the use of flat plates or similar crude appliances for this purpose, should be avoided.

All of the above types have been constructed with and without a seal coat of bituminous material. The best practice, however, favors the use of a seal coat.

(c) **Carpeting Methods:** In the case of macadam roads, the mode of procedure is to thoroughly clean the surface by sweeping with hand bass brooms or horse sweepers or a combination of these methods. The bituminous material, which is generally heated, is applied to the surface with the aid of pouring cans, hose attached to gravity tanks, hand-drawn gravity distributors, horse-drawn or power-driven gravity distributors and pressure distributors. After a varying interval, some kind of mineral coating is generally applied to cover the bituminous material. The construction of bituminous surfaces on bituminous concrete pavements during the construction of the latter is usually accomplished by the use of brooms, squeegees or hand-drawn gravity distributors. For a periodic application of bituminous materials all the above methods are used.

Relative Advantages and Use of Tar, Tarry Compounds, Asphalt, Bitumen, and Other Materials. Tests and Chemical Analysis of Tarry, Bituminous and Asphaltic Compounds.—Bituminous surfaces: Since 1910 there has been slowly crystallizing an objection to the use of bituminous materials on macadam roads which require from one to three weeks to "set up" to such an extent that tracking will not occur. Refined coal tars and water gas tars, combinations of asphalts and tars, and certain asphalts have given satisfaction in this respect as they have "set up" satisfactorily within 6 to 48 hours. Usually about ½ gal. per square yard has been used which has been applied either in one or two applications. In the construction of bituminous surfaces at the time of the building of macadam roads, it has been found possible to employ the same grades of asphalt as are employed in the construction of bituminous pavements by penetration methods provided large stone is used in the surface and the latter is dry and thoroughly broomed.

Bituminous Concrete Pavements: In the construction of both the mix and the seal coat of Types A, B and C, asphalts, possessing the proper physical and chemical properties, have given excellent results. Coal gas and water gas tars have been used in the construction of Type A and to a very limited extent in the construction of Types B and C. In the construction of Type A, coal tar has been used in the mix and an asphalt for a seal coat with satisfactory results. The use of high carbon tar of a certain consistency does not appear to give satisfaction as a seal coat when the traffic includes many horse-drawn vehicles. Compounds of asphalt and tar have been used in the construction of Type A and to a limited extent in the construction of Types B and C.

The amount of bituminous material used is expressed as either so many gallons per square yard of wearing surface or as a given per cent. by weight of the mix. In the various types mentioned, the amount of bituminous material used varies from 5 to 10 per cent. by weight.

Climatic Effects Causing Slipperiness of the Roadway—Remedies.—In some cases bituminous concrete pavements with seal coats of tar and certain grades of asphalt have been slippery, especially in cold weather. Many types of bituminous pavements are rendered non-slippery by the application of an additional covering of stone chips or pea gravel.

Effect on Public Health, Fish Life, or Vegetation.—The effect of using bituminous surfaces and bituminous pavements has been beneficial from the above standpoints except that the odors characteristic of certain asphaltic oils are obnoxious.

Specification of the Methods of Construction.—Detailed specifications have been drawn up covering the construction of bituminous surfaces and the various types of bituminous concrete pavements referred to above. These specifications generally cover the quality and size of the various components of the mineral aggregate, the physical and chemical properties of the bituminous material and detailed descriptions of the methods to be used in mixing and in the laying of the wearing surface. Typical detail descriptions of methods are covered by the following references:

Bituminous surfaces: Trans. Am. Soc. C.E., 1911, Vol. LXXIII., pages 44-73, and 1912, Vol. LXV., pages 548-571. Bituminous concrete pavements. Types A, B and C: Trans. Am. Soc. C.E., 1911, Vol. LXXIII., pages 99-135, and 1912, Vol. LXXV., pages 572-648. Type A: Borough of Queens, N.Y., Special Report, 1912. Type B: 1911-1912 Specifications, Washington, D.C.; 1912 Specifications, Lincoln Park, Chicago, "Good Roads," April 6, 1912. Type C: 1911 Specifications, Borough of Richmond, N.Y.; 1912 Specifications, Borough of Queens, N.Y.; 1912 Specifications, New York State Highway Commission, 1912 Specifications, City of Philadelphia.

Cost Data.—Bituminous surfaces: The average cost of constructing a bituminous surface, using 0.5 gal. per square yard with either an asphaltic or a tar product or a combination of the two, is 7 cents per square yard.

Bituminous Concrete Pavements: Besides variations dependent upon local conditions, the cost varies with the

kind and quantity of the bituminous material used, the character of the aggregate and the type of construction employed. Type A: Using an aggregate of one size crusher run stone mixed 1.5 gals. of bituminous material per square yard of 2-in. wearing surface and a flush coat of 0.75 gals. per square yard, the cost varies from 25 to 35 cents in excess of water-bound macadam. Types B and C: The cost of pavements with mineral aggregates of broken stone and sand, with or without other fine material, varies from $1 to $2.25 per square yard including the foundation course and light grading.

Cleansing and Watering.—Bituminous surfaces and bituminous concrete pavements constructed on highways outside built up districts when subjected to considerable motor car traffic are found to remain clean and practically free from dust. When subjected to excessive horse-drawn vehicle traffic in suburban or urban districts, the practice of periodical flushing at night has proved efficacious. Sprinkling with water bituminous surfaces and bituminous concrete pavements is universally condemned as tending to shorten the life of pavements and as being characteristic of uneconomical administration of street cleaning.

THE RAILWAY TIE SITUATION IN EASTERN CANADA.

By E. S. Clements,

The timber supply in Canada is by no means extraordinarily large. From the best information regarding the forests of Canada as a whole, the standing timber totals about one hundred and twenty billion cubic feet, or about fifteen thousand cubic feet per inhabitant, based on the present population. Merely as a matter of comparison, there are in the United States about five hundred billion cubic feet of standing timber, or about six thousand cubic feet per inhabitant.

So that there is only one-fourth as much available merchantable timber in Canada as in the United States, even though there is about 2½ times as much available timber per inhabitant in Canada as in the United States. It must also be considered that to a large extent the timber standing in Canada is quite small, and the amount of merchantable timber per square mile is not very great, particularly in northern forests. This explains the fact that while there are extensive forest areas in Canada, much larger than the present standing forest areas in the United States, relatively there is not the supply of timber in Canada that there is in the United States.

In the eastern portion of Canada the wooded areas along the lakes and the St. Lawrence River have been practically cut off. Lumbering operations in the territory near the lakes and the St. Lawrence River stopped some years ago. The lumber cut off was mostly white pine, but the forests have been pretty thoroughly cut up where they could be reached from the stream.

The principal lumber supplies now for Eastern Canada are the Georgian Bay district, the north shore of Lake Superior and the Ottawa River district. Mills in these sections are cutting Norway pine, spruce, hemlock, tamarack and jack pine. These are the principal woods so far as lumbering operations are concerned. They are what are called workable woods at the present time. There is, however, a large amount of hard wood, particularly in the territory which has been logged over. There is a good deal of hard wood available in the territory between Georgian Bay and the mouth of the Ottawa River, and between the Ottawa River and the lake. This timber has not been cut to any extent. The principal hard woods in this territory are birch, beech and maple. There is practically no oak.

There were 13,683,700 cross-ties purchased in Canada in 1911. The timber at present being used is cedar, spruce, tamarack, hemlock, jack pine.

There is, as stated before, hard wood available, but it is of such a character that it will rot very quickly in the track unless previously treated. The timber at present used is, of course, of a softer and weaker character, and in order to get stronger timber some of the railways have imported longleaf hard yellow pine ties from southern United States. The native woods which are used, excepting cedar, have a life averaging, say, seven years. Some of the woods, like jack pine, have less life than this. Under the present requirements of speed and load, these woods cut very quickly, and it is difficult to hold the track to gauge. This, of course, can be remedied by the use of tie plates, but the woods, excepting cedar, are very short lived and it does not pay to use the tie plates. The ties themselves rot nearly as quickly as they wear out.

A good, sound cedar tie is a most satisfactory railway tie for lighter loads. It gives a long life under light traffic conditions, and is most economical. For heavy traffic conditions and high speed, however, the cedar tie does not make a safe track, even with tie plates. As an example, the Michigan Central Railroad, on its main line, has found it absolutely necessary, as a matter of providing safe track for its high speed heavy trains, to abandon the use of cedar ties. Furthermore, for the railways located in Eastern Canada, generally speaking the cedar tie is becoming somewhat scarce and the quality available has deteriorated very materially. Consequently the Canadian railways have, in the effort to make safe tracks, imported hard pine ties from the United States, even going so far as to import yellow pine ties from Louisiana, hauling these ties 1,500 miles. It is, therefore, of great importance to note that there are hard woods available in Canada at present which, when properly treated with creosote oil, will give most satisfactory results as well as being economical.

Beech, when sound, is stronger than white oak It is very much stronger in compression across the grain than is white oak. Creosoted beech ties which have been used on the Big Four Railway in the United States for over eight years under comparatively heavy traffic show very little rail wear. The most important information as to the use of creosote in beech ties comes from France. Creosoted beech ties in that country give from twenty to thirty years' service. Creosoted beech ties have also been used on the Prussian States Railway in Germany.

The birch tie also lends itself to preservation. Its sap wood can be penetrated thoroughly. There were put in on the New York Central Railway about 1,100 birch ties treated experimentally at Shirley, Indiana, about seven years ago. These ties are at present sound, and their appearance is such that the New York Central Railway has started a campaign to get all the birch ties possible in the Adirondack territory.

Maple ties, that is the hard maple, compares favorably with beech. The sap wood can be thoroughly penetrated with creosote. Of the other woods the jack pine is the most permanent so far as creosoting is concerned. This wood being softer, it is imperative that large tie plates be used. If it is not done the ties will be rail cut long before they begin to decay.

The old English railway tracking practice was to inject from eight to ten pounds of creosote oil per cubic foot of wood. Results from this were such that Baltic fir ties (a soft

pine tie) lasted from fifteen to twenty-five years. It could not be considered good practice, on account of the loss through evaporation, to use less than eight pounds of creosote oil per cubic foot of wood. In the United States the American Creosoting Company, in creosoting some eight or nine million ties per annum, leave in these ties about eight pounds per cubic foot of wood. The actual figures used in this work are:

2¾ gallons of creosote oil for a 6" x 8" x 8' tie.
3¾ gallons of creosote oil for a 7" x 9" x 8½' tie.

Although in the treating of these ties the old English minimum of eight pounds per cubic foot is closely adhered to, these ties are treated by the Lowry process. This process is to inject in the tie an amount of oil in excess of the specified amount to be left in the tie (2¾ gallons of creosote oil for a 6" x 8" x 8' tie), this amount running up to 3¾ gallons for oak and as high as 5 to 6 gallons for pine, and sometimes even higher. The excess amount of oil is withdrawn by high vacuum, only the specified amount of oil being left in the tie. This means that the thoroughness of the penetration of the wood is as good as when twelve to fifteen pounds of oil are used by the common creosoting process, whereas actually only about eight pounds per cubic foot is left in the wood.

The most important element in creosoting wood is a thorough and deep penetration of the creosote oil. Although the old English practice for railway ties was to use from eight to ten pounds per cubic foot, in order to get better penetration present railway practice requires more than this. Ties treated by the ordinary creosoting process means the use of extra oil. By the Lowry process fully as good results are obtained, if not better, with less oil.

The most important element in creosoting timber is to have the timber properly prepared before the injection process is started. It was formerly the practice in the United States to steam timber and artificially season it. It has been proven, however, that steaming is bad practice. It is important to season the timber in air before the creosoting is started. Thoroughly air seasoned timber not only can be more thoroughly penetrated with creosote, but is stronger than green timber. To have thorough air seasoning, it is, of course, necessary to provide the ties sufficiently in advance of the time at which they are to be treated. For beech, birch, maple, jack pine, etc., the seasoning period ranges from five to eight months.

The world's highest-head water-power plant is now nearing completion at Martigny, Canton Wallis, Switzerland. The fall utilized is 5,400 feet, and the pipes conveying the water from the head of the fall to the power-house, a distance of three miles, are specially remarkable. The pressure gradually increases with the fall till the lowest part is reached, where the pipe, having to withstand 2,500 pounds per square inch, had to be made of special ingot-pressed steel. The turbines, which are of the Pelton type, have a total rating of 15,000 h.p. and it is of interest to note that, with the 5,400-foot head, only about 30 cubic feet of water per second will be necessary to develop the full 15,000 h.p. output of the station.

The Toronto Exhibition Grounds, the scene every year of the great Canadian National Exhibition, contains buildings to the value of $2,500,000. Its paved streets and street and interior lighting equipment has no rival on this continent. Over 40,000 lamps are in use during exhibition period.

COAST TO COAST.

Winnipeg, Man.—Complete reorganization of the high-pressure plant, including electrification of the whole equipment, is contemplated by the board of control. At present the whole plant is operated by gas engines supplied with gas from a producer plant in the building. The big container is falling into disrepair and the necessity of making repairs has brought to a head the proposition to change the plant so that electricity, of which the city has so much at small cost, will be the mainstay in operating the immense high-pressure pumps, while gas will be used only as a "standby." Acting on a specific recommendation from City Engineer Ruttan, the board is calling for tenders for two new pumps, which will add 20 per cent. to the pumping capacity of the present plant. It is the intention, when the new pumps are installed, to proceed with repairs to the big gas retainer, which is not in very good shape. The new pumps will supply any temporary deficiency in pumping power while the gas container is being repaired, as they will be connected with the electric power. When this is completed, it is proposed to proceed gradually to change the present equipment of the pumps so that they may be operated directly by electric power, but can be shifted to gas power on a moment's notice. It is estimated that the electrification of the plant would cost in the neighborhood of $50,000, but this amount would soon be saved by cutting off the constant cost of keeping up fires for the gas producer plant. Tenders are being called for two styles of pumps, one style to have a capacity of 360,000 Imperial gallons per minute at a pressure of 150 pounds to the square inch, while the other is to have a capacity of 180,000 gallons per minute at a pressure of 300 pounds. The efficiency of each will be about the same. Another proposal is that the gas producer plant should be cut out altogether when the plant is electrified and that the "standby" gas engines should be operated with gas from the street railway company's gas plant. A 12-inch main is laid to the high-pressure plant, and the big container would hold enough of this gas to operate the engines for any time that the high-pressure is likely to be required.

Sault Ste. Marie, Ont.—Another international question re-opening the rather vexed issue of division of international water powers is involved in an application received by the Dominion Government at Ottawa from the Michigan Superior Power Company. It came through the United States Secretary of War, with the suggestion that the two governments refer it to the joint International Waterways Commission. What is sought by the company is the privilege of damming St. Mary's River at Sault Ste. Marie in order to increase the flow of water to the works of the Michigan, Lake Superior Company at the American Soo. Compensation works to prevent the levels of Lake Superior being injuriously affected are proposed. The application is accompanied by plans and profiles of the proposed work and the compensative undertakings in connection with it. The matter doubtless will go to the Waterways Commission for full investigation, but it is evident that there will be objections not only from American standpoint, but also from navigation interests on the Canadian side. It is divined that the dam will have the effect of diverting much water which now flows through the Canadian channels, and also furnishes power to the Lake Superior Company. In many respects it is similar to the Chicago drainage canal scheme, which, it will be recalled, was vigorously combatted by the Canadian Government and ultimately rejected. A. C. Boyce, M.P., who is in Ottawa, when told of the proposal, stated that the American interests already have a larger slice of the water, the arches of the interna-

tional bridge being three-quarters on that side. "If this scheme goes through," he said, "it simply means starving the Canadian industries and navigation interests."

Ottawa, Ont.—The annual report of the surveyor-general for the last fiscal year shows that 4,550 miles were surveyed by day labor and 12,483 by contract, a total of 17,033 miles. The average cost per mile under the former system was $83.72 and under the latter $26.78. The cost aggregated $615,247. One hundred and sixty-six whole townships and eight fractional townships were completely subdivided while a partial subdivision was made of three hundred and thirty others, and a resurvey either partial or complete was made of two hundred and twenty-five others. The surveys were carried on exclusively in the western provinces. The report discusses a proposal for reciprocity among surveyors and tells of a conference on the subject. It says in part, by way of approval of the scheme: "Even if a part only of the examinations for qualifying as surveyors should be accepted throughout the empire, so that a candidate who had passed that part of the examination in any portion of the empire would be excused having to undergo it again, in order to qualify as a surveyor in another portion of the empire, a step forward would be made."

Ottawa, Ont.—The Department of Public Works has decided to leave the work of surveying Esquimalt harbor, with a view to the location of the new $3,000,000 drydock, which it is proposed to establish there, to District Engineer McLachlin, who is located at Victoria. The order and instructions, it is understood, will be forwarded to him shortly, so that there will be no delay in pushing forward the work. The engineering staff of the Public Works Department is working at the present time on the plans for the piers and harbor work at Victoria. The department is overloaded with similar work, and the preparation of the plans has been somewhat delayed. Chief Engineer Lafleur states, however, that the plans will be ready within the next month, when tenders will be called for at once.

Toronto, Ont.—The repair and renewal of small bridges and culverts during the timber or plank period of construction, has, in purely agricultural districts, been a serious drain on municipal resources, states W. A. McLean, in his annual report on highway improvements in Ontario, but the policy now being adopted of replacing these with concrete or other permanent material is one which, in the near future, promises to relieve taxpayers of this annual expenditure, and permit the outlay to be directed to more necessary road building. Some municipalities, with commendable desire to avoid public debt, are burdening themselves, and delaying progress, in order that all bridges and culverts may be built by annual levy. Where permanent material is used, construction carried on under proper supervision, and repairs provided for, there is every justification for borrowing money to build bridges of steel or concrete, extending payment over a term of twenty or thirty years. In this way those who benefit hereafter will contribute to the cost, and those who use them to-day are not unduly burdened. This does not apply (it must be emphasized) to flimsy steel trusses, weak concrete structures, wooden floors and substructures of steel legs, steel tubes and wooden backing; but only to those in which the greatest degree of permanence and strength is provided with a view to future traffic demands. The future users should not be burdened with charges for which they derive no service. Road building has, in the past, suffered much by this annual demand for culverts and bridges. A decayed bridge, or broken culvert, must of necessity be replaced or repaired, while the road, if at all safe or passable for a part of the year, can wait. It should not be forgotten that, while bridges are necessary, they are only short part of the highway; are only built because of the high way, and are an unfortunate necessity. Users of the road may pass over a bridge or culvert in ten seconds, while it may take ten minutes longer to drive over a mile of road. The writer has found many localities in which excellent bridges are being built, but in which the roads proper are in a neglected state. Good bridges should be accompanied by good roads, and every councillor may feel assured that the community which will sanction expenditure for permanent bridges, will with equal good will sanction the cost of good roads when shown a model of what well-directed expenditure will do in that regard.

St. Catharines, Ont.—Chief Engineer Weller, of the Welland Ship Canal, work on the lower section of which will begin in August, announces that the present old canal will be closed between Allanburg and Marlatt's Bridge, near Thorold, for building a new weir at the head of Lock No. 25 of the present canal, to supply the above-mentioned water. A dam will then be thrown across the old canal at Allanburg, and the old bed of the canal between the dam and Marlatt's Bridge will be utilized as a dumping ground in which to place the material removed from above water in widening the deep cut. The total length of the canal from lake to lake is 25 miles, and the difference in level between the two lakes 325½ feet, is to be overcome by seven lift-locks, each having a life of 46½ feet. The dimensions of the locks are to be 800 feet in length by 80 feet in width in the clear, and with 30 feet of water over the miter sills at extreme low stages in the lakes. The width of the canal at the bottom will be 200 feet, and for the present the canal reaches will be excavated to a depth of 25 feet only, but all stretches will be sunk to the 30-foot depth, so that the canal can be deepened at any future date by the simple process of dredging out the reaches.

Fort William, Ont.—The Dominion Government, realizing the importance of the harbors at the head of Canadian lake navigation, is doing all that can possibly be done to meet the demands of the marine trade, which during the past ten years has increased in volume over 100 per cent. Fifteen million dollars have been spent during the last ten years in harbor imrovements at this city and Port Arthur. This year alone an appropriation of two million dollars has been set aside by the Dominion Government for work in the harbor, and the contemplated improvements yet to be made will cover a period of at least five years more and will cost between fifteen and twenty million dollars. When the contemplated improvements to the harbor have been completed there will have been spent an amount approaching fifty million dollars.

Niagara Falls, Ont.—This city may soon be the scene of an engineering feat that, when completed, will go down in history as one of the greatest engineering triumphs of the times. The engineers of the Ontario Power Company are considering the construction of a tunnel under the bed of the Niagara River just above the Horseshoe Falls, the object being to provide a new water course for their powerful turbines. At the present time, the turbines are fed from two tunnels, each about eighteen feet in diameter, but the ever-increasing demand for power has taxed these channels to the utmost. These two pipes are located just under the ground surface, alongside of the street car tracks that go up to Chippewa, and experience has shown that it is not wise to duplicate this construction for future use. One is made of steel overlaid with concrete, and the other is of reinforced concrete. These are subject to atmospheric changes, and it is on this account that the peculiar location of the new tunnel has been chosen. The under waters of the Niagara River never freeze, and it has been noticed that

the temperature variation is very slight. On this account it would be an ideal spot for a power pipe, as there is a remote possibility of severe changes in temperature causing trouble to the pipes. The beginning of the new pipe will be at the dam just out from Dufferin Islands, and it will be carried almost to the brink of the Falls, then it will swing over to this side, and from here the waters will drop to the turbine house at the foot of the Falls.

Montreal, Que.—A new invention to detect the origin of noises heard at sea was tried out on the Allan liner "Victorian" on the last voyage. The ringing of bells, shouts and other noises, when heard at sea with a fog prevailing or in the darkness, are often hard to locate. The new instrument is the invention of Messrs. W. & T. G. Hodgkinson, of London. The latter gentleman sailed on the "Victorian" in order to give device a thorough testing under deep sea and ocean liner conditions. It worked well on the voyage, and he was fully satisfied with what he learned. The machinery consists of a huge drum so arranged that sound waves may reach it freely from every side. These are automatically recorded, and from this the direction from which they come is calculated. Two ships fitted with the device are at present running on the Mersey with excellent results.

Quebec, Que.—A provincial highway between Levis and Montreal, going through Sherbrooke and the Eastern Townships, is the last move decided upon by the Gouin Government. The announcement was made recently to a delegation of about one hundred representatives of all the counties on the proposed road who had assembled in the Prime Minister's office for the special purpose of presenting their views to the Cabinet. The construction of the highway was certain, explained Sir Lomer Gouin, but the government did not promise that work would be started at once, as the constructive power of the road department was already taxed to its capacity by the construction of a provincial highway on the North Shore, between Quebec and the Canadian metropolis. The proposed highway on the South Shore would, Sir Lomer added, be 250 miles long, with a link from Sherbrooke to Richmond connecting with the International road between Montreal and the United States boundary, and another link between Sherbrooke and Granby, via Magog and Waterloo. In the course of his remarks the Premier said if the government came to the conclusion that it needed more than $10,000,000 for the betterment of public roads in this province, he would be willing to borrow more money or to ask the Federal Government to increase again the provincial subsidies, which it could easily do with the enormous revenue now coming in. The Hon. J. E. Caron declared that the road department had only two skilled engineers at this time on the construction of good roads in this province, while about fifty would be required. He promised, though, that his staff would be completed and working before the end of the season.

Victoria, B.C.—Investigation of the water power resources of British Columbia, which was begun three years ago by the Commission of Conservation at Ottawa, is being continued during the present summer, Arthur V. White, of Toronto, consulting engineer on water powers for the Commission, having recently arrived in Victoria to supervise the work. Engineering parties are being placed in the field to canvass, first of all, portions of the mainland coast and the territory tributary to the Grand Trunk Pacific Railway. The party undertaking this work, according to Mr. White, will probably outfit at Hazelton. "One of the chief objects which the Commission has," stated Mr. White, "is to draw attention to the various natural resources by publishing inventories and descriptions of such resources in its various publications. The Commission has in course of preparation a report which will deal with the water powers of Western Canada. A great deal of space in this report will be devoted to the water powers of British Columbia, and, as the reports are widely distributed throughout the world, attention is directed to such a resource in a manner perhaps that would not otherwise be attained. The present work of the Commission in British Columbia, since its inception, has had the sympathy and practical support of the Provincial Government, and through the Department of Lands has received financial and other assistance, which has contributed much to facilitate the furthering of the data desired. The gathering of information in British Columbia is the most difficult work of this kind which the Commission has undertaken," said Mr. White. "No province of Canada has so many difficult problems to solve connected with the administration of its water resources, involving as it does irrigation, mining, logging, water powers and other interests. But, while this is true, the efforts made by the province through special legislation and regulations are unique, so far as Canada is concerned." Mr. White has with him on his expedition two engineers, C. J. Vick and Napier Simpson, both of Toronto, and other men will be engaged from time to time as is necessary.

PERSONAL.

Mr. THOMAS B. LEE has recently been appointed chief clerk of Robert W. Hunt & Company, Limited, in their head office at Montreal.

Mr. J. S. McLACHLAN has been appointed, by the Department of Public Works at Ottawa, a member of the corps of expert engineers to take charge of the construction of the drydock at Esquimalt, B.C.

Mr. W. A. DUFF, until recently assistant chief engineer of the Transcontinental Railway, has been appointed chief engineer of bridges of the Intercolonial Railway. Mr. Duff is a graduate in engineering of the University of Toronto.

Mr. ROBERT J. THOMAS is the newly-elected president of the American Waterworks Association. Mr. Thomas has been superintendent of waterworks at Lowell, Mass., for the past twenty-three years, and was president of the New England Waterworks Association in 1909.

ARTHUR V. WHITE, Toronto, consulting engineer on water powers for the Commission of Conservation at Ottawa, will supervise the investigation of the water power resources of British Columbia, and left recently for Victoria for that purpose. Mr. White is also consulting engineer to the International Joint Commission.

Dr. J. W. S. McCULLOUGH, chief officer of health for the Province of Ontario, will leave this week for Great Britain to obtain an expert knowledge of the treatment and disposal of sewage according to the most scientific methods known. His study will take him through all the larger cities of England, France, Germany and other countries where the same problems as those affecting Ontario are to be found.

A. N. TALBOT, of the University of Illinois, has been elected president of the American Society for Testing Materials. Professor Talbot was born in Illinois, October 21st, 1857, and graduated from the University of Illinois, civil engineering department, in 1881. He was engaged in railroad work for some years, but in 1885 returned to the university, with which he has been connected ever since. The testing of materials has been Professor Talbot's particular field for some years, and it is largely through his efforts that the materials testing laboratory at Illinois University has grown to be one of the best equipped in the country.

SIXTH ANNUAL ASSEMBLY R.A.I.C.

The sixth general annual assembly of the Royal Architectural Institute of Canada will be held at Calgary, Alberta, on September 15th and 16th, 1913. A very interesting programme is being prepared which will include matters of interest to every architect in the Dominion. The programme will be sent early in August to all the members of the R.A.I.C., and will contain all the particulars concerning the convention.

COMING MEETINGS.

UNION OF CANADIAN MUNICIPALITIES.—Thirteenth Annual Convention will be held in Saskatoon, Saskatchewan, July 15th to 17th. Secretary and Treasurer, W. D. Lightall, 305 Quebec Bank Building, Montreal, P.Q.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelfth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, J. W. H. Watts, R.C.A., Ottawa, Ontario.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Annual Meeting in Regina September 16, 17 and 18, General Secretary, Major Drum, Ottawa; Local Secretary, Dr. Murray, Regina.

AMERICAN ROAD CONGRESS—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.C.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, Lo21 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

NATIONAL ASSOCIATION OF CEMENT USERS.—Tenth Annual Convention to be held in Chicago, Ill., February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—176 Mansfield Avenue, Montreal. President, Phelps Johnson; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

MANITOBA BRANCH.—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack, 83 Canada Life Building, Winnipeg. Regular meetings on first Thursday of every month from November to April.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, A. B. Lambe, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, A. R. Decary; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, E. A. James; Secretary-Treasurer, A. Garrow. Meets last Thursday of the month at Engineers' Club.

CALGARY BRANCH—Chairman, H. B. Mucklestone; Secretary-Treasurer, P. M. Sauder.

VANCOUVER BRANCH—Chairman, G. E. G. Conway; Secretary-Treasurer, F. Pardo Wilson, Address: 422 Pacific Building, Vancouver, B.C.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1293. Meets 2nd Thursday in each month at Club Rooms, 534 Broughton Street.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSIOCATION.—President, Wm Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. W. Lines, Edmonton; Hon. Secretary, W. D. Cromarty, Edmonton, Alta.

ALBERTA ASSOCIATION OF LAND SURVEYORS.—President, L. C. Charlesworth, Edmonton; Secretary and Registrar, R. W. Cautley, Edmonton.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, A. C. Garner, Regina; Secretary-Treasurer, H. G. Phillips, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont; Secretary-Treasurer, Wm. Snaith, The Thor Iron Works, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, C. E. Bawden, Birkbeck Bld., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Hon. W. A. Charlton, M.P., Toronto; Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, James Coleman; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, F. C. Mechin; Corresponding Secretary, A. W. Sime.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Edmund Burke; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Bedford McNeill; Secretary, C. McDermid, London, England, Canadian members of Council:—Prof. J. B. Porter, H. E. T. Haultain and W. N. Miller and Messrs. H. W. Claudet, S. S. Fowler, R. W. Leonard and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, J. L. Doupe; Secretary-Treasurer, W. B. Young, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 193 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, N. Vermilyea, Belleville; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, J. S. Dobie, Thessalon; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary-J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

QUEEN'S UNIVERSITY ENGINEERING SOCIETY.—Kingston, Ont. President, W. Dalziel; Secretary, J. C. Cameron.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

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WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary W. H Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, exc June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*. +—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

PLANS AND SPECIFICATIONS ON FILE.

The following plans and specifications are on file for reference only, unless otherwise noted, at the office of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg, Man.

BIDS CLOSE — NOTED IN ISSUE OF

16-7—Construction of sewer and water-works, Prince Albert, Sask. — 26-6

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Battery Point, N.S., extension of breakwater	July 14.	June 19.	76
Bolton, Ont., sinking test well.	July 15.	July 3.	76
Edmundston, N.B., school building	July 14.	July 3.	76
Hanover, Ont., public building	July 21.	July 3.	76
Hantsport, N.S., construction of a wharf	July 17.	June 26.	78
North Toronto, Ont., grade preparation	July 12.	July 3.	86
Ottawa, Ont., supplying coal...	July 14.	June 19.	84
Ottawa, Ont., Welland Canal...	July 17.	June 12.	84
Prince Albert, Sask., construction of sewer and waterworks	July 16.	June 26.	84
Saskatoon, Sask., bridge	July 15.	June 26.	84
Saskatoon, Sask., boulevard posts	July 21.	July 3.	88
Sea Gull, Ont., extension of wharf	July 14.	June 19.	78
Toronto, Ont., concrete viaduct.	(No date)	.....	86
Toronto, Ont., cutting pulpwood .	Aug. 15.	.....	78
Valleyfield, Que., protection for dam	July 18.	July 3.	84
Victoria, B.C., laying reinforced concrete pipe	July 15.	June 26.	86
Walton, N.S., extension of wharf.	July 17.	June 26.	80
Welland, Ont., gate lifter	July 20.	July 3.	84

RAILWAYS—STEAM AND ELECTRIC.

+—Fort William, Ont.—The Canadian Pacific Railway has awarded the JOHN S. METCALF CO., LIMITED, Montreal, the contract for steel work in connection with the steel river house at Elevator "D." The contract price is $45,000.

+—Halifax, N.S.—The Dominion Government has awarded the COOK CONSTRUCTION COMPANY, Sudbury, Ont., and A. B. WHEATON, Amherst, N.S., the contract for the first section of the work on the large Intercolonial tunnel and harbor scheme. The contract is for five miles of cut-off from Rockingham, near Halifax, to the location of the proposed new docks, and will involve an enormous amount of work, as the engineering difficulties are large. The contract price is a million and a half dollars, and is in two sections. There will be a great deal of excavation necessary, and it is the intention to use all the rock and dirt on the harbor work and in the construction of the sea pier for the new docks.

+—Montreal, Que.—The Canadian Pacific Railway has awarded the DOMINION CONSTRUCTION COMPANY the contract for the construction of the double track from Sudbury to Port Arthur, the contract price being about $20,000,000 and the contract for a short line from Gliny Tay to Agincourt, the contract price being about $10,000,000.

Montreal, Que.—A report from the west states that contracts have been let by the C.P.R. for the following mileages of second track work: Revelstoke to Taft, 24 miles; Wetmore to Kamloops, 25 miles; Kamloops to Tranquille, 9 miles, and that the opening of traffic has been granted by the Board of Railway Commissioners on the second track completed between Mission Junction and Hammond, a distance of 1,829 miles.

+—Vancouver, B.C.—The Canadian Pacific Railway has awarded the CANADIAN NORTH-WEST STEEL COMPANY, Vancouver, the contract for supplying the steel for the Burrard Street viaduct.

LIGHT, HEAT AND POWER.

Calgary, Alta.—Tenders will be received up till the 16th of July, 1913, for supplying paper insulated light and power underground cable. Specifications may be obtained from J. M. Miller, city clerk.

▲—Carlyle, Sask.—Tenders will be received up till the 1st of August, 1913, for the supplying power and lighting equipment. Plans and specifications may be obtained from the consulting engineers at Winnipeg and Calgary. F. J. Stent, secretary-treasurer.

Hamilton, Ont.—Mr. E. I. Sifton, Hydro Engineer, stated that the tie-up in the power system recently was due to more defective insulators discovered in the territory not before inspected by the dozen men the commission has camping along the right-of-way looking for such trouble. The Hamilton controllers had a special meeting and on being told that the difficulty was being experienced near the source of supply, decided to have some steps taken at once to erect an auxiliary plant.

+—Medicine Hat, Alta.—The city has awarded the INTERNATIONAL SUPPLY CO. the contract for drilling natural gas wells in the municipality. Nine new wells will will be drilled, which will be located in various parts of the city by City Engineer Grimmer. The price involved is $75,000.

Medicine Hat, Alta.—The city council has authorized City Engineer Grimmer to place an order for six 500 K.W. transformers. In speaking of this feature of the equipment Mr. Grimmer said that the matter had been carefully gone into with Consulting Engineer Lea. While a voltage of 6,600 was considered large enough for cities of from 25,000 to 40,000, the wonderful growth of Medicine Hat and its future convinced the expert that double that voltage would be eventually required. Accordingly it was decided to install a total of 13,000 volts.

Toronto, Ont.—Acting on the advice of Mr. H. H. Couzens, general manager of the Toronto Hydro-Electric System, the Hydro Commission has decided to provide a steam reserve for the purpose of making impossible such breakdowns in the service as have been experienced recently. Mr. Couzens estimates the cost of such a plant to be about $1,000,000, and states that it should be located near the waterfront.

Winnipeg, Man.—Tenders will be received up till 9th of August, 1913, for the manufacture, delivery, and erection of one 1,000 k.w. motor generator. Plans and specifications may be obtained from the Board of Control. M. Peterson, secretary.

GARBAGE, SEWAGE AND WATER.

+—Calgary, Alta.—On the ground that the firm offers the most superior pipe, the city council, acting on the recommendation of Commissioner A. G. Graves, supported by Water Engineer A. Ellison Fawkes and City Engineer G. W. Craig, has awarded the contract to the GENERAL SUPPLIES, LIMITED, for putting the new high pressure main under the Elbow River. The company offered the 24-inch pipe for this line at $5,244, and it was not the lowest tender. Other tenders included the following: Metals, Limited, $3,750; Broley and Martin, $4,700; Gorman, Clancy and Grindley, $5,129; the Canada Iron Corporation, $5,563.

▲—Carlyle, Sask.—Tenders will be received up till the 1st of August, 1913, for construction of waterworks. Plans and specifications may be obtained from the consulting engineers at Winnipeg and Calgary. F. J. Stent, secretary-treasurer.

Edmonton, Alta.—With capital to the extent of $65,000 invested in the undertaking, a present working force of 125 men, which will be increased within the next month to 225, and five miles of narrow-gauge track connecting their plant, at the corner of Columbia Avenue and Thirteenth Street, with the extreme northern and eastern portions of the city, Messrs. Henry C. and John R. Ulen, of Chicago, commenced work on July 1st, of the sewage contracts from the city involving an aggregate amount of nearly a million and a half dollars.

Edmonton, Alta.—The City Commissioners have received the following tenders for sewers: Alex. Benson, unit prices; C. L. de Vall, $73,918; A. J. McGarry and Hulbert and Wilson, unit prices. For water mains the bids were as follows: C. L. de Vall, G. Stranger, Phillip Agrios, W. J. Graham, all unit prices. These were referred to City Engineer for report.

Esquimalt, B.C.—The ratepayers have authorized the council to raise the sum of $40,000 on the credit of the municipality for the installation of a sewerage system.

Montreal, Que.—City Engineer Janin has recommended that the following tenders be accepted: In Mount Royal Ward the recommendation is that the first section of the main sewer be given to the Harris Construction Co., price $140,432, and the second section to Henault and Heffernan, price $156,437. In Notre Dame de Grace the tenders recommended for main sewer are: F. O. Sullivan, fourth section, $78,940, and Zenon Corbeau, fifth section, $109,857. Among other tenders recommended were the following: Alice Street, Cote St. Lawrence Road to 29th Avenue, A. F. Dillon, $32,350; Rosemount Boulevard, St. Michael to Desjardins, city of Montreal, $22,434; Mountain Street, Sherbrooke Street to north, Henault and Heffernan, $9,571; Contrecoeur Street, from river to Sherbrooke Street, Salvator Ricci and Co., $15,247. The same firm's tender is also recommended for part of Berri Street, $16,857. Tenders by Henri Bertrand, ranging from $740 up to $3,324, are also recommended for work on streets in the north and east. Tenders of Gilbert Paye and Company are recommended for part of Rosemount Boulevard, Delorimier to Cabot, $6,545; Bordeaux, Descarrieres to Rosemount Boulevard, $4,493, and lesser contracts.

Montreal, Que.—A report made to the Board of Control on sewage disposal in Notre Dame de Grace quotes $5,000 as the outside cost for the establishment of a system. R. G. Lea, civil engineer, who made the report, suggests, however, that the scheme should be allowed to stand over till the autumn, as sewage disposal is receiving attention from a parliamentary committee, and is to be discussed at an American convention which Mr. Lea will attend.

Montreal, Que.—The Board of Control has at last received from the Montreal Water and Power Company a definite offer as to what terms, the company will sell its entire plant to the city. The offer may serve as a basis upon which the Board of Control and the City Council can reach an amicable settlement. The report states that it is the company's desire that the buying out of its plant be taken up in an amicable spirit, and that the directors are anxious to make a fair business-like arrangement.

+—Port Coquitlam, B.C.—MESSRS. MOON & SILVERTON, Vancouver, have been awarded the contract for installing a system of trunk water mains. The contract price is $23,579. The pipe they will supply is manufactured by Stewart and Lord, of Birmingham.

Regina, Sask.—Realizing that although the pumps at the power house can furnish the domestic water supply with a struggle, it is rather risky to trust to them alone in case of fire, the waterworks department has secured two turbine pumps with a combined capacity of 1,440,000 gallons per day at ordinary pressure. For fire use they will be run tandem, that is, one raising the stream of water to ordinary pressure and the other doubling that pressure. In the meantime the plans are ready for replacing one of the older power units with the new 5,000,000 gallon pump.

Vancouver, B.C.—The report of City Engineer Fellowes recommending the laying of two-inch water pipes on First Avenue east of Renfrew Street and on Twenty-third Avenue from Kaslo Street to a point 250 feet west has been adopted. Tenders for the supply of 3,750 lineal feet of 18-inch cast iron flexible pipe for the Point Grey partnership pipe for the False Creek submerged main will be called for.

▲—Victoria, B.C.—Tenders will be received up till the 31st of July, 1913, for the fabrication and laying of about 10¼ miles of 36-in. riveted steel pipe and appurtenances on the line of the Sooke Water Supply. Plans and specifications may be obtained from C. H. Rust, Water Commissioner.

▲—Victoria, B.C.—Tenders will be received up till the 31st of July, 1913, for the laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit. Plans and specifications may be obtained from the Sooke Water Supply office, and C. H. Rust. Water Commissioner.

Weyburn, Sask.—Tenders will be received up till the 12th of July, 1913, for the trenching, pipe laying and backfilling ten-inch wooden pipe line. Plans and specifications may be obtained from J. G. Sullivan, Winnipeg, J. G. Martin, Moose Jaw, and T. Martin, Division Engineer of the Canadian Pacific Railway, Moose Jaw, Sask.

BUILDINGS AND INDUSTRIAL WORKS.

+—Charlottetown, P.E.I.—The JOHN S. METCALF CO., LIMITED, Montreal, have been awarded the contract for the rebuilding of the Roman Catholic Cathedral. The contract price is $150,000.

▲—Cochrane, Ont.—Tenders will be received up till the 22nd of July, 1913, for the erection of an ice house, store house, freight house, and two tool houses. Plans and specifications may be obtained from Mr. Gordan Grant, Ottawa, and Mr. T. S. Armstrong, Cochrane, and the Commissioners of the Transcontinental Railway. P. E. Ryan, secretary.

+—Edmonton, Alta.—The Grand Trunk Pacific Railway has awarded the ALBERTA ORNAMENTAL IRON COMPANY, Redcliffe, the contract for the ornamental iron and bronze work on the Chateau McDonald.

Edmonton, Alta.—The City Commissioners have received the following tenders for fire halls: Congdon and Oliver, $17,260 and $17,189; Nesbitt and Miller, $26,697, $11,942, $14,493, $14,043, for halls Nos. 7, 8, 9, and 10 respectively; Dunlop Johnson Construction Company, hall No. 8, $12,700 and $12,890; No. 9, $13,232 and $13,365; No. 7, $26,892 and $27,440; No. 10, $13,187 and $13,300. Jones, Lyttle Company, $27,300, $12,900, $13,300 and $13,200. For plumbing and heating on these fire halls the following were received: Edmonton Metal Works, Nos. 8, 9, and 10, $2,273; McKnight and Frost, $3,984, $1,792, $1,774 and $1,787 for each of the four halls; Ross Brothers, $1,835, $4,120, and $1,835. The city construction department also put in a bid. These offers were referred to the city architect for tabulation and report.

+—Fort William, Ont.—Thte Steel Company of Canada, Limited, has awarded MESSRS. PRACK & PERRINE the contract for the company's plant. The contract price is $300,000.

Fort William, Ont.—The building permits for June of this year amounted to $431,735. For the same month last year they amounted to $232,070. This is an increase of $199,665.

Beaconsfield Station Road, Beaconsfield, Quebec, before Tarvia Modern Pavement was laid.

Beaconsfield Station Road, after Tarvia Modern Pavement was laid.

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Tarvia is a dense, tough, plastic preparation of coal tar.

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ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Hantsport, N.S.—Tenders will be received up till the 17th of July, 1913, for the construction of an extension to a wharf. Plans and specifications may be obtained from the District Engineers at Halifax and Antigonish and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Kemptville, Ont.—Tenders will be received up till the 21st of July, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy-Minister.

Lakefield, Ont.—Tenders will be received up till the 21st of July, 1913, for the construction of a public building. Plans and specifications may be obtained from Thos. Hastings, Toronto, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Lakefield, Ont.—Tenders will be received up till the 21st of July, 1913, for the construction of a public building. Plans and specifications may be obtained from Mr. Thos. Hastings, Toronto, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Lloydminster, Sask.—Tenders will be received up till the 25th of July, 1913 for the interior fittings for post-office, customs and inland revenue office. Plans and specifications may be obtained from Mr. W. T. Mollard, Regina, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—**Medicine Hat, Alta.**—MESSRS. SACKRIDER AND TURNER have been awarded the contract for the erection of the addition to the Elm Street Public school, the price quoted being $59,948. Smith Brothers and Wilson, of Lethbridge, tender was only $2 higher, while Hotson, Leade, and Goode, Horton and Willets, Lussier Construction Company, Fisher and Martin, of Calgary, also put in tenders. The contract for the heating and ventilating was let to MARSH & SCOTT at $13,057.80, and they will also connect up with the ventilating system of the old building for $3,927. Sackrider & Turner undertook to do the plumbing and fitting for $2,500.

Medicine Hat, Alta.—The Great West Iron, Wood and Chemical Co. will construct a car wheel and underframe works in this city. The cost is estimated to be $1,000,000.

+—**Montreal, Que.**—The ATLAS CONSTRUCTION COMPANY have been awarded the contract for the Timmins Building. MR. E. GROSS has been awarded the contract for the painting and glazing.

Moose Jaw, Sask.—The Royal Bank will erect a building in this city. The estimated cost is $70,000.

New Westminster, B.C.—The Provincial Government has sanctioned the construction of the harbor works on the Fraser River. Work will commence at once.

North Bay, Ont.—Work has been started on the erection of the additions to the shops of the C.P.R. here, and among the buildings to be put up will be an erecting shop, with accommodation for the repair of ten locomotives, a car construction and repair shop, and an additional machine shop.

▲—**Ottawa, Ont.**—Tenders will be received up till the 29th of July, 1913, for supplying a steel pontoon gate lifter for Trent Canal. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. J. K. Jones, secretary.

Ottawa, Ont.—A cheque for $75,000 deposited by the Halifax Dredging Company in connection with the contract for building the Prince Edward Island terminal for the I.C.R. car ferry, has been forfeited to the government for failure to carry out the work. New tenders are being received.

Pitt River, B.C.—Tenders will be received up till the 23rd of July, 1913, for dredging required at Pitt River. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Prince Albert, Sask.—The National Iron and Steel corporation will locate a plant in this city which will employ 5,000 men inside of four years. The company will use 4,200 horsepower from the new city power plant now in course of erection at Lacolle Falls.

Redcliffe, Alta.—The H. Munderloh Company of Montreal will erect a plant in this city for the manufacture of sheet glass. The plant will cost $200,000.

+—**Regina, Sask.**—MR. CHARLES D. OLIVER, the Canadian representative of the System M has been awarded the contract for the steel work on the new Sherwood store. In this system, the columns, girders and beams used in the buildings are composed of structural steel used in tension only, the strength in compression being developed by the concrete surrounding the steel work. Practically, the buildings erected on this plan differ from the usual run of steel frame buildings in that they are steel reinforced with concrete rather than concrete reinforced with steel.

Regina, Sask.—The Farmer's Co-operative Company will erect a fruit storage warehouse in this city. The estimated cost is $20,000.

Saskatoon, Sask.—Tenders will be received up till the 12th of July, 1913, for the cleaning and painting of steel work of the traffic bridge over the South Saskatchewan River. Plans and specifications may be obtained from the Board of Highway Commissioners; A. J. McPherson, chairman.

+—**Toledo, Ohio.**—The MacARTHUR CONCRETE PILE AND FOUNDATION COMPANY, New York City, has been awarded the contract for the concrete piles required in the foundation of the new Ash Street bridge.

Toronto, Ont.—Tenders will be received up till the 15th of July, 1913, for the erection of court house and registry office at Haileybury; a court house at Fort Frances, poultry building at the Ontario Agricultural College, Guelph; dormitory building for the Ontario Institution of the Blind, Brantford, and a dormitory building for the Ontario Institute for the Deaf and Dumb, Belleville. Plans and specifications may be obtained from the Department of Public Works, Toronto. H. F. McNaughton, secretary.

Toronto, Ont.—The new viaduct plans for Toronto mean the abandonment of the million-dollar dock project of the Richelieu and Ontario Navigation Company. This dock was to have been built out as far as the present Windmill line, but the five-million dollars' publicly-owned dock plans of the harbor involve the expropriation of the property now held by the R. and O. line.

+—**Toronto, Ont.**—The Dominion Abattoir Company has awarded the SMART-TURNER MACHINE CO., LIMITED, Hamilton, the contract for supplying a triplex power pump.

▲—**Valleyfield, Que.**—Tenders will be received up till the 18th of July, 1913, for the construction of a protection for the Government dam. Plans and specifications may be obtained from Chief Engineer, Ottawa, Supt. Engineer, Quebec, Canals, Montreal and the Department of Railways and Canals, Ottawa. L. K. Jones, secretary.

+—**Victoria, B.C.**—The School Board has awarded MESSRS. KNOTT & JONES the contract for the erection of the Esquimalt school. The contract price is $64,000.

Welland, Ont.—The building permits for the month of June amounted to $34,976. For the same month last year they amounted to $19,313. This is an increase of $15,663. D. T. Black, town engineer.

▲—**Windsor, Ont.**—Tenders will be received up till the 29th of July, 1913, for the construction of an incinerator. Plans and specifications may be obtained from M. E. Brian, city engineer.

+—**Winnipeg, Man.**—The Bank of Hamilton has awarded MESSRS. JOHN GUNN & SONS the contract for the erection of a new building at Minnedosa.

+—**Winnipeg, Man.**—Mr. W. B. Chambers has awarded MESSRS. SIMMONS BROTHERS the contract for an apartment block. The contract price is $55,000.

+—**Winnipeg, Man.**—MR. JAS. McDERMID has been awarded the contract for the new Pantages theatre building. It will be of French renaissance style, and the contract price is $180,000.

+—**Winnipeg, Man.**—The ALBERTA ORNAMENTAL IRON COMPANY have been awarded the contract for the ornamental iron and bronze work on the new Confederation Life Building.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—The city paving plant is giving a splendid demonstration these days of the city doing its own paving. The plant is now laying 2,000 yards of paving a day, and is putting down a better quality of pavement than any it has ever been possible to obtain by contract. The saving being effected amounts to about 50 cents a yard, or $1,000 a

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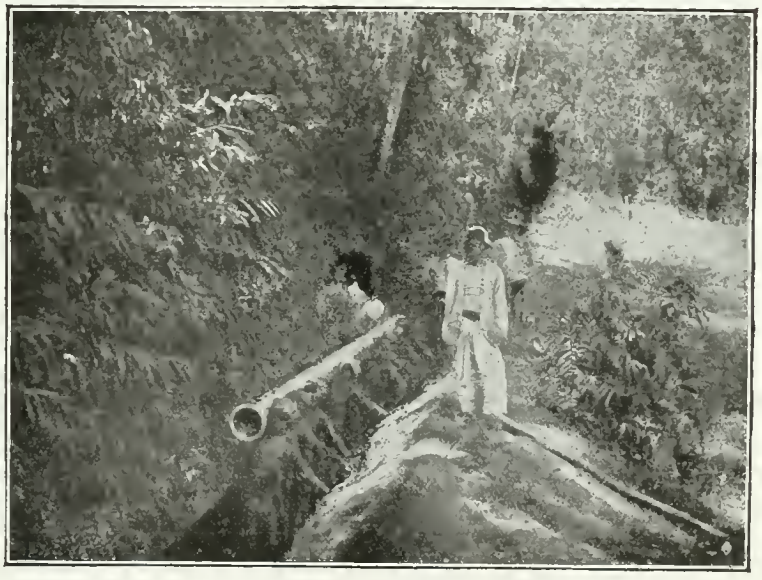

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day, to the city. Under the supervision of Commissioner Samis, the repairs to pavement poorly laid by contractors in the past are being made with good expedition, and the Mineral Rubber Company is completing the work left undone on its last year's contract.

Halifax, N.S.—Tenders will be received up till the 19th of July, 1913. for the construction of bridges and culverts in the County of Guysboro. Plans and specifications may be obtained from E. H. Armstrong, Commissioner of Public Works and Mines, Halifax, N.S.

+—Montreal, Que.—Tenders are being considered by the Board of Control for asphalt plants. The lowest was that of the BITULITHIC PAVING CO., LIMITED, namely, $31,950 for fixed plant. As this exceeded the amount voted for the purpose, the council will be asked to vote the necessary extra amount in order that this tender may be accepted. For a movable plant, the tender of F. D. CUMNER & COMPANY, for $16,500, was recommended.

Port Arthur, Ont.—Tenders will be received up till the 14th of July for the grading, constructing curbs and laying Rocmac roads. Plans and specifications may be obtained from the corporation office, J. J. Hackney, Commissioner of Utilities.

▲—Saskatoon, Sask.—Tenders will be received up till the 15th of July, 1913, for the construction of a concrete bridge over the South Saskatchewan River. Plans and specifications may be obtained from the Board of Highway Commissioners. A. J. McPherson, chairman.

▲—Saskatoon, Sask.—Tenders will be received up till the 21st of July, 1913, for supplying boulevard posts. Specifications may be obtained from Mr. E. Harrison, City Electrical Engineer, and the Board of Commissioners. F. E. Harrison, chairman.

Saskatoon, Sask.—Tentative plans for the proposed concrete bridge which will span the river at 25th Street, have been submitted to the city commissioners, and the general scheme has been approved by them on behalf of the city. The drawings are not complete as far as details are concerned, but they are sufficient to provide all the information necessary for the contractors who will tender for the work. After July 15th, by which time the tenders must be all in, the provincial government will issue new and complete plans giving all the information required to carry on the work. The city will pay one-third and the government two-thirds of the cost which was formerly estimated at $300,000. At the last election the ratepayers authorized an issue of $100,000 debentures to cover the city's share of the expense, but owing to the money situation in London these have not been disposed of.

+—Seattle, Wash.—The Board of Public Works has awarded MESSRS. NETTLETON-BRUCE-FACHBACK, Seattle, the contract for a dam at Cedar River. The contract price is $687,110.

+—Selma, Ala.—The DOLARWAY PAVING COMPANY have been awarded the contract for the laying of 20,000 square yards of pavements. The contract price is not given.

+—St. John, N.B.—The Board of Commissioners have awarded the WARREN BITULITHIC COMPANY the contract for laying its pavement on four streets at $1.88 per yard. The total contract price is $29,916.

+—St. John, N.B.—The Board of Commissioners have awarded the following paving contracts:—For paving Union Street, the following tenders were received:—Messrs. George and L. Corey, granite block, $6,937.50; vitrified brick, $7,500.00; Granite Street Paving and Construction Co., granite block, $4,755.50; vitrified brick, $4,859; B. Mooney and Sons, granite block, $4,778.60; vitrified brick, $4,850.60; A. R. C. CLARK, granite block, $4,474; vitrified brick, $4,564. The latter company were awarded the contract. For paving Germain Street, the following tenders were received:—A. R. C. Clark, granite block, $4,161.50; vitrified brick, $4,161.50; George and Corey, granite block, $6,315.75; vitrified brick $6,335.75; ERNEST RYERSE, granite block, $3,716.50; vitrified brick, $3,552.50. The latter company were awarded the contract.

+—Vancouver, B.C.—The Canadian Northern Railway has awarded the CANADIAN NORTH-WEST STEEL COMPANY the contracts for the construction of ten bridges. They will be of the heavy plate deck girder span type.

CURRENT NEWS.

Lethbridge, Alta.—Immigration Agent A. E. Humphries has been requested by Commissioner J. Bruce Walker, of the immigration department, to open a hundred pound sample of Lethbridge coal for transhipment to Berlin, Germany, where it is to undergo a test by a large industrial concern who believe that the semi-bituminous coal of Southern Alberta is peculiarly fitted to their requirements. Commissioner Walker says in his letter to Mr. Humphries: "The department is anxious to ship this sample to Berlin, where it is proposed that it shall undergo a certain test and if satisfactory the coal may form the nucleus of an organization of considerable industries using coal of a special character."

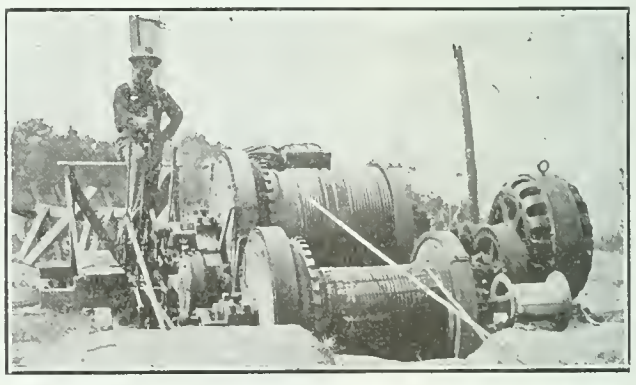
Sault Ste. Marie, Mich.—For the second time this year all previous records for one month's commerce through the American and Canadian canals at Sault Ste. Marie is broken by the showing made in June, when freight carried through the waterways aggregated 12,113,613 tons. These figures given in the statistical report compiled by Superintendent L. C. Sabin under direction of Lieutenant-Colonel Mason M. Patrick, district engineer, compare with a freight movement of 11,376,195 tons in May this year, and with 10,747,159 tons in June, 1912. The amount is nearly as great as the freight movement for the entire season of 1894 when the total traffic through the canals was 13,195,860 tons.

Saskatoon, Sask.—A notable convention to be held here July 15th, 16th, and 17th, will be that of the Union of Canadian Municipalities. This will bring more than 300 mayors, aldermen and commissioners, controllers and other civic officials to Saskatoon, to confer upon matters of civic moment. Every possible arrangement is being made for the entertainment of the visitors, who will be given opportunity to see the modern lines of Saskatoon's civic administration, and who will be able to look over the city's public utilities. The following subjects will be discussed at the convention: Watering the Stock of Public Utility Corporations, Providing for the Welfare of the Working Population, Inter-provincial Highways, Treatment of Garbage versus Incineration, Wants of Rural Municipalities, Improved Systems of Water Filtration and Purification, Under-representation of Cities, Town Planning, Experiences of a General City Manager, Improvement and Preservation of the Great Inland Waterways.

MOTOR-DRIVEN HOIST USED ON A SCRAPER.

In order to remove the worthless soil above a valuable deposit of clay, the Twin City Brick Co., St. Paul, Minn., uses a drag bucket operated by a motor-driven hoist.

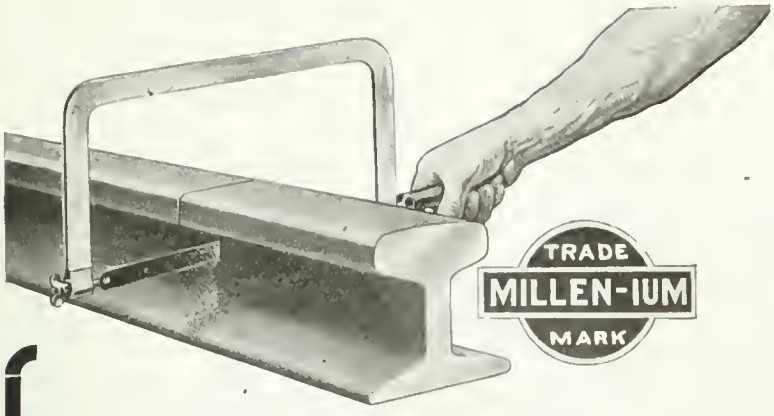
The clay deposit forms a bluff above the plant and the bucket is dragged over the surface, removing the soil on its down trip and returning empty. The bucket handles about 300 cubic feet of soil and makes a trip every two minutes.



Showing Hoist Driven by Induction Motor.

The hoist is a double drum American, and is driven by a 75 horse-power Westinghouse induction motor.

The use of electric-drive is especially desirable for such an operation because it eliminates the hauling of fuel and water, enables one man to handle the entire machine, and involves no delays while steaming up. The hoist, being without a boiler, is also much easier to re-locate.



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Hack Saw Blades

are certainly making good with exacting users throughout the country, as we were sure they would.

Our confidence in these British blades is based on thorough tests in our own warehouse, extending over several months, cutting Shelby Tubes in lengths to suit our customers. They cut cleaner and faster, and stand up to this difficult work better, than any other blades we have ever used.

Our confidence in their high quality is expressed by putting them out under our own name and the "MILLEN-IUM" Trade Mark.

Millen-ium High Speed Hack Saw Blades are not cheap in first cost—but you'll get the most service out of them per dollar paid.

Write us for a Sample Millen-ium Blade for either hand or machine work, stating the kind of material you wish to cut, and we'll send it promptly without charge.

JOHN MILLEN & SON, Limited

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Manufacturers of

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for large pipes.

Controlling Valves

for reservoirs, stand-pipes and railroad water tubs

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and rate-of-flow gauges and controllers for filters

Automatic Air Valves

and combined air and vacuum valves for water mains.

MANOMETERS VENTURI TUBES

CHEMICAL FEED DEVICES

OPERATING TABLES FILTER STRAINERS

"HEAD AND FALL" Recording Gauges for Water Wheel Plants

WRITE FOR CATALOGS

Simplex Valve & Meter Co.

112 North Broad St. - PHILADELPHIA, Pa.

The Hampton Sedimentation Tank

Used in connection with an electrolytic hypochlorite treatment, the process is **ABSOLUTELY ODORLESS** and the effluent is free from disease germs.

Nine years of operation in large and important installations in England have demonstrated that an effluent exceptionally low in suspended solids and as free from odor as the entering sewage may be obtained with The Hampton Tank.

The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction of the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

Sterilization Co.

Union Building, Clinton Street

NEWARK, N.J.

Also engineers for the electrolytic treatment of water.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

19612—June 17—Approving location station grounds of G.T.P. Ry. through Charles Indian Reserve No. 1, mileage 317, Coast Dist., Rge. 5, British Columbia.

19613—June 17—Approving proposed station site and station of G.T.P. Branch Lines, at Totzke, in Sec. 20-38-26, W. 2 M, on Prince Albert Branch, Saskatchewan.

19614—June 18—Authorizing C.P.R. to construct bridge No. 312, near Elmsley Station, Havelock Sub. Div., Ont. Div., Ontario.

19615—June 18—Authorizing C.P.R. to revise grade of present grade crossing on Sims St., Webbwood Sub. Div., Lake Superior Div., Tp. Hallam, Dist. Algoma, Ontario.

19616—June 18—Approving plan "D" showing details of substructure of bridge No. 265, at mileage 46.80 on 13th Dist., Hamilton Division, G.T.R., Ontario.

19617—June 18—Authorizing Corporation Tp. Brantford, Ont., to construct, at its own expense, a public highway, known as "Humberstone Ave.," across Brantford & Hamilton Electric Ry. Co. in Tp. Brantford.

19618—June 11—Cancelling approval of station (G.T.P. Ry.) at Empire Ave., Lot 8, Con. 2, Tp. Neebing, mileage 0.7, Lake Superior Branch, as approved under Order No. 19377, dated May 26/13.

19619—June 17—Authorizing Hamilton St. Ry. Co. to cross, subject to conditions contained in by-law No. 1430, at rail level, the switch track of T.H. & B. Ry. at Burlington (Gilkinson) St., city of Hamilton, Ont., subject to and upon certain conditions.

19620—June 12—Approving location C.P.R. Suffield-Blackie Branch, from a point in Sec. 9—13—17, W. 4 M., in westerly direction to a point in Sec. 13-19-27, W. 4 M., mileage 58.29, to mileage 149.9 of said branch, in Province of Alberta; and authorizing construction of said branch across eighty-nine (89) highways, mileages 58.29 to 149.9, diversion of certain highways and closing up portions so diverted.

19621—June 19—Authorizing C.P.R. to construct bridge No. 65.4, near Addington Station, Havelock Subdivision, Ont. Div., Ontario.

19622—June 19—Recommending to the Governor in Council for sanction the Indenture of Lease entered into between C.L.O. & W. Ry. (C.P.R.) and the C.P.R.

19623—June 19—Authorizing C.L.O. & W.Ry. (C.P.R.) to construct across road allowance between Lot 35, Con. 1, Tp. Hamilton and Co. Northumberland, and Lot 1, Con. 1, Tp. Hope and Co. Durham, Ont., at mileage 124.83 from Glen Tay; and rescinding Order No. 17163, dated August 1st, 1912, in so far as it authorizes said crossing.

19624—June 18—Directing that G.T.R. trains, operated over crossing of highway known as Wellington St. Crossing, just north of Aurora Station, Ont., be limited to a speed not exceeding ten (10) miles an hour; that all switching movements over said crossing be flagged.

19625—June 19—Extending, until July 17th, 1913, time within which G.T.R. install bell at crossing of Main Street, village of Thorndale, Ontario, required under Order No. 18887, dated March 17th, 1913.

19626—June 19—Authorizing G.T.R. to construct siding into premises of Galt Stove & Furnace Co., Ltd., town of Galt, Ontario; siding to be constructed within three months from date of this Order.

19627—June 18—Approving location G.T.P. Branch Lines Co.'s station on its Battleford Branch, at Lett, in Sec. 27-37-16, W. 3 M., Saskatchewan.

19628—June 18—Approving (1) revised location G.T.P. Branch Lines Co., Biggar-Calgary Branch, in W. ½ Sec. 29-33-18, W. 3 M., Dist. of Saskatoon, Sask.; and (2) approving location of said company's station in W. ½ of Sec. 29-33-18, W. 3 M., Saskatchewan.

19629—June 17—Authorizing C.N.Q.R. to construct across public road in village of St. Eustache, Parish of St. Eustache, Co. of Two Mountains, Quebec; and reserving question of protection to be provided at said crossing.

19630—June 17—Authorizing C.N.R. to construct spur for Manitoba Gypsum Co., Ltd., through Lot 20, R.L. 41, and Lot 4, R.L. 42, St. James, in city of Winnipeg, Man., subject to and upon certain conditions; spur to be completed within three months from date of this Order.

19631—June 18—Authorizing C.N.R. to divert River Road, near Victoria Bridge, Calgary, Alta., and to take necessary land for purpose of carrying out proposed diversion; company to maintain said road diversion for a period of one year from date of this Order.

19632—June 19—Extending, until Sept. 1st, 1913, time within which C.N.O.R. install gates at crossing of Bridge Street, village of Yarker, Tp. Camden, Co. Addington, Ont., as required under Order No. 17739, dated October 4th, 1912.

19633—June 18—Authorizing G. R. Duncan, Fort William, Ont., to construct siding from his property, being a part of S.W. ¼ of Sec. 52, in Tp. McIntyre, across Waterloo St., Port Arthur, to right of way of C.N.R., C.N.R. to build remainder of siding.

19634—June 19—Authorizing N.Y. Central & Hudson River R.R. Co. to construct spur into property of Howard Smith Paper Mills, Ltd., on Lot 556, on official plan and book of reference of town of Beauharnois, Quebec; spur to be constructed within three months from date of this Order.

19635—June 19—Authorizing C.P.R. to construct road diversion in Secs. 15 and 22-23-18, W. 5 M., at mileage 36 from Golden, B.C. After such diversion company may close portion of present road allowance to be diverted as aforesaid, within limits of its right-of-way.

19636—June 20—Authorizing C.P.R. to construct spur for Canadian Lumber Yards, Ltd., Winnipeg, Man., from a point on existing spur in lane in Block 72, City of Moose Jaw, Sask., thence across said land and across Subdivision Lots 23 to 38; spur to be completed within three months from date of this order.

19637—June 20—Authorizing C.P.R. to open for traffic portion of Edmonton Subdivision of its line, from Strathcona, B.C., to a point south of Jasper Ave., Edmonton, including high level bridge over North Saskatchewan River; provided in operation of said bridge speed of trains be limited to rate not exceeding 12 miles an hour.

19638—June 20—Directing that crossing of Rue Plinguet by C. P.R., in City of St. Boniface, Man., be protected by watchman between 7 a.m. and 7 p.m.

19639—June 19—Approving location C.P.R. additional track (double track), from Islington, Tp. Etobicoke, mileage 10, to Guelph Jct., Tp. Nassagaweya, at mileage 39.1, London Subdiv., Ont. Div.

19640—June 19—Authorizing C.P.R. to construct road diversion in Sec. 28-23-18, W. 5 M., at mileage 33.47 from Golden, B.C. After such diversion company may close portion of present road allowance within limits of its right-of-way.

19641—June 19—Authorizing C.P.R. to construct road diversions at Sec. 6-24-18, W. 5 M., mileage 31.2 from Golden, B.C., and also at mileage 35.6 in Secs. 15 and 22, Tp. 23, R. 18, W. 5 M.

19642—June 20—Authorizing G.T.R. to construct siding for Samuel McCord, Toronto, Ontario; siding to be completed within three months from date of this order.

19643—June 16—Approving location Ten (10) G.T.P. Branch Lines Co. stations in District of Cariboo, B.C.

19644—June 19—Approving location Kettle Valley Rly. Co., from mileages 0 to 20, Hydraulic Summit to Penticton, B.C.

19645—June 18—Authorizing Algoma Eastern Rly. Co., subject to conditions contained in Order-in-Council, dated June 10th, 1913, to construct dock at Goat Island, near Town of Little Current, Manitoulin Island, District Manitoulin, Ontario.

19646—May 16—Authorizing C.P.R. to operate interlocking plant at Batiscan River Bridge, on Quebec Subdivision of its railway, at mileage 102.5, subject to and upon condition that when a distant semaphore is at "Caution," all trains must stop at that semaphore until it is cleared, as well as at the home semaphore.

19647—June 14—Extending, until Aug. 15th, 1913, time within which C.P.R. install electric bell at crossing of highway at Glen Major flag-station, Ont., by Toronto-Montreal Line of C.P.R., and required to be installed by Order No. 18872, dated March 15, 1913.

19648—June 20—Amending Order No. 19571, dated June 12th, 1913, by striking out word "Carmen" where it occurs in said order, and substituting therefor the word "Carman."

19649—June 18—Authorizing C.P.R. to construct road diversion in Sec. 4-20-19, W. 3 M., and construct its Swift Current Northwesterly Branch, by means of a grade crossing, across said road diversion, at mileage 40.84 (from Swift Current).

19650—June 20—Directing that, within 90 days from date of this order, C.P.R. install improved type of automatic electric bell at crossing of March Road, 6.4 miles west of Ottawa, Ont., 20 per cent. of cost of installing bell to be paid out of "The Railway Grade-Crossing Fund," and remainder by C.P.R.

19651—June 20—Approving (1) revised location C.L.O. & W. Ry. (C.P.R.) from mileage 75.45 to mileage 77.45 from Glen Tay; and (2) location of said company's line from mileage 77.75 in westerly direction to mileage 79.5, a point on western boundary of E. ½ Lot 31, Con. 1, Tp. Sidney, Co. Hastings, Ontario.

19652—June 20—Extending, until July 31st, 1913, time within which C.P.R. install gates at crossing of Lake Shore Road by G.T.R. and C.P.R., at Vaudreuil, Que., required to be erected under Order No. 19308, dated May 16th, 1913.

19653—June 18—Amending Order No. 18419 to provide that crossing over 17th Ave. East, Calgary, Alta., is authorized upon following conditions: (a) Approach on east side be reduced to 3 per cent. grade and graded in to driveway to residence of Wm. Pearce; and said approach to be gravelled to prevent dust from blowing in on his residence, work to be done to satisfaction of Asst. Engineer of Board at Calgary. (b) In consideration of said reduction of grade, said Pearce consents to waive all claim for damages; and (c) Railway Company (G.T.P.B.L.Co.) dedicate land necessary for purposes of crossing, which is to be constructed in accordance with regulations of Board. And authorizing company to construct across Ninth Ave. and 26th and 30th Avenues, said City of Calgary, at its own expense.

19654—June 20—Authorizing C.P.R. to construct extension to existing spur on Lots 4 and 5 on north side of Chelsea Ave., at West Toronto, Ont., for Dearborn Drug & Chemical Works.

19655—June 21—Authorizing C.P.R. to construct three (3) bridges on Havelock Subdivision, Ont. Div., Ontario, namely: (1) Bridge No. 29.0, between Maberly and Ungave Stations; (2) Bridge No. 13.4, near Perth Station; and (3) Bridge No. 67.8, near Addington Station.

19756—June 19—Approving location C.N.R. station at Onoway, Alta.

19657—June 21—Authorizing C.N.O.R. to construct bridge to carry its railway over Raimbault Creek, Parish of St. Laurent, Co. Jacques Cartier, Que., mileage 48 from Hawkesbury.

19658—June 12—Authorizing City of Edmonton, at its own expense, to construct Shand Ave., across C.N.R., in said City of Edmonton, Alberta.

19659—June 20—Approving location C.N.R. station at Ardath, Sask.

19660—June 23—Authorizing G.T.P.R. to construct undercrossing on its main line, in N.W. ¼ Sec. 24-45-9, W. 4 M., at mileage 681.8 west of Winnipeg, Dist. North Alberta, Alberta.

19661—June 23—Rescinding Orders Nos. 16981 and 17785, dated respectively July 9th, 1912, and October 17th, 1912.

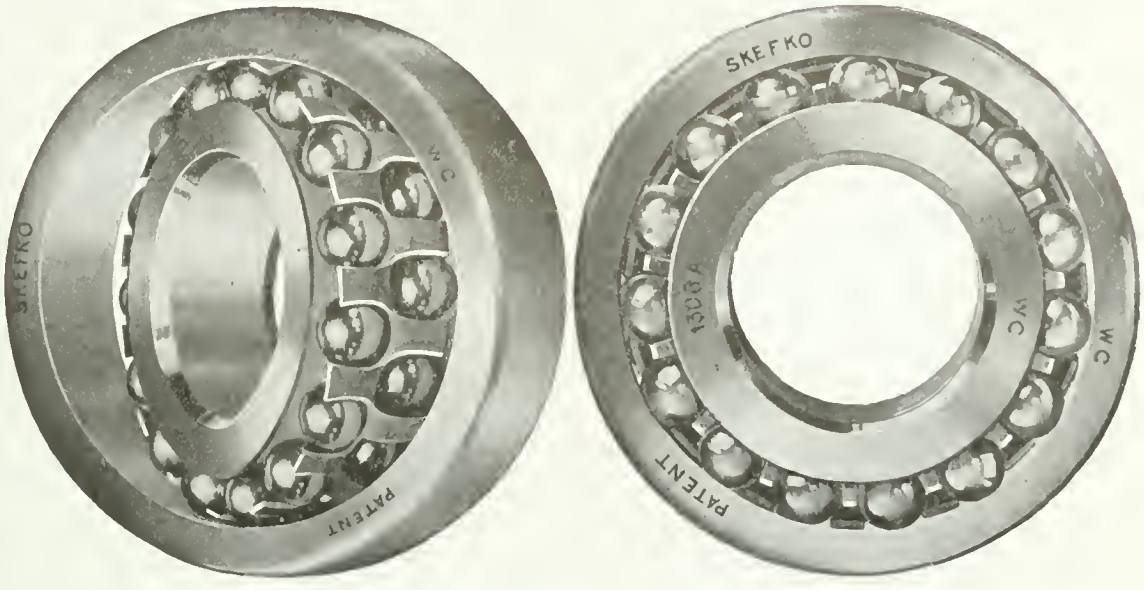
19662—June 21—Authorizing C.P.R. to construct spur for City of Medicine Hat, Alta.

19663—June 21—Amending Order No. 18736, dated Feb. 19th, 1913, to provide that gates be installed within 60 days from date of this order (at crossing of Montcalm St., St. Boniface, Man.)

19664—June 21—Authorizing C.P.R. to construct (1) two spurs across 15th St. East, and lands adjoining thereto, on north side of company's right-of-way, City of Calgary, Alta.; (2) a cross-over between above mentioned spurs; and (3) sub-spur in the block of land adjoining 15th Street East on its east side; spurs to be completed within three months from date of this order.

19665—June 24—Authorizing C.P.R. to operate trains through junction, mileage 5.94 on Ottawa Subdivision, at Breslay, Que., without first being brought to a stop.

No User of Ball Bearings Can Afford to Neglect these Points



1. **Double Row of Balls**—virtually two bearings in one, a splendid feature under any load condition.
2. **Pressed Retainer in One Piece**—made from Swedish Lancashire Iron. No rivets, wires or screws to work loose, jam balls, disarrange spacing or make noise.
3. **Outer Race Spherical**—providing for a frictionless self-alignment that absolutely and automatically compensates for shaft spring.
4. **Best Swedish Crucible Steel**—Carefully heat-treated and uniform in hardness throughout. Unequalled for toughness, carrying capacity, accuracy and durability.

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is the only truly self-aligning bearing. This feature alone is worth most careful consideration.
¶ SKEFKO Self-Aligning Double Row, Double-Capacity, Double-Life Ball Bearings cost no more and are made in international standard sizes. Their use is practical under any speed and load condition and the lubrication and protective housing can be made to conform to any service requirements.
¶ SKEFKO Bearings are the recognized standard and are replacing other constructions in many types of machinery.
¶ Our literature explains these matters in detail. Your best interests demand that you investigate. Tell us your bearing troubles and ask for our bulletins.

SALES AGENTS

The Canadian Fairbanks Morse Co.

Limited

ST. JOHN QUEBEC MONTREAL OTTAWA TORONTO
WINNIPEG SASKATOON CALGARY VANCOUVER

TENDERS CALLED FOR

PLANS AND SPECIFICATIONS ON FILE.

The following plans and specifications are on file for reference only, unless otherwise noted, at the office of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg, Man.

BIDS CLOSE		NOTED IN ISSUE OF
16-7	Construction of sewer and water-works, Prince Albert, Sask.	26-6

THE COMMISSIONERS OF THE TRANSCONTINENTAL RAILWAY.

NOTICE TO CONTRACTORS.

TENDERS FOR BUILDINGS AT COCHRANE.

Sealed tenders addressed to the undersigned, and marked on the envelope "Tender for Buildings at Cochrane," will be received at the office of the Commissioners of the Transcontinental Railway, at Ottawa, Ont., until twelve o'clock noon of the 22nd day of July, 1913, for the erection of an Ice House, Store House, Freight House, and two Tool Houses at Cochrane, Ontario.

Plans and specifications may be seen and full information obtained at the offices of Mr. Gordon Grant, Chief Engineer, Ottawa, Ont., and of Mr. T. S. Armstrong, District Engineer, Cochrane, Ont.

Tenders must be made on the forms supplied by the Commission, and be signed and sealed by all the parties to the tender, and witnessed, and be accompanied by an accepted cheque on a chartered Bank of the Dominion of Canada, payable to the order of the Commissioners of the Transcontinental Railway, for a sum equal to ten per cent. (10%) of the amount of the tender.

The right is reserved to reject any or all tenders.

By order,

P. E. RYAN,
Secretary.

The Commissioners of the Transcontinental Railway.
Dated at Ottawa this 24th day of June, 1913.

Newspapers inserting this advertisement without authority from the Commissioners will not be paid for it.—44403.

TENDERS WANTED.

Sealed tenders addressed to the undersigned, marked Tenders for "Incinerator," will be received up till 4 o'clock in the afternoon of the 29th day of July, 1913, for supplying all labor, tools, and machinery for the construction of an incinerator of a capacity to dispose of at least 25 tons per day of garbage and refuse. Incinerator must also be capable of destroying all kinds of refuse, including night soil and dead animals.

Contractors must supply their own specifications and designs, including brick or reinforced concrete building.

A marked cheque for 10 per cent. of amount of tender must accompany each tender, made payable to the order of the City Treasurer, which cheque will be subject to forfeiture in case of failure on the part of the successful tenderer to enter into a written agreement and bond with the City of Windsor with approved sureties when called upon to do so.

Incinerator must be guaranteed for at least one year from date of operation.

The lowest or any tender not necessarily accepted.

M. E. BRIAN,
City Engineer.

Windsor, Ont., July 3rd, 1913.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

TRENT CANAL.

Steel Pontoon Gate Lifter.

NOTICE TO CONTRACTORS.

Sealed tenders, addressed to the undersigned and marked "Tender for Steel Pontoon Gate Lifter, Trent Canal," will be received at this office until 16 o'clock on Tuesday, July 29th, 1913.

Plans, Specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Trent Canal, Peterborough, Ont.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the usual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque for the sum of $1,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Assistant Deputy-Minister and Secretary.

Department of Railways and Canals,
Ottawa, 25th June, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—44228.

NOTICE TO CONTRACTORS

Sealed proposals will be received at the offices of the Water Commissioners, City Hall, until 12 noon, July 31st, 1913, for the fabrication and laying of about 10¼ miles of 36-in. riveted steel pipe and appurtenances on the line of the Sooke Water Supply pressure conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer for such construction, pursuant to the provisions of By-law No. 814.

Plans and Specifications can be seen, and Forms of Tender obtained at the Sooke Water Supply Office, 1414 Douglas Street, Victoria, B.C.

The lowest or any tender not necessarily accepted.

C. H. RUST,
Water Commissioner.

Victoria, B.C., June 27th, 1913.

For further Tenders see page 86.

The Lowest Rate

It is not easy to obtain the lowest possible rate when insuring industrial buildings.

The time to consider the insurance cost is when the plans are being prepared for the building.

Architects can obtain the benefit of our highly-specialized knowledge of insurance ratings and fire protection, with the result that their buildings can be so planned that the insurance cost is as near "nil" as it could possibly be.

In the case of buildings already completed we will make inspection and suggest means of lessening the fire hazard that will likely more than pay for themselves by securing lower insurance rating.

E. M. SELLON & CO.
LIMITED
INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
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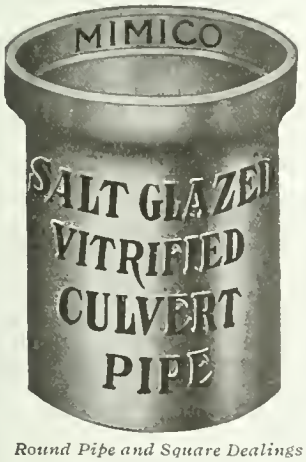
136 St. James Street - Montreal

MIMICO BRAND
SEWER PIPE

Excellent clay, modern machinery, up-to-date kilns and—above all—CARE in every process, makes "Mimico Brand" the best vitrified, salt-glazed sewer pipe in Canada.



Round Pipe and Square Dealings

Have you written for your copy of our 1913 catalogue?

In the issue of June 26th, *The Canadian Engineer* said:

"The Ontario Sewer Pipe Company, Limited, of Mimico, Ontario, have issued a new catalog and price list that is very attractively and conveniently arranged. Besides containing photographs of the plant and of the various products of the company, price lists, tables of weights, thickness, etc., the booklet contains much information of a useful nature, such as the pressure of water at different elevations, the carrying capacity of sewer pipe, results of absorption tests, notes on sewer planning, etc."

The Ontario Sewer Pipe Co.
LIMITED
MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24".

RENOUF PUBLISHING CO.
25 McGill College Ave.
MONTREAL

TAYLOR - THOMPSON — **Concrete Costs.**

Tables and Recommendations for Estimating the Time and Cost of Labor Operations in Concrete Construction and for introducing Economical Methods of Management.

By FREDERICK W. TAYLOR, M.E., Sc.D., and SANFORD E. THOMPSON, S.B., Mem. Amer. Soc. C.E., Consulting Engineer. Small 8vo, xxii+709 pages, 82 figures. Cloth $5.00 net.

Eighteen copies of "CONCRETE COSTS" were purchased by one contractor for distribution among his organization.

SECOND EDITION, Revised and Enlarged.
TOTAL ISSUE—16,000.

TAYLOR - THOMPSON — **Concrete, Plain and Reinforced.**

By FREDERICK W. TAYLOR and SANFORD E. THOMPSON. 8vo, xl+807 pages. Cloth, $5.00.

In this edition is included the developments in the construction of reinforced concrete since the issue of the first edition.

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TOTAL ISSUE—14,000.

JOHNSON - BRYAN - TURNEAURE —**The Theory and Practice of Modern Framed Structures.**

In three parts. Part I—STRESSES IN SIMPLE STRUCTURE. 8vo, xii+326 pages, illustrated with cuts throughout the text. Cloth, $3.00 net.
Part II—STATICALLY INDETERMINATED STRUCTURES AND SECONDARY STRESSES. 8vo, xvi+538 pages, 313 figures. Cloth, $4.00 net.
Part III—DESIGN. (In preparation.)

TENDERS CALLED FOR

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

BEAUHARNOIS CANAL.

PROTECTION WORK FOR VALLEYFIELD GOVERNMENT DAM.

NOTICE TO CONTRACTORS.

Sealed tenders, addressed to the undersigned and marked "Tenders for works for protecting the Government dam at Valleyfield," will be received at this office until 16 o'clock on Friday, July 18th, 1913.

Plans, specifications and form of contract to be entered into can be seen in or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Quebec Canals, Montreal, Que.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque for the sum of $3,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 25th June, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—44229.

TENDERS.

CONCRETE BRIDGE AT SASKATOON.

Sealed tenders will be received up to 16.30 o'clock on Tuesday the 15th day of July, 1913, for the under-mentioned work:—

Construction of a concrete bridge over the South Saskatchewan River at Saskatoon.

Tenders for this work must be accompanied by accepted cheque on a chartered bank, or other satisfactory deposit for the sum of $15,000.00 Deposits of unsuccessful tenderers will be returned when contracts are signed.

The right to reject any or all tenders, or to waive any defects or irregularities therein is to be at the discretion of the Chairman of the Highway Commission.

Plans, specifications, forms of tender and all information may be obtained on application to the undersigned.

A deposit of $50 must accompany each request for copy of plans and specifications; this amount will be refunded on the return of plans.

A. J. McPHERSON,
Chairman, Board of Highway Commissioners.

Regina, Saskatchewan, June 20th, 1913.

(The unauthorized insertion of this advertisement will not be paid for.)

TOWN OF CARLYLE, SASKATCHEWAN.

WATERWORKS AND ELECTRIC LIGHTING.

Sealed tenders, addressed to the undersigned, will be received up till 18 o'clock on Friday, 1st August, 1913, for the following contracts:—

1.—Construction of brick power house and concrete reservoir, and laying approximately 800 lineal feet of pipe in trenches, and relative works.

2.—Supply of Air-lift Pumping System.

3.—Supply of Duplex Steam Pump.

4.—Supply and erection of two H.R.T. Boilers and Stack.

5.—Supply and erection of compound vertical steam engine.

6.—Supply and erection of Generator, Exciter, and Switchboard.

7.—Supply of poles, arms, hardware, copper wire, transformers and meters.

8.—Supply of Series Tungsten street lighting apparatus.

9.—Erection of Pole Line.

Tenders must be accompanied by an accepted cheque for five per cent. of the amount of the tender, or alternatively by the bond of an approved guarantee company.

Plans and Specifications and other information may be obtained at the offices of the Consulting Engineers at Winnipeg and Calgary. A deposit of $25 will be required on Contract No. 1, which will be returned to bona fide tenderers on return of the plans.

The Corporation do not bind themselves to accept the lowest or any tender.

F. J. STENT,
Secretary-Treasurer,
Carlyle, Sask.

The John Galt Engineering Co., Limited,
Consulting Engineers.

CITY OF SASKATOON.

TENDERS WANTED.

Sealed tenders, addressed to the City Commissioners, Saskatoon, and endorsed "Tender for Boulevard Posts," will be received until 12 o'clock noon on **Monday the 21st day of July, 1913,** for sixty cutter's 5-light Boulevard Posts No. 1121.

Specifications and form of tender may be obtained on application to Mr. E. Hanson, City Electrical Engineer, Saskatoon.

The lowest or any tender not necessarily accepted.

F. E. HARRISON, Mayor,
Chairman of Commissioners.

Saskatoon, Sask., June 25th, 1913.

EXTENSION OF TIME.

CITY OF VICTORIA, B.C.

Sealed proposals will be received at the offices of the Water Commissioner, City Hall, until 12 noon, July 31st, 1913, for the fabrication and laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer, for such construction, pursuant to the provisions of By-law No. 814, and adopted by the Council.

Plans and Specifications can be seen, and Forms of Tender obtained, at the Sooke Water Supply Office, 1414 Douglas Street, Victoria, B.C.

The lowest or any Tender not necessarily accepted.

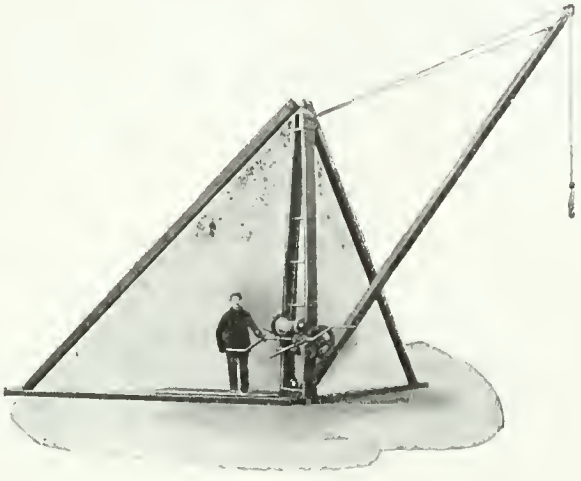
C. H. RUST,
Water Commissioner.

Victoria, B.C., June 14th, 1913.

For further Tenders see page 84.

BEATH SCOTCH DERRICKS

Hand or Power



THE construction of Beath Scotch Derricks embodies several points of merit not found in other makes.

All stress parts are **steel,** not cast iron. Bottom Pintle Bearing is of ball and socket type and works in a bath of oil, thus ensuring an easy movement at this joint.

Beath Derricks are provided with self-oiling bearings, ensuring easy operation and reducing wear to a minimum.

We also make Jinniwink Derricks, Stiff Leg Derricks, Guy Derricks, and Steel Derricks for heavy service. Hand or Power operated.

Send us your enquiries for Derricks

W. D. Beath & Son, Limited

ENGINEERS AND MANUFACTURERS

20-30 Cooper Avenue, - Toronto, Canada

INTERNATIONAL ELECTRICAL CONGRESS.

Preliminary plans for the International Electrical Congress, which is to be held in San Francisco during the week beginning September 13th, 1915, in conjunction with the Panama-Pacific International Exposition, and under the auspices of the American Institute of Electrical Engineers, are being effected by the committee on organization.

In the week preceding the Congress there will be a meeting of the International Electrotechnical Commission.

The Congress is being divided into twelve sections as follows:—

1. **Generation, Transmission and Distribution.**—Central station and sub-station design, control and operation. Long distance transmission of electric power.

2. **Apparatus Design.**—Generators motors and transformers. Prime movers and their relations. The rating of machinery.

3. **Electric Traction and Transportation.**—City, surface and rapid transit railways; interurban and trunk lines; electric vehicles, ship propulsion, mining railways, elevators and hoists.

4. **Electric Power for Industrial and Domestic Use.**—Factories, mills, refrigeration, heating devices, etc.

5. **Lighting and Illumination.**—Arc and incandescent lighting; the science and art of illumination.

6. **Protective Devices; Transients.**—Switches, circuit breakers; condensers, electrostatics, disruptive phenomena, high frequency phenomena.

7. **Electrochemistry and Electrometallurgy.**—Electrolytic and metallurgical apparatus and processes.

8. **Telegraphy and Telephony.**—(a) All communication of intelligence by the use of wires; (b) Electromagnetic waves and radio telegraphy and telephony.

9. **Electrical Instruments and Electrical Measurements.**—Switchboard, portable, standard and absolute instruments. Testing and standardization methods; absolute measurements.

10. **Economics of Central Stations and Systems.**—Load factors, power factors and all problems affecting the economy of central stations; also rates and regulation by public service commissions.

11. **Electro-Physics.**—Radio-activity; Rontgen rays; gas and vapor conduction; electron theory; constitution of matter.

12. **Miscellaneous.**—Such as History of Literature of electrical engineering; symbols and nomenclature; engineering education and ethics.

In each section it is desired to include as many as practicable notable papers dealing with the status or the progress of the art. Offers of papers and suggestions in this connection should be directed to the Secretary of the Committee on Organization, Dr. E. B. Rosa, Bureau of Standards, Washington, D.C.

CURRENT NEWS.

Vancouver, B.C.—At a recent meeting of the civic water committee recently Dr. Underhill, medical health officer, reported as to the suitability of the soil from a sanitary standpoint for the proposed lake reservoir, which the city purposes making by the construction of a dam on the Seymour Creek. The health officer in his report stated that after an exhaustive test of the soil he found it free from all animal contamination, the area inspected being suitable for a storage reservoir. He expresses the opinion that he never saw a better natural site for a reservoir, the bed being composed of granite. He will make another test of certain portions of the area during the dry season.

Victoria, B.C.—Following the delivery of the Empress of Russia and the completion of the sister ship, Empress of Asia, by the Fairfield Shipbuilding and Engineering Company, for the Canadian Pacific Railway Company, the company are now taking tenders for the construction of two other large vessels to augment their Atlantic service. The vessels contemplated are each to have a length of about 550 feet and a sea speed of twenty knots, the turbine propelling machinery being capable of developing 24,000 s.h.p. Notwithstanding the high prices ruling, this is only one of the fairly numerous inquiries for high-class tonnage which are at present occupying the attention of British shipbuilders. Both Clyde and Tyne firms are quoting for the two new Canadian Pacific boats.

Second-Hand Machinery

Second Hand Rock Crushers

100% of service in these machines, at **50% of their cost** when new. Send for complete Price List.

1—30"x 14" "Buchanan" Crushing Roll
1—24"x 14" "Buchanan" Crushing Roll (Manganese steel shells)
1—25"x 16" "Mosser" Crushing Roll
1—No. 5 "Gates" Gyratory
1—No. 4 "McCully" Gyratory
2—No. 3 "McCully" Gyratory
1—9"x 15" "Farrell" Jaw
1—No. 3 "Champion" Jaw
1—8"x 8" "Jeffrey" pulverizer

L. F. SEYFERTS' SONS, Inc.
437 North Third St., PHILADELPHIA, Pa., U S.A.

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

$400 WILL BUY a 30 H.P. gas engine and 30 H.P. gas producer; used less than two years on a chopping plant. Israel Brubacker, Elmira, Ont.

FOR SALE—almost new, differential tackle and track; carry two tons. Canada representatives, 193 Spadina Avenue, Toronto.

FOR SALE—almost new, two 700-gallon cypress wood tanks with fittings, and 4 one hundred-gallon tanks on castors. Canada representatives, 193 Spadina Avenue, Toronto.

BOVING AND COMPANY, OF CANADA, LIMITED, PURCHASE NEW PLANT.

The business of the Canadian Boving Company is now being operated under the title of Boving and Co. of Canada, Limited, in order to bring the style into line with that of the other branches of Boving and Co., Limited, London, which are operating in Japan, New Zealand, Brazil, Mexico, etc. Owing also to the great increase in the volume of business and to their having purchased the works of Madison Williams Manufacturing Company of Lindsay, Ontario, the capital of the company has been increased to $1,000,000, a portion of the first issue having been found in Canada.

They are now in a position to turn out in their Canadian works the following machinery:—Water turbines, centrifugal pumps, pulp and paper making machinery, and sawmill machinery. Of these they had previously been making the centrifugal pumps in England, and the water turbines, pulp making and paper making machinery in Sweden, while the sawmill machinery has been manufactured by the Madison Williams Company in Lindsay.

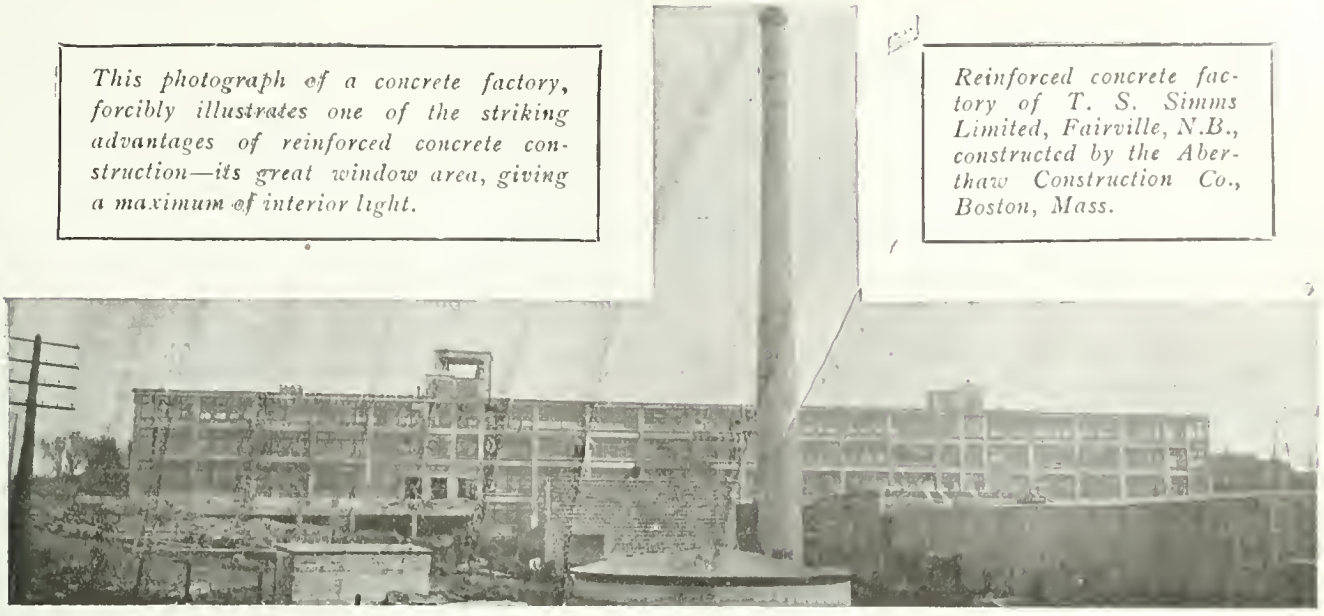
The Canadian Boving Company, Limited, completed their first large plant in Canada in 1910—viz., water turbines of some 8,000 H.P. for the Calgary Power Company.

The experience gained during the past three years by the company has enabled them to gauge the Canadian market, to familiarize themselves with what is actually required by and most suitable for that market, and by reason of their having let out contracts for various details of plants to Canadian firms they have been able to form an accurate idea of the cost of manufacturing such plants in the Dominion.

Their company is working in close alliance with Boving and Co., Limited, Union Court, Old Broad Street, London, England, to whose designs their machinery will be manufactured with such modifications as may be necessary to suit Canadian requirements.

This photograph of a concrete factory, forcibly illustrates one of the striking advantages of reinforced concrete construction—its great window area, giving a maximum of interior light.

Reinforced concrete factory of T. S. Simms Limited, Fairville, N.B., constructed by the Aberthaw Construction Co., Boston, Mass.



Concrete Factories are Most Efficient

The efficiency of a machine is the ratio of the amount of work a machine does, to the amount of work required to operate it. The output is equal to the input minus the work lost or wasted. The less wasted the greater the efficiency.
In the same way the efficiency of a factory may be defined as the ratio of output to input. Output, financially, is increased by reducing unnecessary expenses.

Concrete Stops Wastes

Concrete buildings are proof against fire, water and vermin. They give the maximum light and are sanitary. They resist vibration, and are permanent and durable.

Fire-proofness reduces insurance rates. Water or liquids used in certain processes will not leak through floors to destroy valuable goods below. Rats and other vermin find no place to live in a concrete building, thus eliminating losses from this cause. Maximum light and sanitary conditions increase efficiency of employees. Lack of vibration reduces wear and tear on machines. Permanency and durability reduce depreciation.

The way in which concrete stops these leaks is fully described in our handsomely illustrated 224 page book, "Factories and Warehouses of Concrete." It contains photographs and data of factories and warehouses for all classes of industries.

You can have a copy free if you will mention this advertisement.

CANADA CEMENT COMPANY
LIMITED
MONTREAL

POSITIONS VACANT

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.

By the city of Port Arthur, Ontario, **competent Ontario Land Surveyor** to act as Corporation Surveyor. Permanent position for the right man.

Apply giving experience, references and salary expected.

L. M. JONES,
City Engineer.

WANTED.—Experienced detailer and checker on highway bridge work. Applications, care of Box 56, *The Canadian Engineer*, Toronto.

POSITIONS WANTED

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

YOUNG CIVIL ENGINEER (26) desires position with engineering firm or contractor. Technical education; six years' experience in city, hydro-electric and railroad survey, highway and concrete construction. Good transitman and draftsman. Have had charge of field and office work for past three years. Excellent references. Have own instruments. Box 42, *The Canadian Engineer*, Toronto.

GRADUATE CIVIL ENGINEERS of long and varied experience in this country and United States, desire work for spare time. Designing, detailing and estimating. Reinforced concrete structural steel a speciality. Box 46, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER.—Experienced designer, cost estimator and salesman, works supervision, all kinds of steam engines. Boilers, hydraulic pumps, air machinery and mining plants, seeks position with consulting engineers, contractors, manufacturers or agency business. Highest references, some capital. Box 48, *The Canadian Engineer*, Toronto.

CIVIL ENGINEER, " '07," with broad experience in designing and detailing steel and reinforced concrete, now employed as designer in Montreal, wishes work during evenings and spare time. Box 54, *The Canadian Engineer*, 628 Transportation Building, Montreal, P.Q.

CIVIL ENGINEER, thoroughly experienced in reinforced concrete design, steel framed buildings, foundations; competent to take full charge of design, estimate, and supervise construction, desires responsible position. Moderate salary. Available on short notice. Box 58, *The Canadian Engineer*, Toronto.

MECHANICAL AND ELECTRICAL ENGINEER desires position in charge of plant, or in firm of contractors. Ten years' experience in shop and power station. Used to all classes of boilers, engines, and high and low tension plant. Manufacturing and commercial experience. Box 60, *The Canadian Engineer*, Toronto.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

COLLEGE GRADUATE CIVIL ENGINEER, neat draftman, wants work for his spare time. Designing, drawing, tracing, estimating, every thing in engineering line; lowest prices. Box 64, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

GRADUATE ENGINEER, five years' experience in railroad work, including heavy concrete work, steel and timber bridge construction, and heavy earth work. Box 68, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

POSITION WANTED, as general superintendent, assistant superintendent, or foreman, in building construction, by one with long experience in large work. Satisfactory references. Box 72, *The Canadian Engineer*, Toronto.

CONDENSED ADVTS

Advertisements under this heading three cents per word per insertion · Minimum charge fifty cents per insertion.

PATENTS FOR SALE Of the Canadian Patent No. 134013 and the United States Patent No. 1020197 for a very important improvement on **Link-Chains (Driving-Chains).**

Patented in 12 countries. Large success certain to be expected. Highest references from first-class firms.

ARNO GÜNZEL, Altenburg, S/A., GERMANY.

SARNIA WATERWORKS.

In connection with the recent ceremony of turning the first sod for considerable extensions to the waterworks of the town of Sarnia, Ont., it is interesting to note that the waterworks commission have finally decided to install steam turbine-driven pumps, after having spent considerable time in investigating all other types, including the vertical high duty type of pumping engine.

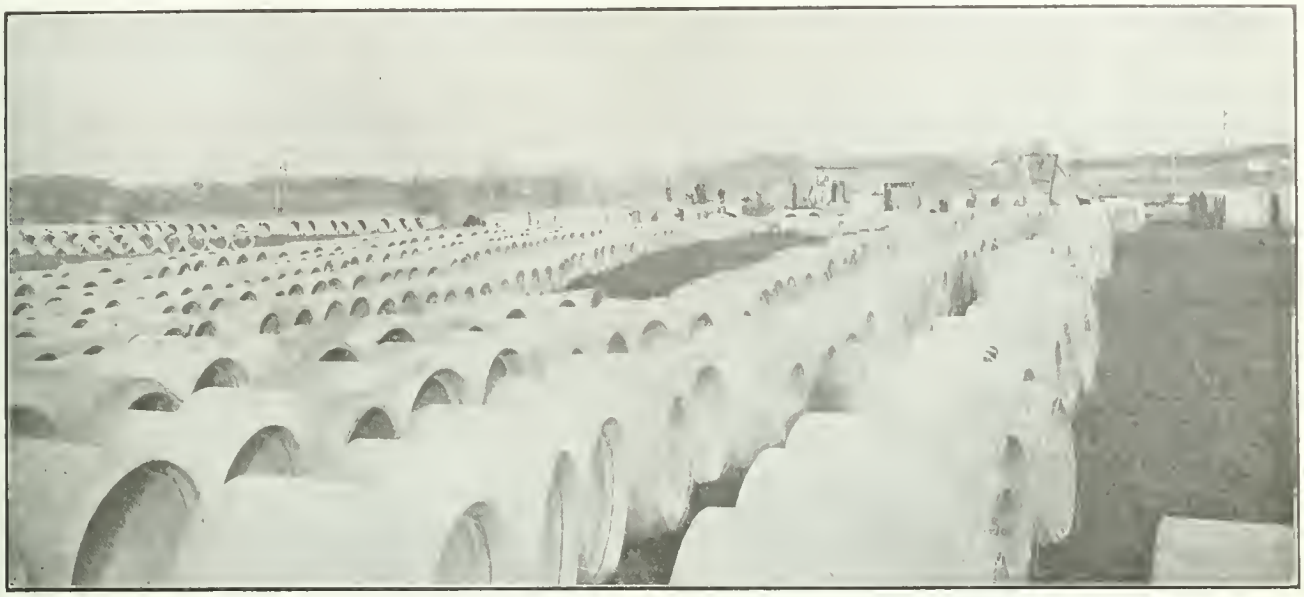
The available speed of the pump is 1,500 revolutions per minute, which is fixed by the fact that at some future time it may be required to connect the pump to an electric motor to operate on the Hydro-Electric 25-cycle supply. Herring bone gears are used to connect the pump to steam turbine operating at 3,600 revolutions per minute. By using this speed for the steam turbine, 20 per cent. less fuel is used than if steam turbines were run at the same speed as the pump. The gears are entirely enclosed in a cast-iron casing and are practically noiseless.

There are two similar units to be installed. The pumps are of Mather and Platt single-stage turbine type, each capable of delivering three thousand imperial gallons per minute against 200 feet head. The complete contract has been placed in the hands of the Canadian Allis-Chalmers, Limited, and will be manufactured at their Montreal works.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED CONCRETE PIPE

PATENTED



Manufacturing 24, 30, 36 and 54 inch pipe for North Side Trunk Sewer, Watertown, N.Y.

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Massachusetts, Connecticut, New York, New Jersey, Delaware, Pennsylvania, Maryland, Virginia, Kentucky, Georgia, Florida, Ohio, Illinois, Kansas, Washington, Oregon, Indiana, South Carolina, Missouri and Texas.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Halifax, July 8th, 1913.

Axes.—Ordinary chopping axes, single bit, $6.50 per dozen; double bit, $11. Special brands, prices on application to jobbers.

Bar Iron.—The market for bar iron is open, but the situation is firm, and prices range as bigh as $2.35 base.

Black Sheet Iron.—This commodity is in good demand. We quote 24-gauge, $2.60.

Cast Steel.—The market is steady at 10 to 15c., according to makers.

Cement.—Stocks are low and market is steady, $2 per bbl.

Coil Chain.—The jobbing prices of English proof chain in Halifax are as follows:—3-16x4, $7.15; 7 16x3, $6.25; ¼, $5.35; 5-16, $4.60; ⅜, $4.35; 7-16, $4.20; ½, $4; ⅝, $3.65; ¾, $3.50; ⅞, $3.50; 1, $3.50; 1⅛, $3.50.

Fencing Wire.—We quote: plain twisted and galvanized at $3 per 100 lbs.; barb at $2.50 per 100 lbs.; bright staples in 100-lb. kegs at $2.65, and in 50-lb. lots, $3.15. Galvanized staples are 25c. extra.

Galvanized Sheet Iron.—The wholesale prices are as follows: 16 to 20-gauge, $3.85; 22 to 24, $4; 26, $4.50; 28, $4.75. These prices are for less than case lots.

Ingot Tin.—The tin market as usual is a fluctuating one, and the present price is about 60c. net cash.

Lead Pipe.—The price quoted to-day is about $6.65 for the ordinary jobbing quantities.

Linseed Oil.—Raw is fully worth $1.20 and boiled, $1.25 per gallon. Orders are small, the outlook firm, and higher prices looked for.

Nails.—Nails are firm. Wire nails, $2.45, and cut nails, $2.60. Business in this line is reported active.

Peavies.—There is a better enquiry than last year. Prices are unchanged at $11 to $13 per dozen, according to make, but we are advised that there will be an advance.

Pig Lead.—We quote $6.75 for English and $6.50 for Canadian.

Pipe.—Wrought iron, 1-in., $5.25.

Roofing Paper.—The demand is good. Tarred paper, $1.70 per 100 lbs.; three-ply, roofing, 90c. per 100 lbs.; two-ply roofing, 65c.; sheathing paper, 30 cents per roll; tarred sheathing, 40 cents per roll.

Rope.—The price of cordage for next spring's supplies is unchanged. For large lots dealers should write jobbers for quotations. Small lots are as follows: Sisal, 9½c. base; lolster rope, 9¾c.; British manilla, 9½c. base; best manilla, 10¾c., base.

Sheet Lead.—The price of sheet lead is also very firm, 3 lbs., and heavier, $6.25 per cwt., in rolls, and $7.25 in smaller quantities.

Steel.—Tire, $2.55; spring, $2.70; machine, $3.25; toe caulk, $3.50; sleigh shoe steel, $2.50; the above are all base prices.

Tin Plates.—I. C. coke, $4.50-$4.75; I. C. charcoal, $5.00; I. X. charcoal, $6.00.

Turpentine.—Prices now quoted are as high as $0.85 in bbls., and $1.05 to $1.15 in smaller quantities. The market is open.

White Lead.—For Canadian pure, in 50 and 25-lb. irons, $7.20 is being asked. Brandram's B.B. genuine in 25, 50, and 100-lb. irons, $7.85, and B.B. No. 1, $6.60.

Zinc.—This commodity is very firm, $8.25 for casks and 9c. pound for smaller quantities. Spelter is 8c. pound.

Montreal, July 5th, 1913.

In the first half of the year the United States made a remarkable record for production and consumption of iron and very little new buying. There is no indication of increased consumption, but much reason for believing new business will develop satisfactorily during last half.

The outlook for iron is better in most sections, on increased demand, but prices are still very low. In the south the extremely low quotations recently made have disappeared and prices are firmer, with considerable sold as high as $11. In eastern territory there has been more activity, and about 35,000 tons is pending in New York.

New York says that a considerable tonnage of pig iron has recently been sold. Inquiry is also in larger volume. Southern foundry, malleable bessemer, and charcoal prices fell from 25 to 50 cents per ton. Basic in Eastern Pennsylvania also went off 25 cents, but in the Valley no reduction took place. There is a growing disposition among merchant furnaces to reduce production and a number of furnaces have gone out of blast. In the Birmingham district, alone, four furnaces ceased operation recently, and several more may stop shortly.

There is very little change in steel conditions in the United States. Reduction in warehouse prices of steel is not regarded as significant. Dealers have been cutting prices on immediate delivery steel, and a readjustment on warehouse steel had been looked for for some time past. On future delivery, steel prices are firm. Reports of a better tone in steel abroad are encouraging, but these reports, unfortunately, are also denied.

The Montreal pig iron market shows very little change. It is doubtful if much American iron is reaching Montreal, but prices here are now on a basis to meet competition from the United States. It may be that a little Buffalo iron is reaching here, and, if so, the basis would be about $19.50 to $20 a ton, on cars.

English and Scotch iron is being offered to some extent, but it is not at all active. Some of it is being used for mixing purposes and prices range around $22.50 a ton on the dock for No. 1 Summerlea or Carron Iron. Selected Summerlea and special Carron is about $22, and soft Summerlea or Carron is $19.50. Some Clarence or Middlesbro' iron is probably changing hands around $19 on the dock. There have been reports to the effect that the price of $14 has been shaded in one or two instances at Buffalo, but this report is not altogether believed in Montreal. It is still possible to bring this iron into Toronto at $18.50, and this keeps the price of Canadian iron down.

The 300-ton furnace of the Canada Iron Corporation at Midland has been blown out and will be out of commission until about the middle of August. It is being re-lined, an operation which is apparently necessary every two or three years, the company, no doubt, taking the opportunity of the present low prices of pig iron to make the necessary repairs. The 150-ton furnace still continues to operate. With the exception mentioned, the probabilities are that the Canadian furnaces are operating full time. New business is being withheld until the situation in the United States clears up.

Prices hold very steady, being again unchanged, as follows:—

Antimony.—The market is firm at 10¼.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ¾ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $2 per 100 pounds; carpet felt, $2.50 per 100 pounds; tar sheathing, 43c. per roll of 400 square feet; dry sheathing, 35c. per roll of 400 square feet; tarred fibre, 62c. per roll; dry fibre, 50c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Coal and Coke.—Anthracite, egg, $8.50; chestnut and stove, $8.50 per ton, net; furnace coal, $8.25, net. Bituminous or soft coal; Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b. cars, Montreal.

Copper.—Prices are 16¾c. Excellent demand.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c, and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are: Queen's Head, $4.35; Colborne Crown, $4.25; Apollo, 10¾ oz., $4.25. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lead.—Prices are firm at $5.35.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Nails.—Demand for nails is active and prices are: $2.50 per keg for cut, and, $2.45 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, $1 to $1.25 per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.45 to $1.55 per gallon, in barrels.

Pipe.—Cast Iron.—The market is active and strong:—$36 for 6 and 8-inch pipe and larger; $37 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 73½ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black and 63½ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, July 9th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Antimony.—Unchanged at $10.25 per 100 lbs., very firm.

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $10.

Building Paper.—Plain, 35c. per roll; tarred, 43c.

"FLEUR DE LIS"

Galvanized Iron

Will work as well as "Queen's Head." Not so heavily coated.

JOHN LYSAGHT, LTD.
Makers, Bristol
A. C. LESLIE & CO., LTD.
MONTREAL

C. TENNANT SONS & CO.

MONTREAL, (LIMITED)
C.P.R. Telegraph Chambers, MONTREAL
Representing J. & E. WRIGHT Limited
UNIVERSE WORKS BIRMINGHAM, ENGLAND
Highest Quality WIRE ROPES
The Standard for all purposes
Also E. BAYLIE & CO., Limited
CHAIN WORKS STOURBRIDGE, ENGLAND
FINEST QUALITIES OF CHAINS AND CABLES

J. H. NEW, President. R. H. NEW, Vice-President.

THERE IS NOTHING MADE IN THE WORLD

THAT WILL COMPARE WITH

REAL VITRIFIED SALT GLAZED SEWER PIPE

For SEWERS DRAINS or CULVERTS.

The product of our factory we claim to be just as good as is made, and our system we feel excels our competitors. That's the reason we're so busy, and that's why we have such a big list of satisfied customers all over Canada.

ESTABLISHED 1860.

The Hamilton & Toronto Sewer Pipe Co., Limited

HAMILTON and TORONTO

R.I.W. No. 49 PAINT PROTECTS STEELWORK

TOCKOLITH

TOCKOLITH

ALL STRUCTURAL STEEL IN THE WOOLWORTH BUILDING PROTECTED WITH TOCH BROS.

R. I. W. PAINTS

R. I. W. DAMP-RESISTING PAINT COMPANY

(TOCH BROS.)

Canadian Office—201 MAIL BUILDING, TORONTO
" Factory, 1372 Bathurst Street,

DISTRIBUTORS:

Black Building Supply Co., Limited, Toronto
A. R. Pruneau, Quebec
Lawrence Hardware Co., Limited, Halifax, N.S.
Thos. Black, Winnipeg
Can. Equipment & Supply Co., Limited, Calgary & Edmonton
Dartnell Limited, Montreal
Canadian Agency & Supply Co., Limited, Ottawa
Gandy & Allison, St. John, N.B.
People's Building Supply Co., Fort William
Wm. N. O'Neil & Co., Vancouver

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and ouff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, tor roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Coal.—Prices are quoted for this week as follows:—Youghiogheny lump, $3.85; river, $3.68; slack, $2.94; Solvey coke, $6.50; Connelsville coke, $5.45. Egg, stove and nut coke, $5.25. Pea, $6.75. Good market at these prices.

Copper Ingot.—The market is higher at 16 to 16¼c., sheet copper case (16 oz. soft), 23½ to 25¼c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cent.

Felt Roofing.—Fairly active at $2.10 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $26 per 1,000. Fire clay, American, $8; scotch, $12. Market steady.

Fusee.—Electric Blasting.—Double strength, $3.50 per huodred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-ioch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-ioch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Lime.—Retail price in city 30c. per 100 lbs., f.o.b. car; in large lots at kilns outside city 25c. per 100 lbs. f.o.b. car without freight. Hydrated lime $10 per ton at warehouse; delivered, $10.60; 30c. per siogle bag at warehouse.

Lumber.—An active movement is going on ,of both timber and lumber, prices much the same as before. Pine is good value at $32 to $40 per M. for dressing, according to width required; common stock boards, $28 to $33; cull stocks, $22; cull sidings, $20. Southern pine dimension timher from $32 to $45, accordiog to size and grade; finished Southern pine, accordiog to thickness and width $34 to $48; spruce hemlock is in demand and held quite firmly, we quote $22 to $26; spruce flooring in car lots, $25 to $29; shingles, British Columbia, are steady, we quote $3.75; lath, No. 1, $4.60; white pine, 48-inch, No. 2, have gone up and are now held at $4.25; for 32-inch, $2.75 is asked.

Nails.—Wire, $2.30; cut, $2.70, spikes, $3.00 per keg of 100 lbs., base.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable eoquiry for 1912.

Putty.—In bladders, strictly pure, per 100 lbs., $2.60; in harrel lots, plaster is being used. Plasterer's, $2.15 per barrel of three bushels, at warehouse.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.50 per barrel.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, retail price, $3 per barrel, and but small stocks on hand at warehouse. New York hydrated lime $10 per ton at warehouse.

Ready Roofing.—Prices are as per catalogue.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quehec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Rope.—Sisal, 9¼c. per lb.; pure manilla, 10¼c. per lh., base.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	0-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sires of angles and tees.

Sheet Copper.—23c. per lb

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.20; 22-24, $3.35; 26, $3.50; 28, $3.95; 29, $4.25; 10¾, $4.25 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 50 to 52c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60; Pan Canadian navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6.50 to $8 per cwt.

CAMP SUPPLIES

Evaporated Apples.—6c. per lb.

Butter.—Dairy prints are 23 to 25c. per lb.; creamery prints, 27 to 28c. per lb.

Canned Goods.—Peas, $1.35 to $1.75; tomatoes, 3s, $1.40 to $1.50; pumpkins, 3s, 85c.; corn, 97½c.; peaches, 2s, $1.50; strawberries, 2s, heavy syrup $2.40; raspberries 2s $2.15 with a tendency for lower prices on canned fruits.

Cheese.—New, large, 13¾ to 14c.; twins, 14¼c.

Coffee.—Rio, Green, 16c.; Mocha, 23 to 25c.; Java, 25 to 31c.; Santos, 17 to 18c.

Dried Fruits.—Raisins, Valencia, 8c.; seeded, 1-lb. packets, fancy, 8c.; Sultanas, choice, 10c.; fancy, 12c.; Filitras currants, cleaned, 7½ to 8c.; Vostizzas, 7¼ to 10c.; uncleaned currants, 7 to 7½c.

Eggs.—New laid, 21 to 23c.

Flour.—Prices are maintained; thus, Manitoba flour, first patents, $5.40; second, $4.90; strong bakers', $4.70; Ontario flour, winter wheat patents, higher, at $4 to $4.25.

Feed.—Bran, $25 per ton; shorts, $27 per ton, scarce.

Lard.—Tierces, we quote 14½c.; tuhs, 14¾ to 15¼c.; pails, 14¾ to 15¼c., tendency for higher prices.

Molasses.—Barbadoes, barrels, 35 to 50c.; West Indian, 27 to 30c.; New Orleans, 30 to 33c. for medium.

Pork.—Not much doing, short cut, $27 to $28 per barrel; mess, heavy, $22 to $23.

Rice.—B. grade, $3.33 per 100 lbs.; Patna, 6½ to 7c.; Japan, 6 to 7½c.

Salmon.—As before stated. We quote Fraser River, talls, $2.50; flats, $2.50; River Inlet, $2.35; cohoes, $2.20.

Smoked and Dried Salt Meats.—Long clear bacon, 15¾ to 16c. per lb. tuns and cases; hams, large, 18 to 18½c.; small, 20c.; rolls, 15½ to 16c.; breakfast bacon, 19 to 21c.; backs (plain), 24c.; backs (peameal), 24c.; shoulder hams, 13c.; green meats out of pickle, 1c. less than smoked.

Spices.—Allspice, 18 to 19c.; nutmeg, 30 to 50c.; cream tartar, 28 to 30c.; compound, 18 to 20c.; pepper, black, pure, Singapore, 19 to 20c.; pepper, white, 28 to 30c.

Sugar.—Granulated, $4.40 per 100 lbs. in bags; $4.45 in barrels, Acadia, $4.35; yellow, $4.30 per 100 in bags.

Syrup.—Corn syrup, special bright 3¾c. per lh.

Teas.—Japans. 22 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, 17 to 45c. per lb.

Vegetables.—Canadian potatoes, 75 to 80c.; Delawares, 85c. to 95c.; Egyptian, $2.75 bag; cabbages, 50c. dozen; apples, Winter, $2 to $3.25; turnips, 45c. hag; carrots, 65c.; parsnips, 75c. bag; beets, 75c. bag.

Winnipeg, July 8th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c.; anvil and vise combined, each $5.50.

Axes.—Chopping axes, per doren, $6 to $10.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kilo run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Building Paper.—Sheath, $1.10 per roll. Tarred felt, 8, 10 and 16 oz., $2.35 per 100 pounds. No. 1 tarred, 88c. per roll; plain, 72c.

Copper Wire.—Coppered market wire, No. 7, $4 per 100 lbs., No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Lumber.—No. 1 pine, spruce, tamarac, 2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, except 10 feet, $29; British Columbia fir and cedar, 2 x 4, 2 x 6, and 2 x 8, 12 to 16 feet, $32; 2 x 20, 4 x 20, up to 32 feet, $42.

Nails.—f.o.b. Fort William, $2.50; Winnipeg, $2.90; cut, f.o.b., Winnipeg, $3.35.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50: galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Roofing Paper.—60 to 67½c. per roll.

Shingles.—No. 1 British Columbia cedar, $4; No. 2, $3.50; No. 1, dimension, $5; No. 1, band saw, $6.

Spikes.—Basis as follows:—¼, 5 and 6, $4.25; 5-15 x and 5-16, $4; ⅜ x 6, 7 and 8, $3.80; ½ x 8, 9, 10, and 12, $3.65; ⅝, $3.55; ¾, $3.50.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Staples.—Fence, $2.50.

Timber.—Rough, 8 x 2, to 14 x 16 up to 32 feet, $38; 6 x 20, 8 x 20, up to 32 feet, $42.

Tool Steel.—8½ to 15c. per pound

Volume 25. Toronto, July 17, 1913

Contents of this issue on page 181

The Canadian Engineer

An Engineering Weekly

THE DESIGN OF CENTRAL HEATING SYSTEMS

PART I.

STATIONS TO SERVE BUSINESS AND RESIDENTIAL SECTIONS HAVE MANY ADVANTAGES. ECONOMICAL AND AESTHETICAL FEATURES OF CENTRAL STEAM OR HOT WATER PLANTS.

By A. G. CHRISTIE, M.E.,
Assistant Professor of Steam Engineering, University of Wisconsin.

A LEADING consideration in discussing heating problems is the duration of the season in which heat is required and the degree of cold experienced during such periods. Experience with several heating systems in the State of Wisconsin has shown that the average season during which heat must be maintained on the distribution service extends from October 1 to June 1, a period of eight months.

Table I. shows the normal and mean monthly temperatures for Madison, Wis., over a period of years.

Table I.—Normal and Mean Monthly Temperatures at Madison, Wis.

Month	Normal Temp.	1906-07	1907-08	1908-09	1909-10	1910-11	1911-12
October	48.8	50	47	51	47	54	48
November	34.2	36	36	38	43	30	29
December	22.7	25	27	23	15	21	29
January	16.5	17	22	20	17	19	1
February	19.6	21	21	24	16	26	14.6
March	30.1	38	35	30	45	36	23
April	44.5	38	46	40	49	44	47
May	58.	49	57	55	53	63	58
Average	34.3	34.2	36.4	35	35.6	36.6	31.2

It can be seen that the year 1906-07 might be taken as approximately a normal season as far as heating demands are concerned.

Residence and Other Isolated Heating Systems.—In order to maintain comfortable living conditions in residences, offices, factories, stores, etc., during these cold months, it is obviously necessary to provide some means of artificially heating such rooms or shops. Usually this has been done in the past by providing individual heating apparatus for each building, which generally consisted of either a hot air furnace, a hot water heater, or a steam boiler, each with its accompanying heat distributing apparatus. Anthracite coal has been principally used, until recently, as fuel for burning in the furnaces of such heaters, largely on account of its cleanliness, its small ash content and its freedom from smoke. But the price of anthracite coal suitable for domestic purposes has now reached $9.50 per ton at Madison, Wis., and similarly high prices prevail in other cities and towns throughout the state. On account of this high price many householders and others are commencing to burn bituminous coal in their furnaces. Such coal can be successfully burned without smoke on only a few specially designed grates. It is therefore to be expected that as the price of anthracite is increased, the smoke nuisance in cities and towns will be aggravated by this increasing use of bituminous coal in domestic heating furnaces.

In a report on the work of the Smoke Investigation Committee at Pittsburg, Pa., it was pointed out that smoke not only results in losses to the coal consumer from the escape of unburned volatile matter, but also to the community as a whole through increased house cleaning bills, increased laundry bills, and damage to stocks of goods in stores and warehouses. Smoke limits plant growth, augments the persistency of fogs, decreases daylight and increases the prevalence of lung, throat and nose diseases among citizens of smoke-producing districts. In small cities these evils, though present, are not apparent to so marked a degree as in the large cities. Nevertheless, there are substantial reasons, as indicated above, for an active campaign for smoke abatement in any community, and such movements are now in vogue in all parts of the country.

In many cities steps have already been taken to minimize the smoke nuisance. Ordinances prohibiting chimneys from smoking more than a given number of minutes per hour have been passed, and smoke inspectors have been appointed to enforce these ordinances. Their attention has been principally directed towards the chimneys of large users of coal and to the locomotives on the railroads. Up to the present time little or no attention has been given to the chimneys of private residences. A short time ago the writer spent an early morning on a mountain top overlooking a large American residential city. The atmosphere was particularly clear that morning at daybreak and the homes of the city could be distinguished without difficulty by the naked eye. Just about sunrise coal fires were started in the furnaces of these houses and in an hour the whole city was obscured by a dense smoke cloud. The citizens of this city point with pride to their fine streets, beautiful homes and clean atmosphere, and are justified in doing so, while at the same time a long distance view of their locality showed that they made much smoke that they were not aware of.

Such conditions would be impossible with central station heating if the furnace designs at the station had been carefully made and the plant was operated intelligently.

Domestic heating apparatus needs attention in maintaining the fires, clearing out ashes, and cleaning and repairing the equipment before putting it into use each fall. These services are often not paid for in cash but are performed by the owner or one of his household. Yet there is a demand on such a person's time for this work. Then, again, there are also the many petty annoyances and irritations connected with the maintenance of the heating system which for comfort it is desirable to minimize or do away with entirely. Among such might be mentioned the fact that fires frequently go out when needed most, furnaces must be cleaned and fixed at the beginning of the season, coal gas escapes and is objectionable in the home or office and dust comes into the house from unloading coal and removing ashes and makes extra cleaning necessary. In apartment houses, the usually unsatisfactory janitor is practically eliminated when central heating service is supplied.

There is a tendency in such cases where individual furnaces are used to fire hard during the daylight and evening hours, and to bank the fires and allow the temperature of the building to drop during the night. This tends toward economy in fuel costs, although there is frequently a certain amount of physical comfort sacrificed for the sake of economy.

When hard coal is used, strict economy is practised. Storm windows and doors are put up after the first fall frost and from then on ventilation is sacrificed, while no space is heated that is not absolutely needed. This statement can be corroborated by any who have lived in rooming houses.

Many people follow the custom of purchasing the whole season's fuel supply during the summer months when coal is cheap. This often involves a certain degree of hardship as a comparatively heavy expenditure must be made at one time instead of having it spread out over a period of several months.

The Advantage of the Central Heating Plant.—Instead of providing individual heating furnaces in each building, a single building may be provided in a central location to accommodate the complete heat generating units for a given district, and heat can be transmitted to the different buildings by a system of underground pipes carrying hot water or steam. It is the purpose of this series of articles to discuss a number of phases of these central station heating systems in the light of personal experience and of the latest information available, especially with relation to conditions existing in Wisconsin.

When compared with individual heating plants, the central station systems have many points of superiority. Steam can be produced more economically in the large boilers in central plants than in small individual boilers. House heating boilers of 25 h.p. have shown efficiencies ranging from 40 to 50% under test conditions. Under average operating conditions such results would not be obtained continuously, and it is probable that the average operating efficiency is not far from 35%. Large sized boilers tested under actual daily operating conditions show efficiencies ranging from 60 to 80%, with an average of possibly 65%.

To illustrate some results that are actually obtained in a central heating plant of the best design, the boiler efficiencies obtained from three different tests of the boilers of the Capitol Heating Station at Madison, Wis., are as follows: The first two tests were made on single 400 h.p. Stirling boilers fitted with Murphy stokers. Boiler efficiencies of 80.9 and 82.9% respectively at nearly full load rating were obtained from these tests. A year after the first tests, a trial was made on two boilers together, with less than half load on each, with a resulting boiler efficiency of 66.2%.

Other results of considerable interest are from tests made in 1911 by Messrs. Pugh and Watson, seniors in the College of Engineering, forming a portion of their work for the degree of Bachelor of Science in Mechanical Engineering. The tests were made on several of the 350 horse-power B. & W. boilers at the University heating station at Madison, Wis. Their object was to determine the efficiency of operation and the rate of evaporation of the various boilers under actual operating conditions. The boilers under test were fired by the regular crew in the same way as all the other boilers in the plant, so that the results represent average conditions of operation. These trials showed boiler efficiencies ranging from 64.6 to 77.3%, depending on the amount of scale on the heating surfaces and the particular type of furnace construction installed under the tested boiler.

It can thus be seen that there is a difference in efficiency under average operating conditions in favor of the central station of from 75 to 100%.

A table in Bulletin No. 40 of the Bureau of Mines gives the details of operation of fifty-seven central heating plants. In commenting on the costs of service, the authors state as follows: "A comparison of the prices charged by central stations as given in this table with the cost of fuel only for an ordinary house heating boiler shows that in many cases the cost of producing heat on the premises equals the price charged by the central stations. When heat is purchased the customer avoids the annoyance of having to supervise the operation of the heating plant as well as of the dust resulting from the delivery of fuel and the removal of ashes."

In the central station smoke can be almost entirely eliminated by the frequent firing of small quantities of coal on properly designed grates. Slack and other cheap grades of bituminous coal can be used instead of the more expensive grades supplied for household furnaces. It is also possible to install such sized boilers at the central station that those in service may operate at maximum economy at all times. It is therefore apparent that the central station can effect considerable savings over individual plants so far as boiler operation and coal are concerned.

The savings already mentioned are offset to some extent by the fact that the central heating system is expensive to install and thus a heavy overhead charge must be made on the service rendered to meet interest, maintenance and depreciation charges on such distribution apparatus. At the same time, an operating force must be employed at the central station.

When a prospective customer undertakes to compare central station charges for heating with the cost of his individual service he usually considers only his coal costs and neglects to allow for the interest, maintenance and depreciation charges on his own furnace equipment, which would be rarely less than about $15, even in the smallest houses.

When central station heat is used, the fire risk on property is diminished and hence insurance rates are

lowered. The property becomes more desirable on account of his heating service and, therefore, can command a higher price if one wishes to sell. It has also been found that in residences with such connection it is easier to secure and keep servants. These considerations are of considerable economic importance to every property owner and householder in a city where district heating is proposed and should therefore receive the careful consideration of the prospective customer.

That the central heating station is receiving considerable attention of late is evident from the following quotation from Bulletin No. 40 of the Bureau of Mines, which states: "The central heating plant is not a new thing; in fact, some of the plants have been in operation for twenty to twenty-five years. Development in this direction has been very slow, however, until within the last five or six years, when the idea has received renewed attention." A table in the same bulletin gives data on 57 plants throughout the United States in 1907, and from this table it is evident that the plants are most numerous in the States where coal is relatively cheap. It will be shown in a later part of this article that a very considerable portion of the cost of central station service is the overhead charges on the distribution system, and this proportion increases as the price of coal decreases. It is therefore apparent that in these cities where coal is cheap the citizens prefer central station service for other reasons than economy in fuel cost. If, under such conditions, this service has certain acknowledged merits to commend its use, it seems hard to understand why it has not been more widely adopted in localities where coal is expensive and where the distribution costs would form in consequence a smaller proportion of the charges for central station service. It seems evident that the value of this service will be recognized in the near future and that in consequence the number of central heating plants will increase quite rapidly.

Isolated plants in large office buildings, stores, hotels, factories, etc., are able to furnish the necessary heating, together with the power and light required, at a low combined cost. If a central heating company wishes to secure such business, it must be prepared not only to supply heat but also electricity under more favorable conditions than would the isolated plant. This may not necessarily mean at a lower cost, for many executives are willing to pay for the relief from the care and anxiety incident to the installation and maintenance of a steam-electric power plant.

The Central Heating System as a Public Utility.—A central heating system must be considered as a public utility, and it therefore comes under the control of the "Public Utility Commissions" in such states as these exist. In Wisconsin public utilities are controlled by the Railroad Commission.

The methods employed by the commission in making its valuations are of very great interest and deserve the careful study of all engineers engaged in public utility work. There have been no rulings up to the present time on any case involving district heating, so that there has been no fixed rate of return recognized. In the case of utilities supplying electricity, 8% profit on the entire valuation has been taken as a basis for ratio-making. The books of all public utilities must be kept according to methods and forms prescribed by the commission.

Public utility corporations in the State of Wisconsin are so regulated by the commission representing the state that they are true servants of the public. At the same time the guarantee of a fair return on capital honestly invested has so enhanced the value of the stocks and bonds of these corporations that they are now considered "gilt-edge" on the stock markets.

These laws have been extracted at some length to make perfectly clear the conditions that would be imposed on a corporation that proposes to organize and do a central station heating business in the State of Wisconsin.

The property of a public utility corporation can be assessed at an appraised value by the commission and taxed for municipal and state purposes in the same manner as other real property.

The corporation is required to report at regular intervals to the commission on forms provided for such purposes. These reports cover service records and financial statements.

There are greater natural limitations to the extent of the service of a heating station than in the case of an electric plant. The distance over which heat can be transmitted cannot compare with the transmission of electricity owing to the higher first cost of the underground distribution system and the greater power lost in forcing the heating medium—either steam or hot water—to the outlying portions of a long system. There will be a certain radius around the central station over which heat can be supplied to customers at a reasonable cost after allowing a fair return on the investment.

The greatest distance over which heat can be transmitter from a central station is determined by the allowable friction losses in the mains and the amount of service at the end of the line. Mr. Chas. R. Bishop, in a paper before the New England Section of the National Electric Light Association, stated that in general this radius of distribution should be from one to one and three-quarter miles from the central plant. From data pertaining to the heating stations in the United States, it would appear that a reasonable radius of distribution is from 4,000 to 5,000 feet.

Plant Location and Design.—In considering plant location and design, it is of first importance to determine the probable extent of the heating service, for on this depends the entire design of plant equipment and underground pipe lines. The central business portions of cities and the more thickly populated well-to-do residential sections will provide the greatest heating loads for the least capital expenditure.

When a central heating plant is under consideration, a careful examination should be made of all territory, both business and residential, that it is proposed to serve, and a scaled map of this section should be prepared. The distance to the extreme portions should not exceed about two miles from the station. The type of each building (whether wood, brick, concrete, etc.) should be noted on this map, together with the classification of the use to which the building is put, as, for instance, stores, residences, theatres, hotels, etc. The next step is to secure weather records of the city or of a neighboring city. Then the maximum and minimum temperatures throughout the heating season should be plotted. From these curves it is possible to select other cities where similar conditions prevail, and data should be secured from those cities as to the maximum and average heat demands for each type of structure in such a town. This information should be applied to each block or section of the town in question and the results will form a fair estimate of the probable requirements that must be met by the proposed heating system. The design of mains from the station may now be commenced and the proportions of these should be such as to

meet modern engineering requirements for such service. The complete system for which the plans were made need not be installed during the first season. The plans, however, should always be made for the ultimate installation capacity. Otherwise, the system would become inefficient as the load increases.

Theoretically, the central heating plant should be located at or close to the centre of the area over which heat is to be distributed. But this location is often out of question in an actual case owing to high costs of real estate, poor facilities for handling coal and ashes, lack of suitable water supply, and the location elsewhere of existing plants whose facilities will be utilized. A high first cost of real estate for the plant places an initial heavy overhead charge on the service, though this may sometimes be offset by other economies to be gained by a central location. Neighboring property owners frequently object to the location of such a station adjacent to their buildings on the plea that the attendant noise, dirt and smoke will tend to lessen the value of their holdings. The New York Edison Company has had to defend several suits for damages due to alleged injury to surrounding property from soot and cinders which were discharged by the smokestacks during periods of heavy loads. The Murphy Heating Company, of Detroit, on the other hand, have located their central station near the heart of the business district instead of on the river front. In general, however, it is not advisable to buy an expensive site even in a centralized location unless there are special considerations that make such a site more desirable than any other one available.

The cost of handling coal and ashes at the central station must be a minimum if low operating costs are to be obtained. This is more nearly possible when the plant is located beside a railroad or a dock so that coal cars may be switched to or unloaded into the station itself. When coal has to be trucked a considerable item is necessarily added to the costs of operation, and thus to the heat sold to customers. The saving of such charges will very frequently greatly offset the extra losses in pipe lines reaching to the distributing centre from a less central location.

A central heating plant, especially one using a low-pressure steam distribution system where the condensed steam is wasted to the sewers, uses a large quantity of water daily. It is desirable that such a plant should have access to a water supply independent of the city mains, either by means of a small pumping plant on a nearby lake or stream or by artesian wells. When the plant contains electric generating equipment which is run condensing during the summer season, large amounts of water must be at hand for cooling purposes. Such possible water demands should receive careful consideration in connection with the location of the plant.

In a later part of this series, it will be shown that the losses in distribution systems vary with the length and size of the pipe lines. Hence a central location is the most desirable from a distributing standpoint, for then the heating load can be secured by comparatively short pipe lines throughout the district it is proposed to serve and these lines can radiate in all directions from the plant. This would result in minimum heat losses and would also provide a more uniform pressure over the whole system provided the pipe lines were properly designed.

Systems for Distributing Heat.—Heat may be distributed from a central station either by means of hot water or by low pressure steam. At the present time there is a considerable difference of opinion regarding the relative advantages of these two systems. It is not intended in this thesis to advocate either system but rather to discuss the application of both in central heating practice.

Flow and return pipes must be provided in the hot water system. The return water enters the plant at a lowered temperature, passes through some type of re-heater and is then forced out through the system again by pumps. Several types of re-heaters utilizing the exhaust steam from engines are in use. Hot water systems are spoken of as "closed" or "open." On the former system closed heaters are used and the pump forces the return water through the heater and out into the flow pipe. By attaching a condenser with an air pump in series with these heaters, it is possible to carry any degree of vacuum desired. Live steam heaters in series with the exhaust heaters are also in common use for meeting peak loads. Sometimes it is desirable to place these above the level of the boilers so that the condensed steam flows back by gravity. The amount of heating to be supplied by this heater is adjusted by throttling the steam supply. Frequently a number of the boilers in the plant are so piped up that they can serve as water heaters.

The "open" system of hot water heating operates with open heaters or with a type of barometric condenser called "co-minglers." In the latter the exhaust steam and return water mix together and are drawn off by the circulating pump connected to the tail pipe which discharges the mixture into the heating system. The condensed steam goes to make up the losses in the system from leakage, while the excess is used as boiler feed. With the closed system the condensed steam from the re-heaters is pumped back into the boilers. The open system requires more power to circulate the water than the closed system as the return static pressure is necessarily lost in the vacuum of the co-mingler or in the open heater. The selection of the open or closed system depends largely on local conditions. When engines are used, and it is desired to carry a vacuum, the co-mingler would be the logical choice though other systems are also used for the same purpose.

Vacuum and pressure systems are both in use for distributing steam heat. In the vacuum system two pipe lines are installed—a large pipe to carry the low pressure steam to customers' installations, while a smaller one under vacuum acts as a return for the condensed steam to the plant. It is possible at times to operate this system with a partial vacuum at the engine exhaust, thus increasing the power and economy of the engine. The condensed steam is all returned to the plant and can be used again for boiler feed water. In some localities this item is of considerable importance.

The pressure system consists of a single pipe line with a steam pressure between 3 and 10 pounds about atmosphere. The condensed steam is usually metered at the customer's premises and wasted to the sewer. Exhaust steam from engines is generally used on this system, augmented when necessary by live steam passed through reducing valves. This is the simplest system of all.

It seems generally agreed with regard to the first cost of plants that both the station and distribution equipment of the steam pressure system can be installed for less money than the vacuum or either hot water system. On the other hand, the piping must be better insulated to prevent excessive line losses as the steam temperature is higher than if hot water or vacuum systems were used.

Steam is capable of furnishing such general service as cooking, laundry work, etc., which water will not do. Steam can be adapted to customer's hot water installations already in place, either directly or through reheaters, and can be applied to hot air systems by means of indirect radiators. Hot water, on the other hand, cannot be successfully applied without alteration to steam systems which are already installed.

When the cost of operation is considered, hot water systems have the advantage that partial vacuums can be carried on the engine exhaust. However, as the load factors are usually low in electric stations, it is advisable in all cases—as will be pointed out later—to figure the plant for the production of heat alone, in which case this apparent advantage largely disappears. Higher circulating pressures must be maintained on hot water systems than with steam. Hence heavier and more expensive pipe lines and fittings must be installed.

The elevation of the area to be served in relation to the plant location, and also the height of the highest building to which heat is furnished, will determine the pressure to be maintained on a hot water system. This is usually about 15 pounds above the static pressure at the plant. If a city is hilly, then the hot water system cannot compare favorably with steam on account of excessive pressure in the pipes, the power required for pumping and the friction losses in the system.

Some device must be employed on hot water systems to regulate the amount of water flowing through the customer's radiators. Valves with adjustable openings controlled by a special key are sometimes installed. On other systems choking discs or nipples are inserted in the return pipes and also at each of the radiators. The holes in these are so proportioned that only the proper amount of water will be forced through the radiators by the prevailing pressure.

Hot water lends itself more readily to temperature regulation than steam. With the latter some form of thermostatic control must be employed, while with hot water a schedule of flow temperature to be maintained at the central station can be prepared for varying outside temperatures and wind velocities. In this way the customer receives heat in just the right amount to avoid overheating his rooms in any kind of weather.

The amount of steam used by various customers can be determined by metering the condensed steam and charges for service may be based on this amount. The customer then pays for the heat used and may be as economical or wasteful as he desires. In such systems cooling or economizing coils with 15 to 20% of the total radiation capacity should be installed by each customer to recover the heat in the condensed steam before discharging it through the trap and meter to the sewer. This is an absolute necessity in some cities where citizens are prohibited by ordinance from discharging water into the sewers above 125° F. or so.

Hot water service, on the other hand, cannot be metered, and charges for the same must be made on the basis of square feet of radiating surface or on some other flat rate basis. In actual service it has been noted that where there is no financial incentive to economy 25 to 50% more heat will be used than is actually required. As a result of this, all flat rates must be higher proportionally than metered service, and so the economical customer helps to pay for the carelessness and extravagance of others.

As a rule, steam service is more popular in business sections, while in residence districts hot water seems to be more generally sought.

When a customer has his residence or building piped up for hot water and the district heating system supplies steam, all that is necessary to secure central station service is to install some form of heat transformer or interchanger, of which there are many on the market. These devices consist, as a rule, of double tube manifolds with the steam supply connected to the inner tube while the hot water circulates between the tubes. The steam in condensing gives up its heat to the water which rises and establishes a circulation in the same manner as when a coal-fired heater is used. The condensed steam can be metered and charged for in the usual way. Kitchen and bath heaters can also be piped up to one of these heat interchangers, or a coil of pipe carrying steam can be placed in the water reservoir itself.

Some schedule of service for varying outside temperatures should be prepared for the guidance of the central station operators with either hot water or steam systems. For the former, tables of flow temperatures to be maintained at the central station should be prepared, with corrections to be applied for various velocities and directions of wind. Such a schedule of temperatures is shown in Table II., and applies to a central hot water heating station in Columbus, Ohio.

Table II.—Relation Between Outside Temperature and Hot Water Flow Temperature.

Temperature. Weather.	Flow.	Temperature. Weather.	Flow.	Temperature. Weather.	Flow.
70 above	stopped	36 above	157	Zero	210
68 "	106	34 "	159	2 below	212
66 "	112	32 "	162	4 "	215
64 "	117	30 "	165	6 "	218
62 "	121	28 "	170	8 "	221
60 "	125	26 "	175	10 "	224
58 "	128	24 "	178	12 "	226
56 "	131	22 "	180	14 "	229
54 "	133	20 "	184	16 "	232
52 "	135	18 "	187	18 "	235
50 "	137	16 "	189	20 "	237
48 "	139	14 "	191	22 "	240
46 "	141	12 "	194	24 "	243
44 "	144	10 "	196	26 "	246
42 "	147	8 "	198	28 "	249
40 "	150	6 "	201	30 "	252
38 "	154	4 "	204		
		2 "	207		

The above schedule is to be applied in still weather only. With falling outside temperature and a wind of 12 miles per hour add 5 degrees; with falling outside temperature and a wind of 18 miles per hour, add 10 degrees.

[A second part of this article, dealing with the design of heating stations, pipe lines and conduits, will appear in the next issue of *The Canadian Engineer*.—Ed.]

Drills of hard electric steel have recently been adopted in connection with the boring machines employed by the State mining authorities in the Goslar district of Germany. The result is stated to be not only an increased output, but a marked reduction in the number of replacements necessary, and also in the number of drills that require sharpening.

THE FIRE HAZARD IN TURBO-GENERATORS.

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THAT there is a great chance of serious damage by fire, following arcing in turbo-generators, and suggestions for minimizing this hazard form the subject of a paper by Mr. Lawler appearing in the July number of the Journal of the American Society of Mechanical Engineers.

The chances of electric generators of the older types being seriously injured by fire in the event of some part of the insulation failing is slight. Occasionally arcing will ignite the insulation at some point, but it is seldom that the fire will spread much before it is extinguished. This freedom from fire damage is due principally to the comparatively low speeds, the accessibility of the combustible insulation, and the fact that the machines, being of large mass per unit capacity, the insulation is considerably distributed.

This condition of practical freedom from fire is reversed in the case of generators of the turbo type, for when a short circuit occurs in one of them there is a great chance that the insulation will be ignited and the machine be badly damaged; in fact such damage has occurred in a number of instances.

The chief causes of the increased hazard in the more modern type generators are as follows:—

1. The volume occupied by this type of machine is very much less for the same capacity than that of the older types of generators, so that the combustible insulation is more concentrated and, therefore, much of it is exposed, even to a slight arc or fire. The covering on the conductors depends greatly for its insulating qualities on the presence of oils or gums of a highly combustible nature. The amount of this combustible insulation on the higher voltage generators is naturally greater than in the low voltage machines.

Owing to turbo-generators having only a few poles the end connections between slots form a large proportion of the total length of conductors, in fact in some designs approximately one-half of the coils are outside of the slots. These end connections, one-half being on one side of the machine and one-half on the other, are exposed to fire, and as with a pile of loosely laid sticks, fire will rapidly extend from the insulation on one coil to that on the others.

2. Owing to these generators being of exceedingly large capacity in many instances, (one of 30,000 kva. capacity now being constructed) an enormous amount of energy is involved in a short circuit, especially at the instant the short occurs and as the arc is confined in the limited space with the combustible insulation, it would seem impossible for the insulation to escape being set on fire at many points simultaneously.

3. The machines are cooled by forcing large quantities of air through the spaces between the conductors. The large and constantly renewed supply of oxygen will hasten combustion when it is once started.

The air is given somewhat of a rotary motion by the rapidly revolving rotor which has the ventilating vanes on it and consequently fire when started will be quickly swept around the exposed insulation.

4. The generators are totally encased with the exception of the air inlets and outlets and even these in some designs are under the machines. This construction prevents access to a fire and much valuable time will necessarily be consumed before extinguishing agents can be used effectively. When the field current is cut off, as is necessary in case of short circuit, the only means of bringing the rotor quickly to rest is lost and it will continue to run for a long time after the steam has been shut off. Some machines will run for over an hour. This continued rotation is not conducive to the quick extinguishing of fire, especially when the ventilating vanes are mounted on the rotor.

In addition to the possible causes of arcing existing in the case of the older types of generators, the turbo-generator is subject to momentary large current rush at instant of short circuit, even if the short is external to the machine itself, unless means are taken to keep the current within safe limits. The heavy rush of current causes mechanical stresses in the conductors, which in some cases are severe enough to distort the conductors, especially where outside the slots, and to injure the insulating covering, resulting in a short circuit within the generator itself. In some designs the internal reactance of the machines will permit of the momentary current rush amounting to 40, or possibly more, times the normal full-load current of the machines.

The possibility of the conductors being distorted has been reduced in some cases by designing generators with sufficient internal reactance, or by providing external reactance such that the current at the moment of short circuit will not be great enough to damage the generators. Attention has also been given to supporting the stator end connections to prevent their distortion. These means have undoubtedly greatly increased the safety of the turbo-type of generator from possibilities of internal short circuit, but in no way tend to prevent a fire resulting should an arc occur.

A short circuit in the rotor will probably not result in a severe fire unless under exceptional conditions. This is also true if the short circuit occurs inside of a stator slot. A short circuit involving a stator coil, however, is more apt to occur at the end of the slot where the conductors are exposed.

As asbestos is now used largely for insulating the rotor windings and as these windings are well protected, it is probable that only in cases of severe fire in a machine will the rotor windings be damaged to any extent.

While the generators may be free from fires during the earlier portions of their life owing to the proper use of reactances which prevent external troubles seriously affecting the machines, as they get older the ordinary causes of breakdown of insulation are liable to occur and fires result. Probably in most cases generators will not be discarded until some trouble, usually in the nature of a short circuit, has occurred at least once in each, so that it is reasonable to expect that unless further preventive means are taken, turbo-generators stand a good chance of serious damage by fire at some time during their life. Although many fires have occurred, probably most of them have happened during the generator development stage. Generators of the turbo type are of such recent production that none of them has yet reached a life which could be considered old and, therefore, the troubles which can be expected near the end of their life by fire have still to come.

Undoubtedly the manufacturing companies have given serious thought to the matter of the reduction of the fire hazard in turbo-generators and have employed all

means practical at the present time to this end, but there is still very much to be desired. The following several means if taken together would seem to minimize the chances of a serious fire:

1. If a suitable material could be found a non-combustible outer covering could be placed over the insulation on the stator end connections. This would greatly delay the spread of fire and even if no other protective means were taken, would undoubtedly prevent much serious damage. Where fire extinguishers were used the covering would at least hold back the fire until they could be brought into play. At present no material suitable for such a covering appears to be available.

2. If a non-combustible outer covering should be put on, its advantages would be partially lost in time unless the cooling air were freed of the dirt and oily vapor liable to be in it. This could be done by filtering, as has already been advocated several times.

3. Means could be provided for cutting off the air supply in case of fire in generators by placing dampers in the inlet ducts designed so as to be normally held open by fusible links. The links could be placed so that they would be quickly fused by the heat and allow the dampers to close automatically. By reducing the oxygen supply to that entering by leakage the action of the fire would be slow.

4. Arrangements could be provided for the quick introduction of carbon dioxide gas into the machines. The carbon dioxide could be kept in liquid form and piped through valves, expansion tanks, etc., to the generators. The valves could be arranged to be opened by the closing of the air inlet dampers so that the gas would be automatically introduced into the generators. This gas would be very effective in extinguishing fires inside the machines after the air supply had been cut off.

The employment of some efficient method of reducing the fire hazard in generators of the turbo type either along the lines mentioned or in some other way is important. The value of these generators is great and the damage by fire may amount to a considerable proportion of the first cost. It is probable that the damage is more liable to occur towards the end of the life of the generators, but even then the loss may be large, both directly and indirectly. The large central stations have reserve units so that the increased damage due to fire in one of their generators would probably not affect the continuity of service, but the increased time necessary for repairs may be long and during this time the reserve capacity will be weakened. In the case of industrial plants the longer time needed for repairs might be serious. Many manufacturing concerns who generate their own current depend on only one unit and, therefore, their whole production, or a large part of it, would be affected.

UTILITY AND ATTRACTIVENESS IN ECONOMIC RESERVOIR DESIGN*

DESCRIPTION AND DESIGN OF A CIRCULAR REINFORCED CONCRETE RESERVOIR, 200 FEET IN DIAMETER, 26 FEET DEEP, WITH SIDE WALL WHOLLY ABOVE GROUND.

By ALEXANDER POTTER,
Consulting Engineer, New York City

MUSKOGEE, Oklahoma, takes its water supply from the Grand River. The present intake is located in the channel of the river, about 1,800 feet above its confluence with the Arkansas River. Two 16-inch cast iron pipes, each 2,600 feet long, laid in the bed of the Grand and across the Arkansas, convey the water to the pumping station. Low-lift pumps raise the water to a three-million-gallon settling basin. The water is then pumped through a 24-inch main, 20,800 feet long, to the city. A standpipe located in the northern part of the city, equalizes the pressure in the town.

The improvements to the water system are the result of recommendations made by the writer, who, in the fall of 1910, was retained by the city to investigate the existing water and sewerage systems, and to devise methods and means to adapt the existing systems, then overtaxed, to the present and probable future needs of the city. The improvements consist of the replacing of the two 16-inch suction lines by a 4-ft. 6-in. intake constructed in rock tunnel, with an intake tower at the upper end; the installation of additional high and low-lift pumping units; the construction of a water purification plant, including a six-million-gallon settling basin; the construction of the six-million-gallon reservoir with which this article deals; together with the construction of a 24-inch supply main, 12,600 feet long, connecting the reservoir located on the other side of the city from the pumping station with the existing distribution system.

The Need of a Large Storage Reservoir.—The object in constructing the reservoir was twofold; namely, to increase the pressure throughout the town, and to have at all times a large quantity of water available at a sufficently high elevation to maintain the pressure in the town at times of heavy draft or in case of a serious breakdown of the pumping station or force line.

The pressure in the central portion of the city ranges from sixty to seventy pounds. At times of heavy draft, these pressures cannot be maintained. A stand-pipe, 25 feet in diameter and 120 feet high, was erected in 1903 to help maintain the pressure in the city. The effect of the stand-pipe in this direction, however, is very slight, because of the small quantity of water in the pipe at the height at which it is required.

Conditions Which Influenced Design of Reservoir.—A storage and distribution reservoir, to be effective, should always be located as close to the city as possible; otherwise, too great a fluctuation in pressure will exist in

* Before the Convention of the American Waterworks Association, Minneapolis, June 25, 1913.

the distribution system. A site suitable for a reservoir exists within the city limits. In the northern part of the city, there is a knoll which reaches an elevation of 653 feet above mean sea level. The stand-pipe was erected on this knoll when the plant was built. In the extreme western end of the city is another knoll, known as Agency Hill, which reaches an elevation of 760 feet, thirteen feet lower than the highest water level in the standpipe. The top of this knoll has a hog-back shape, and averages about 200 feet in width. This is the only hill available for the construction of a distribution reservoir of the size required.

Good waterworks practice would require a city of the size of Muskogee to maintain a fire pressure of at least seventy-five pounds. A reservoir with its average water level at the elevation of the surface of the ground on the hill, viz., 760 feet, would give a static pressure of only

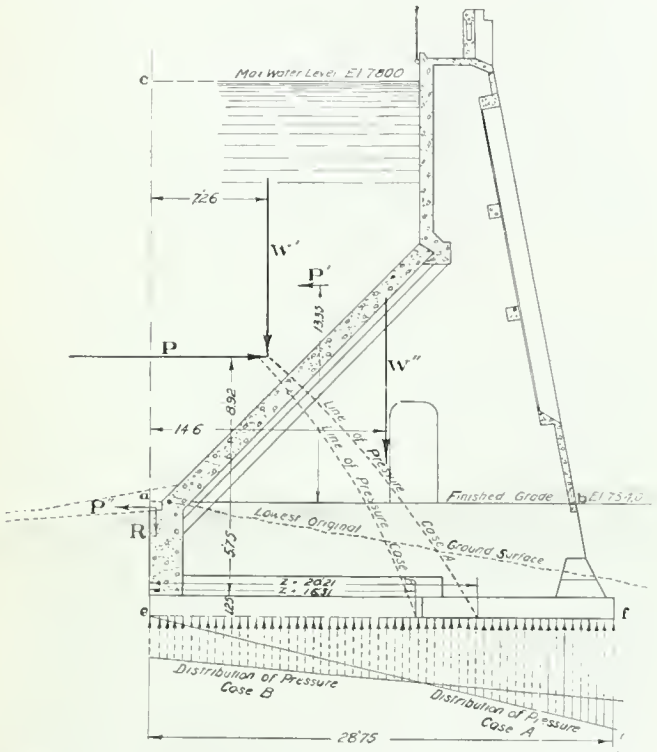

Fig. 1.—Section of Dam, Showing Diagram of Forces.

69.4 pounds over the central portion of the city. It was decided to adopt some type of construction that would insure a normal water level in the reservoir at least 20 feet above the surface.

The shape of the top of the hill, the size of the reservoir, the necessity of having most of the water stored above the ground, all tend to make the structure one of more than usual interest.

The top of the hill consists of three or four feet of clay and scattered boulder, underlaid with layers of clay and shale.

Reinforced concrete is practically the only material that could be used to construct a reservoir of the proportion and shape required by the conditions assumed above.

Possible Types of Construction.—A circular shape was decided upon. This shape is usually the most economical, but under the existing conditions, unquestionably so.

To obtain the required capacity of 6,000,000 gallons, a circular tank with its diameter limited to 200 feet requires a depth of 26 feet. To construct a circular tank of these dimensions in which the internal pressure is resisted by the tension in the shell, was considered inadvisable; first, because of the high cost of construction, and second, because of the probability of structural defects developing at the junction of the shell and the bottom. Such defects might permanently impair the value of such a structure as a reservoir.

A circular reservoir 200 feet in diameter will, when filled with water, expand 0.96 inches, on the assumption that the steel in the shell is stressed to 12,000 pounds per square inch. This enlarging of the cylindrical shell, as it affects its connection to the bottom of the tank, can be taken care of in one of several ways, all of which are more or less unsatisfactory:

First. By rigidly connecting the bottom to the side and making the bottom a thin section not more than 6 inches thick and sufficiently reinforced with steel so that it can stretch this amount without producing cracks large enough to allow the water to escape.

Second. By the use of a water-tight expansion joint at the point where the bottom joins the shell.

Third. By preventing the expansion at the bottom of the shell.

The third method calls for heavy, massive construction, is correspondingly costly, and is not successful unless the lower portion of the tank is designed with the greatest of care. When this is done, the economy of this type of construction no longer obtains, as the stress in the circular reinforcement depends on the expansion of the shell, which, if prevented by a rigid connection at the bottom, will reduce the working tension in the circumferential bars directly proportional to the amount by which the expansion of the shell is prevented.

As all of the methods mentioned for overcoming the weakness at the connection of the bottom to the cylindrical shell, are more or less experimental in a large reservoir, the writer was opposed to this type of construction. The amount of circumferential steel reinforcement required in the circular type, also increases with the square of the diameter. Therefore, the economy in the cost of construction found in the smaller tanks, no longer obtains in the larger sizes.

Another type of construction for the side walls of large reinforced concrete tanks is the cantilever section. This type of construction is not, it is believed, adapted to tanks deeper than 15 feet. In a tank of this type there is always the possibility of hydrostatic pressure developing under the broad base, thereby endangering the stability of the structure.

A third method, and one which has been in general use, is that in which the side walls are supported by buttresses or counterforts. This method of supporting the wall sections is a very economic one for tanks of considerable size in which the depth exceeds 8 to 10 feet. A modified type of this construction, in which the deck is inclined and supported by buttresses, is a very economic one for tanks of greater depth and is the one adopted for the Agency Hill reservoir described in this paper. The latter type of construction is not adapted to rectangular tanks of considerable depths. In rectangular construction, the corners are very apt to give trouble. Here, the pressures are at right angles to each other, and with the resultant deflections which are appreciable at the top of the tank, also as right angles, it is almost impossible to prevent large cracks from forming at the corners. These cracks are apt to be of such magnitude as to render the structure of little value as a reservoir. This criticism does not hold good when circular or elliptical construction is resorted to.

Description.—The reservoir as built is circular in form, 200 feet in diameter on the inside, and 31 feet deep in the centre. The walls of the tank are supported by fifty buttresses, radially spaced. The deck is carried straight between the buttresses, thus the reservoir is not truly circular but a fifty-sided polygon. For a distance of 10 feet below the water level, the sides are carried down straight; below this point, the sides are inclined at an angle of 45°. The bottom of the reservoir is a segment of a sphere, with a maximum ordinate of 5 feet at the centre.

The shape adopted is one in which practically all of the available water is stored above the surface of the ground. Of the total storage, amounting to 6,000,000 gallons, only 580,000 gallons, or 9.7 per cent. of the total storage, is below the finished grade, and approximately 40 per cent. is stored in the upper 10 feet, thus making it a very effective pressure-equalizing reservoir.

Fig. 1 shows the stresses acting on a portion of the dam subtending an angle of 7° 12′ at the centre, all of which is supported by one buttress. In this figure are shown all of the forces acting on the section.

The horizontal component "P" of the water pressure acts radially outward and amounts to 244,880 lbs. Its line of action is 8.92 feet above the line a-b (Fig. 1). The total weight of the water—W′—resting on the inclined deck is 218,560 lbs. with its line of action 7.26 feet to the right of the line a-c. The prismoidal form of the body of water resting on the inclined deck makes the computations, both for the amount of these pressures and their locations, somewhat involved, and for this reason they are not reproduced in this paper.

The weight of the concrete section—W″—based on 145 lbs. per cubic foot of concrete, amounts to 191,000 lbs. Its centre of gravity is 14.6 feet from the line a-c.

As several intermediate factors enter into the computations necessary to determine the line of pressure in the buttress and the distribution of the foundation pressure over the footing course of each buttress, it was deemed best to compute the limiting values of these pressures under the following assumptions:

Case A.—Based on the assumption that each section must stand independent of its neighbor.

Case B.—Based on the assumption that the various sections are united into a monolithic structure and that all the forces resulting therefrom are taken into account to the full extent that they may be counted upon to develop in the structure.

Case A.—The point where the resultant pierces the base, e-f, under this assumption can be obtained by taking moments about the point "e," as follows:

$$P\ (= 244{,}880) \times (8.92 + 5.75 + 1.25) = 3{,}898{,}490$$
$$W'\ (= 218{,}560) \times 7.26 = 1{,}586{,}700$$
$$W''\ (= 191{,}000) \times 14.60 = 2{,}788{,}600$$
$$\Sigma M = 8{,}273{,}790$$

$$z = \frac{\Sigma M}{W' + W''} = \frac{8{,}273{,}790}{409{,}560} = 20.21$$

"z" is the distance from the line e-a to the point where the resultant pressure on the foundation pierces the base.

The total width of the base is 28.75 ft. Therefore, the line of pressure falls 1.13 ft. outside of the middle third, thus making it appear that there will be considerable uplift at the heel of the buttress. This, however, is not the case. The total supporting area amounts to 117.65 sq. ft. Under the assumptions of Case A, the maximum pressure at the toe would amount to 6,727 lbs. per square foot, and the minimum to 29 lbs. per square foot. There is no uplift whatever at the heel. If, instead of a spread footing, a rectangular-shaped footing of the same area were used, the maximum pressure in the footing would be 7,755 lbs. per square foot, and the minimum, a tension of 795 lbs. per square foot.

Case B.—The line of pressure determined under Case A will not be the true line of pressure in the complete structure. In the complete structure a number of forces are developed, all of which add to the stability. The effect of these on the stability of the structure will be taken up in detail.

Effect of Bottom Connection.—Prior to placing the concrete in the bottom of the reservoir, further study of the problem indicated a probable weakness in the design of allowing the 6-in. bottom slab to span the refilled excavation made necessary in building the cut-off wall between buttresses. The plans of the bottom, therefore, were revised as follows:

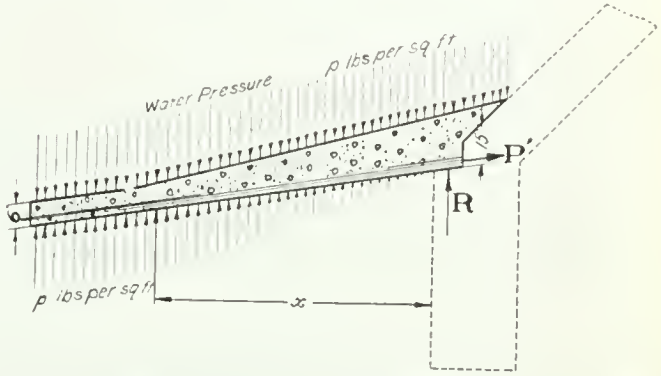

Fig. 2.—Connections at Base, Showing Acting Forces.

To strengthen the structure, the reinforced concrete bottom rests upon and is tied into the face slab by steel reinforcement. The concrete bottom is 6 inches thick and is reinforced wih ⅜-in. bars spaced 12-inch centres. Seven feet from the wall, the thickness of the concrete bottom was gradually increased from 6 ins. to a depth of 15 ins. directly over the supporting wall. The reinforcement in the bottom immediately adjacent to the wall consists of ⅜-in. square bars spaced 6 inches at the perimeter. The bottom is tied into the deck by half-inch bars, 5 feet long, spaced 12-inch centres.

Fig. 2 shows the connection of the bottom to the sides. In this figure are shown all of the forces that act on the section A, viz., the weight of the water resting on the bottom with an intensity of "p" pounds per square foot, the supporting pressure of the foundation increasing from zero at the support to a maximum of "p" pounds per square foot, "x" feet distant from the support; R, the reaction per lineal foot of the supporting wall, and P′, the pull per lineal foot exerted by the side walls. This construction would add appreciably to the stability of the buttresses in transferring the line of pressure nearer to the centre of the wall.

In Fig. 2 the distance "x" is limited by the strength of the bottom slab. Assuming a fibre stress of 20,000 pounds per square inch as the limiting stress that can be developed in the steel without permanently impairing the strength of the structure, we obtain a value of 6.28 ft. for x and a value of 3,400 pounds for R. The force T is developed in the ½-in. bars spaced 12-inch centres along the perimeter of the bottom and can reach 5,000 pounds per lineal foot without injury to the structure.

A new city engineer was appointed about this time, who was placed in actual charge of the construction. He was wholly out of sympathy with all the writer's plans.

The need of some additional reinforcement of the bottom at this weak point of connection was apparent when pointed out. As a substitute therefor, all the excavated material disturbed by the construction of the toe of the deck slab was removed and the space filled with plain concrete and the original thickness of the bottom maintained. This not only required more concrete, but it effectually destroyed the function of the drain laid at the foot of the wall to prevent hydrostatic pressure from developing under the structure. The opinion of the writer was not asked upon the wisdom of this change.

Effect of Continuity of Circumferential Reinforcement on the Stability of the Structure.—The circumferential reinforcement of the structure consists of sixty-five ¾-in. bars, eleven ½-in. bars, and six ⅜-in. bars, giving a total cross-section of 39.97 square inches. All of this reinforcement is lapped sufficiently at all connections so that the steel reinforcement of the shell can be considered to be practically continuous. As the shell expands under the internal pressure, this steel reinforcement is subjected to tension, thereby resisting directly a certain amount of internal pressure. The writer has every reason to believe that the diameter of the tank when filled with water will increase by ½ to 1 inch at the top. This expansion of the tank under pressure produces a stress of from 6,250 to 12,500 pounds per square inch in the circumferential steel reinforcement.

Assuming the average stress in the ring tension due to the circumferential reinforcement to be 6,000 pounds and to increase from 3,000 pounds at the bottom to 9,000 pounds at the top, the total outward pressure per lineal foot of tank thus resisted by the steel, amounts to 2,585 pounds. This is obtained from the formula,

$$T = pr$$

where T = ring tension = 6,000 × 39.97 = 239,820 lbs.
p = total hydrostatic pressure per lin. ft. of perimeter resisted by ring tension.
r = radius of tank, 92.75 ft. measured at the same height as the resultant line of action of the horizontal water pressure.

The height at which the force "p" acts can only be approximately determined. The centre of gravity of the steel reinforcement is 11.5 ft. above the line a-b and with the assumption as to the distribution of the pressure, the line of action of "p" is about 13.35 ft. above the line a-b.

In Fig. 1 are shown all of the forces acting on a portion of the dam, supported by one buttress, when this section is considered to form a part of the complete structure. The additional forces acting on the section, due to the rigid connections, are P′, R and P″.

P″ represents the radial tension that may be developed by the steel reinforcement connecting the bottom with the inclined deck. The value of P″ may reach 5,000 lbs. per lineal foot, or 52,900 lbs. per buttress, without injury to the structure.

R represents the reaction of the bottom on the supporting wall. This may also attain 3,400 lbs. per lineal foot or 35,900 lbs. per buttress.

The pressure—P′—under the assumptions made, amounts to a maximum of 2,585 lbs. per lineal foot of circumference, or 31,600 lbs. per buttress.

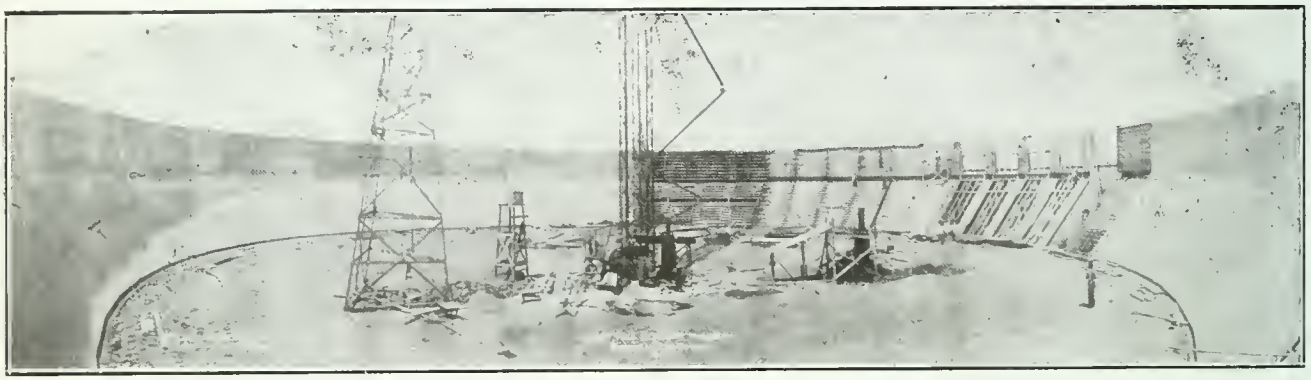

Fig. 3.—Interior of Reservoir During Construction.

Taking moments about the point "e" of all the forces acting on the section, under Case B we have:

P = 244,880 × 15.92	+ 3,898,490	
W′ = 218,560 × 7.26	+ 1,586,700	
W″ = 191,000 × 14.60	+ 2,788,600	
P′ = 31,600 × 20.35		— 643,060
P″ = 52,900 × 7.00		— 370,300
	+ 8,273,790	— 1,013,360
	— 1,013,360	

$$\Sigma M' = 7{,}260{,}430 \text{ ft. lbs.}$$
$$\Sigma V' = W' + W'' + R = 445{,}460$$
$$z = \frac{\Sigma M}{\Sigma V} = 16.31$$

Under Case B, the pressure line cuts the base 16.31 feet from the heel, well within the middle third. This gives a foundation pressure ranging from 4,962 to 2,544 pounds per square foot.

The foregoing computations show that the pressure at the toe of the buttress footing may range from 4,962 to 6,727 pounds, and the minimum pressure at the heel from 29 to 2,544 pounds. These pressures are conservative for the character of the foundation upon which the footings are placed.

The buttresses, which are radially spaced, are 15 inches in thickness. At the point where the inclined deck starts, there is considerable tension on the side of the buttress nearest the water. This tension is taken up by three ⅞-inch square bars at a unit stress in the steel of 9,000 lbs. per square inch, making full allowance for the

weight of the section; ignoring this, the stress in the steel will be 15,000 lbs. per square inch. Two ⅞-inch square bars are carried up along the face of the incline of the buttress to take care of any possible tensile stresses, especially at the upper end of the incline where these stresses may be considerable.

The face of the buttress upon which the deck rests, is corbeled out to 30 inches. The corbel is reinforced by two ⅝-inch square bars tied together by ⅜ square ties spaced 12 inches centres. These ties serve both the purpose of reinforcing the corbel against cantilever action developed by the deck resting on the outer ends of the corbel and preventing the splitting of the buttresses.

When the structure was about half completed, the writer discovered an error that had crept into the plans which called for ⅜-inch square bars in the spread footings of the buttresses in place of ¾-inch square bars as required by the computations. The footings as constructed do not give, in the opinion of the writer, a sufficient factor of safety in adequately distributing the pressure over the area assumed in the design, and it was therefore deemed highly advisable to reinforce the spread footings.

The method suggested for reinforcing the footings required the cutting out of a section of each buttress already constructed, and placing upon the footing a reinforced concrete beam 3 feet wide on the base and about 27 inches deep under the buttress and 12 inches deep at its outer end. This beam was to be reinforced with six ¾-inch square bars.

To obtain a good bond between the old buttress and the new work, it was proposed to maintain a head on the semi-liquid concrete so as to force it into the buttress and to maintain this head until the new concrete had obtained its final set.

It is regrettable that the city officials failed to appreciate the importance of strengthening the footings, which could have been done at a nominal cost and would not have added more than one per cent. to the total cost of the structure. In thus refusing to comply with the plans, they have assumed all responsibility for the structure. Although it is strong enough as built to withstand all the pressures that may come upon it, there is always a possibility that one of the buttresses may settle sufficiently to impair the usefulness of the structure as a reservoir. The cost of repairing this defect may exceed many times the cost of reinforcing the footings in accordance with the plans. Had the suggestion been carried out, it would have effectively reinforced the spread footing so as to enable it to properly distribute the pressure over the foundation.

Construction of Deck.—The deck, with the exception of the top, is not tied into the face of the buttress by steel reinforcement. The vertical portion of the deck is 10 inches thick. The thickness of the inclined portion varies from 12 inches at the top to 15 inches at the bottom. The steel reinforcement is stressed to an average of 5,200 pounds per square inch in the vertical portion of the deck, and to 10,000 pounds in the lower or inclined portion. The deck of the reservoir is constructed as a monolith; no expansion joints are used. This type of construction throws additional tension upon slab reinforcement, especially in its upper portion. Provision has been made, in the design, for this additional stress by using a somewhat lower working tension in the slab reinforcement than is otherwise necessary. A widening of the diameter of the tank at the top, of as much as an inch, will increase the stress in the circumferential reinforcement to 17,200 lbs. per square inch.

Fig. 4.—Nearing Completion, Exterior View.

Attention is called to the connection of the inclined to the straight portion of the deck. This joint, which is naturally a weak one, has also been made a construction joint. It has been strengthened by a 12-inch by 16-inch concrete beam reinforced with four ¾-inch square bars.

Hydrostatic Uplift.—In this article, no mention whatever has thus far been made of the possibility of hydrostatic pressure developing either under the concrete bottom or against the curtain wall, and thereby affecting the stability of the structure. This is guarded against by underdraining the spherical bottom with four and six-inch tile drains. Five 4-inch lines of drains are laid radially and drain to a sump at the centre of the reservoir. From this point a 6-inch drain is carried radially outward to a free outlet on the hillside. A circular line of 4-inch tile drain is laid entirely around the outer edge of the spherical bottom just above the footing of the 24-inch circular cut-off wall.

With these provisions, it is almost impossible to conceive of hydrostatic pressure developing to an extent to make it necessary to take it into consideration in the stress analyses. Under the worst possible conditions, with all the underdrains clogged, the hydrostatic uplift is limited to the bottom of the reservoir and the footing of the 24-inch wall, and even then the effect of it on the stability of the structure is negligible.

Architectural Treatment.—The city bought the property immediately adjacent to the reservoir to convert it into a park. To improve the appearance of the structure, the buttresses are widened out to three feet at the back, and between them a concrete curtain wall, four inches thick, is carried up for a distance of four feet above the finished grade. Between the tops of the buttresses, concrete arches are sprung. Each arch has a rise of three feet and a clear span of three feet less than the distance between the buttresses. The recess thus formed is filled at a depth of 12 inches with a thin curtain wall of stucco placed on hy-rib. At intervals of 5 ft. 7 ins., the hy-rib is supported by reinforced concrete beams. A concrete walk, 2 ft. 8 ins. wide, extends entirely around the reservoir. On the outside of the walk, a concrete railing in conformity with the architectural treatment of the reservoir is built. The false construction just described gives the reservoir a pleasing appearance of massiveness.

A driveway, 33 ft. 6 ins. over all, extends entirely around the reservoir.

Piping and Drains.—The water enters the reservoir through a 24-inch line. The outlet is located at the centre of the reservoir and is of the same size. Circulation is maintained by two check valves, one in the inlet and the other in the outlet, so arranged that the direction of the flow in these pipes cannot be reversed.

The overflow is located 18 inches below the top of the tank. The overflow pipe is 10 inches in diameter. A 10-inch cast iron pipe with its inlet in the lowest part of the spherical bottom and its outlet on the hillside, drains the reservoir.

Monolithic Construction.—Some question may be raised as to the economy of constructing a reservoir of the size described without expansion joints. The principal advantage that can be gained by monolithic construction is a general increase in strength. In a large structure, this increase in strength is by no means as great as a casual inspection leads one to believe. It is obtained only at a sacrifice. The stresses in the deck, when built continuous, are no longer static determinate quantities, and their amounts cannot be ascertained with any degree of accuracy. The stresses developed in the deck acting as a beam are also increased a more or less indeterminate amount by the expansion of the shell under pressure. For these reasons, comparatively low unit stresses must be used in designing the deck. The gain in strength due to continuity of deck construction, practically decreases as the square of the diameter in a structure of the type described. The increase in strength due to continuity of deck construction in large tanks is therefore very small.

Watertightness of the Structure.—Under ordinary conditions, the writer is opposed to the use of waterproofing ingredients or waterproofing applications, as both add considerably to the cost of concrete work. It is far better to put the value of the waterproofing materials into the concrete work itself by adding more cement. In general, the use of waterproofing ingredients or application tends to poor construction work, the contractor counting upon the waterproofing to materially help out careless construction.

The only waterproofing called for in the specifications under which the reservoir was constructed, was two coats of neat cement wash to be applied with a whitewash brush on the inside of the basin. The second coat must be applied before the first one has had time to get very hard.

Before the final acceptance of the work, the contractor is called upon to render the structure watertight if leakage develops in the basin in excess of five gallons per minute. The reservoir has been filled for a number of months to within ten feet of the top, and the leakage, as measured at the outlet of the underdrains, at no time has exceeded half a gallon per minute. No leakage whatever is visible on the outside of the shell.

Horizontal construction joints are used freely. The unfinished surface of these was always left in as rough a condition as possible, but was never roughened up after the concrete had partially set. The writer's experience has been that this roughening often loosens the stones in the partially set concrete, but not sufficiently so that the loose stones can be removed by brushes, a condition which is apt to impair the watertightness of the structure.

To start a day's work, the old concrete surface was thoroughly cleaned with wire brushes and water, and a semi-liquid mortar mixed in the same proportions as the mortar in the concrete was poured over the old work to a depth of half an inch. This method has given good, watertight horizontal construction joints.

Vertical construction joints were permitted only over the buttresses as such joints are very difficult to make watertight.

Cost of the Structure.—The following is an approximate estimate of the materials required for the structure, together with the contract unit prices:—

7,271 cu. yds. excavation, including grading, @ $0.55	$ 3,999.05
100 cu. yds. rock excavation @ $1.70	1,700.00
965 cu. yds. 1:2:4 concrete masonry @ $9.00	8,685.00
1,739 cu. yds. 1:3:6 concrete masonry @ $7	12,173.00
3,400 bbls. cement @ $1.50	5,100.00
189,900 lbs. steel reinforcement @ $0.0425	8,070.75
650 lin. ft. parapet wall @ $1.40	910.00
196 lin. ft. 24-in. cast iron pipe @ $5.40	1,058.40
215 lin. ft. 10-in. cast iron pipe @ $2.00	430.00
110 lin. ft. 3-in. cast iron pipe, drain, @ $0.50	55.00
12,300 lbs. cast iron specials @ $0.05	615.00
Two 24-in. check valves @ $200.00	400.00
One 24-in. gate valve @ $240.00	240.00
One 10-in. gate valve @ $25.00	25.00
880 lin. ft. 4-in tile-drain @ $0.12	105.00
160 lin. ft. 6-in. tile-drain @ $0.20	32.00
90 lin. ft. 12-in. vitrified pipe @ $0.70	63.00
One strainer 24-in. outlet pipe @ $7.50	7.50
630 lin. ft. 1-in. pipe railing @ $0.40	252.00
500 lbs. wrought iron @ $0.05	25.00
20,300 sq. ft. of stucco on hy-rib @ $0.15	3,045.00
Total contract price	$46,991.30

The reservoir was built on the summit of a hill about a mile from the nearest railroad station. All water used for concreting had to be carted up the hill, a distance of about a mile.

The final estimate exceeded the bid price by a very small percentage. The contractor's profit on the work approximated twenty per cent., indicating a reasonably economic reservoir, yet one which presents a very attractive appearance.

THE PENETRATION METHOD IN MACADAM ROAD CONSTRUCTION

By W. W. Crosby, C.E.,
Chief Engineer to the Maryland Geological Survey.

IN last issue of *The Canadian Engineer* a paper by Prof. A. H. Blanchard, dealing with the progress that has been made in America during the past three years, in bituminous paving by the mixing method was given. In connection with it, should appear a paper by Major W. W. Crosby, consulting engineer, Baltimore, Md., on the essential points of modern practice in America in the construction in open country of macadamized roads, bound with tarry, bituminous, or asphaltic materials, by the penetration or grouting method. The following is a crystalization of Major Crosby's paper, as read at the Third International Roads Congress in London:

Foundation and Drainage.—The necessity for firmer and stronger foundations, and, to this end, for the best possible sub-drainage, seems to be fairly widely and generally accepted, especially by those whose vision into the future is keen enough to permit them to recognize the probable increase in the demands on the foundations, to be brought about by better surfaces and by the consequent growth in both the amount and weight of traffic as well as in its severity. This necessity is even more apparent when the penetration method of constructing the crust is used because of the fact that such a crust appears to have frequently less inherent rigidity than many built by the mixing method.

Sizes and Shapes of Broken Stone for Bituminous Bound Surface Crusts.—While the mixing method may require a combination of different sizes of broken stone for the best results, with the penetration or grouting method under discussion, this is not the case. The unscreened product of a crusher is often used quite satisfactorily for the bottom course of the crust, though this course is frequently just as satisfactorily built of the coarser portions of this product. The choice depends on local conditions. It is considered inadvisable, however, to allow any particles over 3 ins. in length in this course.

In the second or wearing course, it is the best practice to pay considerably more attention to the screening and sizing of the stone particles. Very good results have been obtained by the use for the second course of cleanly screened stone passing a 1¾-in. round opening and not able to pass a ¾-in. Apparently better results have been secured by the use of pieces passing a 2-in. and retained on a 1-in. screen, and very good results seem to have been secured, where the pieces were most cubical, by the use of stone passing a 3-in., and retained on a 2-in. screen. More uniformity of grouting, together with longer wear, seems to be secured by the use of the larger sizes, and, further, a surface built of the larger sizes seems better able to withstand without damage the crushing strains of the heaviest loads carried on hard tires.

It has not been the best practice to permit too great a difference between the sizes of the screens used for separating the material for this course, about 1 in. being the customary difference in diameters of holes and 1½ ins., the maximum. A great difference seems to contribute toward lack in that much to be desired uniformity of grouting and this is especially noticeable in stone breaking into scaly pieces.

The writer believes that with a fairly cubical broken stone the best results have been obtained by the use of screens 2½ ins. and 1½ ins. in diameter of openings and that in the case of shaley rock 2 ins. and 1 in. have given the best results.

Reference has been made to "cubical" and "scaly" or "shaley" stone. There is general agreement that stones breaking cubically, without glassy fracture—that is, with fairly rough surfaces—and with sharp angles are most desirable.

The Use of Partially Worn Materials in Bituminous Bound Surface Crusts.—From the foregoing it will be seen that partially worn materials are usable for the bottom course of the crust, and they are frequently so used. Experience shows that such use should be accompanied by proper regard for the segregation, by harrowing or screening, of the fine material and detritus generally present with the coarser sizes. But the use of even the carefully separated coarser sizes of the old worn material is not generally permitted for the upper course of the crust as it is considered dangerous to successful results.

Thickness and Composition of the Strength Crust and of the Super or Wearing Crust Under Different Conditions.—So much depends on the particular conditions of the individual case that a general statement on this point is, with difficulty, made of any value. In addition to what has already been stated regarding sizes and shapes of the pieces of stone, it may be further said that the bottom course varies from a minimum thickness of perhaps 2 ins. to a maximum of 8 ins., measured after compaction. The average is probably from 4 to 5 ins.

This course is built both with and without the addition or presence of fine material (passing a ¾-in. or ½-in. screen) as local conditions seem to determine though it seems that the proper use of a moderate amount of the smaller material generally produces a firmer and stronger first course.

Occasionally the completed bottom course has been given a coat of pitch before spreading the upper course stone, but ordinarily this use of the pitch is not followed, nor does it generally seem to be considered necessary to endeavor to secure any penetration of the pitch to the bottom course through the upper course stones.

The super or wearing course, it may be said, is generally from 2 to 3 ins. in thickness after rolling. For the proper penetration and adherence of the bituminous material or pitch of whatever nature, it is now generally agreed that the particles of stone must be clean and free from coats of stone-flour, dirt or dust. Apparently a general preference exists that they should also be dry but there is still much discussion on this latter point, and it is by no means determined what lack of dryness can be permitted without detriment to the results. A very few have even advocated the presence of a certain amount of moisture on the stone before the application of the pitch, but the writer prefers a dry condition, though he agrees that, in most cases, a moderate amount of moisture is not as objectionable as dirtiness or dustiness.

Another most important factor affecting both the courses of a bituminous as well as of a water-bound road crust is the sufficiency of the rolling given them. So generally is it now accepted that with water-bound macadam the utmost possible compaction and interlocking of the stone by rolling is necessary for first-class results, that the truth of the saying that "Rolling is the life of the road" is everywhere recognized. With bituminous macadam built by the penetration method, the concordance on this point seems to be as yet less complete. Some road-builders actually insist on a minimum of rolling before the application of the pitch and others do not require a maximum. With the writer's work, however, there is

no question but that the quality of the results has been in direct proportion to the amount of compaction or interlocking secured by proper rolling, and it is his opinion that results generally show that the proper rolling of the stone before the application of the pitch is of the greatest importance.

Relative Advantages and Use of Tar, Tarry Compounds, Asphalt, Bitumen and Other Materials.—The proper selection of the bituminous material or pitch for use under the penetration or under any method is a most serious one and is influenced by many conditions other than method of use. Such, like price, soil, weather and traffic conditions, desires of users of, and abuttors on the road, the conditions likely to prevail regarding after-maintenance and cleaning, etc., etc., are largely local, and are probably not germane to the discussion in this paper.

Confining the statements to the above subjects and considering only the penetration method of use, it may be said:

The use of unrefined tars has been found unsatisfactory and has been practically abandoned. The extent and character of the refining seems to depend largely on the peculiar conditions to be expected in any case of the use of the material, but some points in this connection are still unsettled. It seems generally agreed that the presence in the tar of more than a minimum of water or ammoniacal liquor renders it undesirable for this method of use; that certain amounts of "light oils" are necessary for giving to the pitch the desired fluidity in handling; that a generous proportion of "middle" and "heavy" oils —especially the latter—is demanded in order that the tar may retain the longest possible "life" or elasticity after use and under the ageing or weathering effects of weather and traffic as well as for giving the "body" to the pitch demanded by this method; and that a limited amount of "free carbon" may be advisable in order to help to give body to the tar and to assist in reducing its susceptibility to changes in temperature. This "free carbon" (matter insoluble in carbon bisulphide) may be either the natural fraction of the tar or it may be added foreign material such as Portland cement or finely powdered limestone. Some crusts built by the penetration method with a low carbon tar have seemed to improve as fine material was supplied by traffic.

At first an opinion existed widely that the value of a tar for road work was in inverse proportion to its percentage of "free carbon" content, but the writer was loath to accept this view because of his knowledge of the proved great value of certain tars in which this fraction was unusually high. Results of practice with the penetration method to date seem to indicate that it is not the simple proportion of the "free carbon" fraction to the whole tar which was of use as a criterion in passing on the value of the tar for the penetration method but rather the ratio between the "free carbon" fraction and one or more other fractions (the heavier oils) on which depends the worth of the whole tar.

The use by the penetration method of tars with a "free carbon" content of less than 2 per cent. has resulted in an objectionable susceptibility of the road surface to summer heats, while the use of tars whose "free carbon" fraction was greater than the percentage of the heavier oils in the same tar has shown a too great hardness or friability under extreme cold.

In the use under the penetration method of the native asphaltic materials and of the oil residuums, a certain amount of "light oil" seems desirable for the sake of fluidity, and a limited amount of "middle" and "heavy" oil fractions for the sake of "life" and elasticity. The "pitch" fraction, being the base in those cases, must possess the desired characteristics of adhesiveness, cohesiveness, lack of brittleness and resilience. The proper proportions of the lighter fractions depend on the characteristics, in those particulars at least, of the "pitch" as well as upon the conditions of traffic, etc.

Early practice under the penetration method condemned the use of "cut back" products,—i.e., those artificially prepared by the addition of oils to previously reduced pitches—probably because in many cases such pitches had not been carefully prepared with this end in view but were by-products or wastes from processes arranged for the production from the raw material of the portions other than the pitch.

The writer believed that not only was it possible to make satisfactory road compounds for use under this method from a pitch by cutting it back with lighter materials, but also that it was quite possible that, in many cases, a far more satisfactory product could thus be obtained than by simple reduction, to the desired consistency, from the raw material.

Subsequent experience has seemed to confirm this theory and some of the most satisfactory results under the penetration method have been secured by the use of pitches compounded by adding the necessary oils to a previously and purposely prepared, fairly hard, asphaltic pitch.

In such cases, the harder pitch possessed all the usual qualities of a good asphaltic paving pitch and the flux, those of a proper flux for making asphaltic cement, except that perhaps more volatile oils were included to permit of easier and better use under the peculiarities of the penetration method. Experience seems to have proved that there is a limit to the amount of "greatness" that can safely be permitted in the flux so—as above—used and that an excess of this characteristic may ruin the results under this method by permitting, if not encouraging, the internal motion between the coarse particles of the crust, especially in the usual case of a deficiency of the smaller sizes.

In the use of the materials referred to, so much depends on the peculiarities of the local demands that brief general statements are again somewhat difficult. A few such may, however, be justified. For instance, experience has seemed to prove that in the use of tars or tar-compounds under the penetration method, better results have been secured where the softer materials have been used provided such softness was not secured by an excessive proportion of volatile or light oils. This seems especially true when considering the tendency of certain pitches to produce surfaces slippery in wet or cold weather.

As regards asphaltic materials (including oil residuum) it seems that in many cases where softness has been given by a generous amount of the middle oils (non-volatile) the resulting surfaces under this method have shifted under traffic in warm weather and evidenced "lubricating" rather than the necessary "binding" characteristics of the pitch compound.

Regarding the quantity of pitch to be used under the penetration method while the character of the wearing course (as to sizes, kind, etc., of the material) will affect the decision, it may be stated that ordinarily the successful amount of bituminous material per square yard of surface seems to have been between 1½ and 2 gals. The writer has built entirely satisfactory work with as low as 1¼ gals. per square yard, but under exceptional condi-

tions. He has also seen instances where as high as 4½ gals. per square yard of tar was used, but with little dissatisfaction with the resulting surface. In fact, the main objection that appeared in those latter cases came from some bleeding of the pitch over the road surface during the first summer after construction, and this was readily obviated by one or two additional coatings of stone chips.

It has been suggested that an excess of pitch in the crust, provided it is located well down in the latter, may be of some decided advantage in that it may furnish a reservoir from which additional life will be given to that pitch exposed on the surface to deterioration by traffic and weather. However, penetration of the pitch to the bottom of the larger sized stone in the surface seems ordinarily to be sufficient for success.

Practice has varied in the application of the pitch under the penetration method, some applying the bulk (say, ¾ of the total amount) at first and then, after spreading a coating of chips and rolling, applying the balance with another coat of chips and more rolling. Others apply all the pitch at once. The writer concludes from his observations and experience that the latter way generally gives more satisfactory results.

With the mixing method, where the quantity of pitch may be reduced to a minimum, certain conditions may render advisable a "flush coat" of pitch and chips. But "in open country" where even slight dustiness may not be objectionable and where slipperiness may be decidedly offensive, the omission of the flush coat is generally, under the penetration method, better because of the longer freedom from unnecessary smoothness. And the writer has not found that the omission of the flush coat has, where the road crust was properly built by this method, rendered the crust visibly more susceptible to the destructive effects of either horse-drawn vehicular or motor traffic.

It seems generally admitted that with the penetration method the use of a "flush coat" is mainly for "insurance," i.e., to overcome or make good any defects from previous poor workmanship or inequalities in the earlier processes.

Uniformity of grouting has been referred to as desirable, and is now generally so recognized. Toward this end as well as for the sake of economy, efforts have been made to supplant the early system of hand-pouring by some mechanical distribution of the pitch. Some very successful machines have been devised for the purpose and it seems generally agreed that the best results under the penetration method are secured by the use of such appliances distributing the pitch under pressure of from 20 to 70 lbs. per square inch.

Cost Data.—The usual variations in cost, resulting from different local conditions, have been omnipresent with the penetration as with any other method. However, it may be stated that with labor at 15 cents, single horse carts at 27½ cents, two-horse carts or wagons at 50 cents, foremen at 30 cents, per hour, stone at $1.75 ton delivered on the work, and pitch at from 7 cents to 10 cents per gallon delivered at a railway station within one mile of the work, the cost for building by the penetration method a pitch-bound macadam using from 1¼ to 2¼ gals. of pitch per square yard averages between 15 cents and 25 cents per square yard over and above the cost of building water-bound macadam under the same conditions. A decrease in this cost has quite steadily occurred and it seems may be looked for further as proficiency in practice and as mechanical appliances for the work are developed.

BUREAU OF MINES' BULLETIN ON EXPLOSIVES

"The Analysis of Black Powder and Dynamite" is the title of Bulletin No. 51 recently issued by the United States Bureau of Mines.

This bulletin outlines the methods of analysis that are used by the Bureau of Mines in the examination of certain classes of explosives. The present form of most of these methods has been worked out in the Bureau's explosives laboratory. The methods employed by Pro. C. E. Munroe were taken as a basis, and were elaborated to meet the demands incident to the treatment of complicated mixtures and to the development of the explosives art. A subsequent bulletin will discuss the methods of analysis of "permissible" explosives, many of the latter being of decidedly complicated character and requiring special treatment. This bulletin presents the methods of analysis of "Ordinary" dynamite, and the ammonia, gelatin, low-freezing, and granular dynamites, and the common grades of black gunpowder and black blasting powder. The bulletin is published by the Bureau for the information of all persons interested in explosives and their safe and efficient use in mining work.

As the term "ordinary" dynamite, though much used, has no conventional meaning, and may be used to cover a wide variety of compositions of matter, it may be noted that the standard dynamite used at the Pittsburgh testing station is a good example of the "ordinary" dynamite known in this country. This testing station dynamite has the following composition:—

Composition of Pittsburgh Testing Station Dynamite.

	Per cent.
Nitroglycerin	40
Sodium nitrate	44
Wood pulp	15
Calcium carbonate	1

As most permissible explosives contain only the constituents found generally in the various types of ordinary dynamite, the chemist will usually find it possible to analyze such explosives either wholly or partly by following the general methods of analysis here given for the type of explosive that seems most closely related to the one under examination. The methods of extraction with ether, with water, etc., outlined in the bulletin are general methods which are applied with equal success to all classes of explosives, and therefore by the use of these general methods, following a thorough qualitative examination, little difficulty should be met except with those classes of permissible explosives that contain large amounts of salts holding water of crystallization, such as alum and magnesium sulphate, or those containing an unusual number of uncommon constituents. Even with such explosives, however, if the information desired is principally in regard to the percentages of explosive ingredients (nitroglycerin, ammonium, nitrate, etc.), the methods outlined in this bulletin may be satisfactorily followed.

The Third International Congress of Refrigeration is to be held at Chicago in September next. It will be divided into six sections, dealing with: (a) Liquified gas and units; (b) the design, construction, operation, and method of testing refrigerating machinery and insulating materials; (c) the application of refrigeration to foods; (d) the use of refrigerating apparatus in the industrial arts; (e) refrigeration in railway and steamship transportation; (f) questions relating to legislation and administration. The secretary-general is Mr. J. F. Nickerson, 431 South Dearborn Street, Chicago. The first Congress was held in Paris in 1908, and the second in Vienna in 1910.

THIRD INTERNATIONAL ROAD CONGRESS, LONDON.

On the 23rd of June, at the invitation of the British Government, and under the patronage of His Majesty King George V., in Central Wesleyan Hall, Westminster, was convened the Third International Road Congress for the deliberation and discussion of matters relating to the world-wide movement for road reform.

That the movement is world-wide is shown by the fact that some 39 countries were officially represented and in all about 3,000 delegates attended. Canada was ably represented by Mr. W. A. McLean, engineer of highways for Ontario; H. S. Carpenter, superintendent of highways for Saskatchewan; W. G. Tretheway, of the York County Highway Commission, and others.*

That the meetings were destined to be eminently successful was evinced by the large number of men, of high rank in public affairs in their respective countries, who had assembled to give their experience in matters so vital to the interests of the community—the improvement of highways.

The opening meeting was presided over by the Right Hon. the Chancellor of the Exchequer D. Lloyd-George, who expressed his deep interest in and the sympathy of the government with the objects of the congress. For some years past there has been in Europe a distinct movement in road reform. This movement found expression in the formation in Paris in 1908 of the Permanent International Association of Road Congresses. At that meeting some 400 men, eminent in professional, scientific and administrative work, chiefly from France, Germany and Great Britain, assembled to discuss matters relating to the movement. This was followed by the Brussels Congress in 1910, at which about 1,000 delegates attended, and the impetus, largely given by the association, is shown in the extraordinary attendance at this, the third congress.

Since the second congress concluded its labors in Brussels the movement in favor of road reform has made immense strides, and the past three years have been a period of constant activity and improvement. The problem of treating roads with bituminous materials has been advanced from the experimental to the practical stage, and has now attained an assured position. Experience has proved that roads can be built of bituminous material which are not only practically dustless but are also capable of carrying the heaviest ordinary traffic.

The manner in which the programme was arranged and carried out in every detail reflects great credit upon the Organizing Committee and the chairman, Sir George S. Gibb. In dealing with a matter of such wide scope, very thorough and systematic arrangement becomes essential and the plan adopted in this instance was as follows:

The papers that were to be submitted were sent in some months previous to the meeting. These were placed in the hands of sub-sectional committees for criticism. The sub-committee reported on the salient features and added recommendations or resolutions. Thus, every paper came before the congress in a predigested form and the resolutions only were discussed. A glance at the following list of subjects of the programme will give some idea of the scope and import of the deliberations of the congress, and when it is considered that many papers were submitted in each case, an estimate can be made of the volume of pre-convention work performed by the committee.

The programme comprised the following:

1. Planning of Streets and Roads.
2. Types of Surfacing to be Adopted on Bridges, Viaducts, Etc.
3. Construction of Macadamized Roads Bound With Tarry, Bituminous or Asphaltic Materials.
4. Wood Paving.
5. Lighting of Public Highways and Vehicles.
6. Observations Noted Since 1908 as to the Various Causes of Wear and of Deterioration of Roadways.
7. Regulations for Fast and Slow Traffic on Roads.
8. Authorities in Charge of the Construction and Maintenance of Roads, Functions of Central Authorities and Local Authorities.
9. Finance of the Construction and Upkeep of Roads.

The exhibition connected with the congress was most interesting and instructive, especially the exhibit of the Road Board, in which many types of construction were shown by portions that had been taken from actual roads, a full description being given in each case. There was also an excellent display of materials, machinery and appliances.

The arrangements for road excursions were fully satisfactory. The writer had the opportunity of going over the Berkshire roads in company with the chief surveyor, and we found them in excellent condition, combining in a high degree all the essential qualities of a good road. The district is almost entirely agricultural, and the roads are subjected both to heavy traffic and that of fast-moving motor-driven vehicles, and meet all the requirements admirably well. There appears to be no reason why we, in the older parts of Canada at least, should not have roads that would meet our conditions as well as these do the conditions that obtain in England. One was most favorably impressed with the manner in which all points were discussed and the manifestly good spirit which prevailed throughout the entire congress. Men of high attainments and character unselfishly gave the best of their services in the promotion of one object, that of making the world a little better for having lived in it.

The impetus given to the movement will be difficult to measure, but one can feel assured that those from Canada will return fired with new zeal for the promotion of that upon which so much of our future depends—highway improvement.

A. T. LAING.

London, June 28th, 1913.

*[The University of Toronto was represented by the writer of this article and by Professors J. McGowan and P. Gillespie.—Ed.]

Some practical rules laid down by the American Foundrymen's Association for obtaining castings resistant to corrosion are as follows: (1) Use white iron if possible. (White irons are especially useful where any acidity is to be encountered.) (2) If not practicable to use white-iron castings, chill those surfaces which are to be in contact with corrosive conditions. (3) If grey iron must be used, get dense, close-grained castings through the use of steel scrap or otherwise. (4) Avoid oxidized metal; use pigirons of good quality, together with good cupola practice. If possible, use deoxidizing agents; for example, titanium or vanadium. (5) Keep the sulphur as low as possible.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Inter-Attrition Theory of Road Wear 181
Engineers and Literature 182

Leading Articles:

The Design of Central Heating Systems 165
The Fire Hazard in Turbo-Generators 170
Utility and Attractiveness in Economic Reservoir Design 171
The Penetration Method in Macadam Road Construction 177
Bureau of Mines' Bulletin on Explosives 179
Third International Road Congress, London.. 180
Letters to the Editor 183
Addition to the Toronto Filtration Plant 184
The Increasing Complexity of Municipal Government 186
The New Highway Bridge at Lytton, B.C. ... 187
Road Resolutions Adopted by the 1913 Congress 189
Hydro-Electric Installation, City of Tokyo ... 193

Coast to Coast 194
Personals 196
Coming Meetings 196
Railway Orders 75
Construction News 76
Market Conditions 92-94
Technical and Municipal Societies 94

THE INTER-ATTRITION THEORY OF ROAD WEAR.

At no time in its history has road building received such attention as the road associations are devoting to it this season. Certainly many discussions, long pending, should be settled and many points scientifically gained as a result. Highway construction and maintenance has sufficient technical knowledge now connected with it to prevent further profuse expenditure upon methods not the most suitable.

A theory gaining ground among road engineers in England, and which has to do with the wear of roads, attributes the chief destructive tendencies to an internal movement among the stones at some depth below the surface, producing an abrasion which results in a gradual rounding off of angles and corners and impairs their interlocking and resisting power. According to a Times' correspondent, the dustlessness of roads, especially if they are made with tarred material, and not merely tar painted on the surface, arises in a comparatively small degree from the fact that the surface is protected from wear. The real saving lies in the fact that between the stones, which are packed together in close association below the surface crust, there is little or no wear, owing to the oily nature of tar or bitumen as a binder, which prevents the faces of the broken stones from actually grinding against each other under rolling weights. The surface wear of an ordinary non-tarred road is, except in cases of heavy continuous traffic, a comparatively negligible factor, and it is undoubtedly heavy weights which are the chief cause of road wear seen above and unseen below the road crust. It thus comes about that the heavy traction engine, even though its tires may be broad and the diameter of its wheels large, from its mere weightiness, apart from any question of speed, causes irresistable crushing of the road surface and the inter-attrition of the stones beneath it. This produces more dust and more mud than the passage of thousands of smaller vehicles even though they may travel at a rapid speed; for light vehicles affect only the part of the road near the surface.

Ordinary tar-macadam or tarred slag, where slag from blast furnaces is used instead of stone, laid in a layer several inches and afterwards rolled, forms a homogeneous foundation for the surface crust, in which the stone probably forms about 75 per cent. of the total volume, and the combined material—that is, small, broken stone and tar, or some compound of it—forms the remaining 25 per cent. of it. When this is rolled together the inter-attrition of the stones is reduced to a minimum, for every angle of every stone is bound together firmly or is coated with an oily surface. The beneficial result extends far beneath the surface of the road itself; so that when these stones move, if they ever do, under the influence of heavy traffic, all that happens is that a certain proportion of superfluous tar or bitumen may be forced to the surface, and ordinary mud, such as is produced by the grinding together of two plain surfaces, does not appear.

Other forms of bituminous binding that meet this intersticial wear, and confine it largely to the upper surface of the road, include several patented surfacing preparations, to be applied to ordinary water-bound macadam road. Tar grouting, where the tar or bituminous mixture is poured upon freshly laid dry macadam immediately after laying and rolling, or a modification of it using standardized pitch, or a further modification, in which a layer of a fine mixture of tar and concrete is laid, and upon which dry macadam is spread and rolled, are

among the processes that are meeting with fair success.

At any rate, the advisability appears now to be practically demonstrated of laying down roads with bituminous material for a depth of several inches, rather than merely painting the surfaces with tar, and leaving the untarred stones underneath to grind against one another, inevitably producing mud and dust.

ENGINEERS AND LITERATURE.

The study of literature in connection with an engineering course is frequently quoted as being decidedly out of place. The fact remains that many young engineering graduates find the writing of intelligent, comprehensive reports upon the work which is in their charge to be one of the hardest problems with which they have to contend, likewise the most disliked and generally the least satisfactorily fulfilled of all their duties. The failing has often been attributed to engineers in general, until one is forced to admit that it is something with which the matter of training has to do and, therefore, which reflects upon the engineering course.

Against the contention that the study of literature is beyond the horizon of the engineering school are the opinions of a great majority of the older followers of the profession—men whose rank and affluence followed the cultivation of a breadth of reading, the necessity of which they recognized in their early problems. The subsequent study of literature brought them into the possession of a better working knowledge of engineering English, which soon reflected itself in what literary work their profession required of them.

To the engineer of to-day it does more. A study of literature means a study of men, of human character, of selection and adaptation, and ability to deal with men. A study of the writings of others enables him to write, furnishes him with more than a meagre share of a knowledge and appreciation of the best in literature, and enables him to converse, with intelligence and equality, with other cultured men in his and other professions. It broadens his scope of society and business, it means recreation, relaxation and inspiration to him. Finally, the most potent thinkers of the world are, one and all, students of literature. A study, then, that has so much to do with the establishment of a man's standing among his fellow-men, should have prominence in any educational course, and to few courses does it apply more materially than to the engineering course.

EDITORIAL COMMENT.

The American Waterworks Association, at its thirty-third convention, held recently in Minneapolis, announced a membership exceeding 1,000. A new constitution was adopted, its chief feature being provision for the establishment of local sections throughout the country. The convention in 1914 will be held in Philadelphia.

* * * *

The first official statement of the new manager of railways for the Dominion Government discloses the intention of creating a 6/10 grade on the Intercolonial, from Montreal to Halifax and Sydney. The change will be affected at the rate of about 100 miles per year, short lengths of the line having to be entirely rebuilt. This remedying of grades, which are in some instances excessively heavy, will greatly increase the effective hauling power of the I.C.R. locomotives.

Mr. Gutelius further announces the intention to double-track the Intercolonial. A section some thirteen miles in length, between Levis and Chaudiere will be completed this season, and other sections will follow. At present the line from Moncton to Pansac Junction and from Halifax to Windsor Junction is under double track.

* * * *

The world's greatest drydock, to provide accommodation at Levis, Que., for the largest ocean liners, is about to be constructed as the first of a series of drydocks and ship repair plants under contemplation by the Department of Public Works. Others will be located at Esquimalt and Vancouver on the Pacific and Sydney, St. John or Halifax on the Atlantic. The contract has just been awarded for the Levis drydock, the cost to approximate $2,600,000, construction to be commenced at once, and to be ready for use in 1915.

LETTERS TO THE EDITOR.

The Road Congress.

Sir,—The International Road Congress held last week in old London was about as cosmopolitan a gathering as one could hope to see anywhere. There were forty countries or states officially represented, and the list of delegates included the best, socially and professionally, that those countries could furnish. His Majesty the King was Patron. The list of honorary presidents included five of his Majesty's ministers. The presidents of six leading engineering societies of Great Britain were among the the vice-presidents, and served, with others, on the organizing committee. It may be of interest to remark that Germany and France were officially represented by the two largest delegations—men, in the main, whose official positions and scientific attainments would lend distinction to any gathering. The proceedings were carried on simultaneously in four different halls adjacent to Parliament and Great George Streets, within a stone's throw of the House of Commons and Westminster Abbey, and in a neighborhood rich in historic associations. The sectional meetings were conducted mainly in English. The remarks of those who contributed to the discussion were invariably abstracted and translated by interpreters for the benefit of those who understood only one language. Generally, the arrangements were satisfactory, and the few disappointments that did occur were usually due to contingencies very difficult to foresee and still more difficult to provide for.

An instructive exhibition of materials and appliances was in progress during the week. This included machinery for the preparation of materials and the construction of roads, proprietary, and other articles and samples of types of highway construction taken from actual roads. Each booth had its demonstrator, usually in frock coat and silk hat, who was gracious and courteous, but not offensively aggressive; who was tolerant of competitors, and who gave one the impression that he understated rather than overstated the merits of his goods. For the Britisher is thorough if he is anything, and depends on the excellence of his article first, and the fairness of his business methods second, to create a market for his products.

Of the actual road sections exhibited, probably none were of greater interest than those supplied by Mr. J. A. Brodie, city engineer of Liverpool. These had been cut from the streets of that city and some of them had seen many years of service. One of these, I recall, consisted of six-inch Welsh granite setts above a six-inch concrete base, the two being separated by two inches of sand filler. The joints between adjacent setts appeared to be filled with grout. This road, subjected to constant heavy traffic, had stood for 41 years and appeared to be still in good condition. Another, of somewhat similar type, except that the binder between the individual setts was asphaltic instead of grout, had stood quite well under what was reported as medium traffic since 1883. Other samples gave evidence of remarkable wear in treated wooden blocks. One section consisted of creosoted dial blocks on an 8-inch concrete base. The blocks appeared to have been originally separated from each other in rows by tiny horizontal wooden strips. This road was in fair condition and had been in service since 1893. But the most ancient of all was the Roman road, discovered in 1897 at Rochester. The construction was substantial beyond doubt, since below the seven-inch paved roadway were: gravel, 9 inches; small flints, 7 inches; chalk, 5 inches, and large flints, 42 inches. Below this, finally, were timber caps and piles, the highway having doubtless been constructed across a marsh. The aggregate depth, exclusive of the timber, was 70 inches. John Bull has undoubtedly some substantial prototypes for his guidance when he turns his attention to the building of highways.

Finally, let me point out, the International Road Congress affords to the observer, mainly by contrast, a view of some of the anomalies of present-day civilization. Mr. John Burns, presiding at the final banquet of the Congress, held at the Hotel Cecil, on Saturday evening, June 28th, in moving the toast to the "International Road Congress," asserted that to the modern road was due the wonderful diminution of infantile mortality and infantile diseases, and that the lack of roads and communications had led to estrangement, hostility and misunderstanding between nations. This great International Congress, composed of representatives of the sober thought of fifty nations, goes somewhat farther and shows how the constructive arts afford a common meeting ground, prevent misunderstanding and promote good-fellowship and international good-will. But this all happens in a week when the Imperial Chancellor of Germany is asking his Reichstag for six new cavalry regiments "for the protection and security of the Fatherland," when the French populace are being forced into universal military service, and when in England the First Lord of the Admiralty has announced that because of the action of the Canadian Senate in rejecting the naval bill, the construction of three dreadnoughts will be accelerated. It is interesting to observe that he too makes use of that hoary fiction, "the safety, not of our trade, but of our lives." Meanwhile, the innocent citizen is perplexed to understand whose concealed hand is working the puppets. That the better spirit of the land is in some degree becoming disgusted with the whole sordid business is evidenced by an incident that happened at Sheffield during the week. A large number of the Roads Congress delegates were the guests of the Hadfield Steel Manufacturing Company at that city on the occasion referred to, and had been given an actual demonstration of the power of the modern projectile in penetrating armor plate. Sir Robert Hadfield, head of the great firm, in addressing the gathering, remarked significantly on its cosmopolitan character, and hoped that when the Congress again met in England his firm would not be engaged in this kind of work. The anomaly of our present civilization is that while efforts looking toward the betterment of the race, its health, its comfort, its education and its happiness, were never more active than they are to-day, the perfection of engines for its destruction was never so complete.

PETER GILLESPIE.

London, July 3rd, 1913.

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Long Distance Measuring With a Stadia.

Sir,—In traversing with a stadia it may seem incredible to some that distances of 3,000 to 4,000 feet are reported to be read or measured. Where precise measurement is required this is not possible at a single setting, but when fairly close approximations are sufficient, such long traverse sights are not infrequently taken. The method used may be of interest.

In these cases only half the wire interval is employed, that is, a 13-foot rod may be read over a distance of 2,600 feet. In some transits the two half wire intervals are not precisely the same, and in cases where the wires are attached, it is impossible to properly adjust them for this work unless they are sent to a repair shop for alteration.

In reading half the wire interval the centre wire is focused on the top of the rod, and the lower wire is marked on the rod with a target, at, for example, ten feet from the top, corresponding here to a distance of 2,000 feet. In such long distances it will, of course, be impossible to read the rod directly, and one must depend upon the rodman for its measurements. A target can easily be seen through the transit from a distance of 2,000 or 3,000 feet.

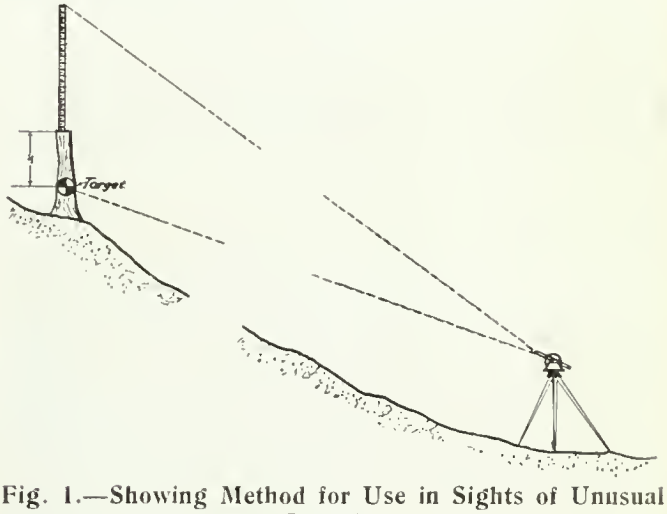

Fig. 1.—Showing Method for Use in Sights of Unusual Length.

The writer has taken many sights of this length in traversing lakes, no effort being made to read the rod, the position of the target only being viewed with the lower wire. As stated, the middle wire was focused upon the upper end of the rod and the reading was made downwards. Thus the target makes it much easier for the transit man, although its use is not required for shorter distances of, say, 500 to 600 feet.

The average 13-foot rod will read up to 2,600 feet in this way. When longer sights are required the accompanying illustration shows a convenient method to pursue.

The rod is held on the top of a tree stump as shown. It is sometimes necessary to cut a tree for the purpose of

securing a stump of sufficient length when longer distances are in use; for example, 3,500 feet or upwards. With the rod in this position the target, whatever it may be—a field book or a page of white paper—is read on some part of the stump. By this means the writer has taken sights of 4,000 feet on several occasions when absolutely necessary, as in the case of an intervening lake. The transit might be set up on one shore of the lake and a sight to the opposite shore might necessitate readings through such a distance. I have known sights of one mile in length to be taken on a lake. These are rare instances, however, and conditions must be suitable, for telescopes are few through which a target can be satisfactorily read at a distance of a mile. Extreme difficulty is experienced in focusing the wire upon it even at a distance of 4,000 feet, it being almost impossible to see the target unless a little ingenuity is used in distinctly outlining it.

Such long-distance sights, provided proper precautions are taken, have great advantages in traversing. One accomplishes more, and again, a single long-distance sight is more correct than two of short distances. The longer the sight the straighter the line. This is well exemplified in chain measuring where the transit man who strives to run a perfectly straight line knows the value of a single sight of, say, 2,400 feet in comparison with two sights of 1,200, or four sights of 600 feet each.

On land, of course, these distances are frequently impossible owing to divergencies of contour; but on the water and in some parts of the western provinces very long sights may sometimes be taken. In the case of the latter, however, level or open prairie work is no longer abundant, the major portion of the unsurveyed west being covered with bush and muskeg.

J. A. MACDONALD.

Ottawa, Ont., July 10th, 1913.

ADDITION TO THE TORONTO FILTRATION PLANT.

IN his report to the Board of Works relative to the proposed extensions to the waterworks system of the City of Toronto, Commissioner of Works R. C. Harris recommends the installation of a mechanical system of filtration to supplement the slow sand methods now in use at the Island.

This report is the first official announcement that has been made concerning the expenditure which the $6,000,000 by-law of January 1st, 1913, was intended to cover. During the past six months the Works Department has given the situation most careful study, and the scheme of extension now advocated is the result of a very thorough investigation. As intimated in the June 26th issue of *The Canadian Engineer*, the Commissioner of Works had decided it advisable to base his report upon the experience and careful investigation of the city's own engineering staff, rather than merely to accept the report of the board of experts appointed previous to his administration.

The new report in full is as follows:—

Gentlemen,—We beg to herewith submit report re addition to Island filtration plant.

There are two standard methods of filtration, viz., slow sand and mechanical, both of which are capable of giving equally effective results.

In the former system, the raw water, without chemical treatment, is passed through beds of sand and gravel at the rate of from three to five million gallons per acre per day, and the effluent is carried by gravity to a clear water reservoir, from which it flows to the distributing pumps.

In the mechanical system, the water is pumped from the source, and a coagulant, usually in the form of sulphate of alumina, is applied before entering a coagulating basin, where sedimentation takes place for several hours. The water is then passed through rapid sand filters at the rate of from seventy-five to one hundred and fifty million gallons per acre per day, then flowing to a reservoir for distribution by pumping.

The slow sand process is particularly adapted to purifying water without color and with comparatively little suspended matter. The mechanical process will successfully handle any type of water, regardless of color of turbidity, and operates at maximum efficiency when raw water conditions are worst.

Ordinarily, the first cost of a mechanical filter installation is considerably less than that of slow sand, and occupies but a fraction of the area required by the latter, while the operating costs are considerably higher than the slow sand method, due largely to the necessity for using coagulant.

For the purpose of acquiring information to enable us to advise the administration, we visited mechanical filter plants at Montreal, Que.; Little Falls, N.J.; Cincinnati, O.; Toledo, O.; Columbus, O., and Niagara Falls, N.Y. We also viewed the slow sand plants at Philadelphia, Pa.; Pittsburg, Pa., and Washington, D.C.

At each of these cities the type of plant used was giving satisfactory results.

At Philadelphia, we found that pre-filtration was necessary before admitting the water to the slow sand beds. This pre-filtration was accomplished by what is known as a "roughing filter," which is in effect a mechanical filter without the use of coagulant, and which removes from the water the greater portion of the suspended matter, thereby enabling the slow sand beds to be used at a rating much above normal.

At Pittsburg, they were having considerable trouble with the water, and were making plant additions to overcome same. This, however, was not due to any demerit of the slow sand method, but is accounted for by the chemical quality of the raw water.

At Washington, the water travels many miles from the source before it reaches the filters, sedimentation taking place in the channels and in certain basins en route.

The mechanical filters above referred to were also giving excellent satisfaction. Especially good results were obtained at Cincinnati, which may, in a measure, be accounted for by the fact that the water is allowed to settle for several days in reservoirs, prior to entering the plant.

The works at Montreal are the most recent in point of construction.

The Medical Officer of Health and Alderman Rowland, chairman of the local Board of Health, also visited a mechanical plant at New Orleans, La., which is giving excellent results.

The plants of both types visited were handling river waters.

The slow sand plant located on Toronto Island, consists of twelve beds, having an area of .8 acres each, designed to handle a maximum of five million gallons per acre per day, or four million gallons per filter, making a

maximum of forty-eight million gallons per day. However, it is necessary to have at all times at least two filters out of operation for cleaning purposes, making the average output of the plant forty million gallons per day. As a matter of fact, we have, for a considerable time, been operating at the rate of forty-three to forty-eight million gallons per day—considerably in excess of its designed rating.

To make provision for a maximum daily capacity of one hundred million gallons, Mr. Allen Hazen, the expert retained by the city, advises an addition of thirteen slow sand beds, each having an area of .8 acres, which would guarantee an average daily output of sixty-seven million gallons, after making allowance for the beds inoperative because of cleaning operations. For short periods this output could be increased to ninety million gallons per day.

This addition, together with the necessary pumping plant and appurtenances, would cost approximately one million dollars. The cost of operation per million gallons, excluding pumping and capital charges, is estimated by Mr. Hazen at $1.83. This seems to be a fair figure.

A mechanical filtration plant, capable of delivering a maximum of sixty million gallons per day, would cost approximately one million dollars—equal in amount to the slow sand addition.

While we have hereinbefore stated that the first cost of a mechanical filtration plant is considerably less than that of a slow sand, it does not hold good under local conditions, where very expensive foundation work must be provided owing to the sand formation of the Island.

The first cost of each type of plant being practically identical, the annual charges on capital account are not included in the comparisons following.

In mechanical filtration, an additional head is required to operate the filters, over and above that requisite in the slow sand method. Making provision for this additional lift, Mr. Hazen estimates the cost of operation per million gallons, exclusive of capital charges, to be $4.80, which, having regard for our investigation, appears a reasonable figure.

For the purpose of illustration, assuming the average daily pumpage for the year 1914 to be fifty-five million gallons, handled exclusively by slow sand filters, the approximate cost, excluding pumping and permanent charges, would be $36,737. If thirty-two million gallons were filtered through the present slow sand beds (their average normal rating), and twenty-three millions through mechanical filters, the annual cost would approximate $61,670, showing a difference of $24,933 in favor of slow sand. In later years, if the proportion of the total supply through mechanical filters largely increased, as it naturally would, the cost difference in favor of slow sand would be greater.

From the foregoing, you will observe that, from point of operating cost, the slow sand process is very much cheaper than the mechanical.

We have found in the operation of the Island plant that, at times of easterly storm, the suspended matter carried from Scarboro', and particularly the fine sand carried in the water, has rendered the filters almost inoperative. Our experience in 1912 showed this condition to obtain for four periods, and while by dint of great effort, we have never come to the point where actual cessation of filtering operations was necessary, we feel that a long continued easterly storm would probably so clog the filters as to render the use of raw water necessary.

Again, from the inset of frost in the fall until the advent of warm weather in the spring, it is not possible to wash the sand scraped from the filter beds, by the methods provided, inasmuch as the pipe lines, etc., would freeze and burst, and the sand and water would be frozen during the washing process. To overcome this, it was found necessary last summer to build a storage sand bin in each filter, wherein the sand scrapings for the winter were held. We have been working night and day since spring to wash this accumulation, plus the sand from the beds in operation, and the quantity necessary for re-sanding.

The complete construction of a slow sand filtration plant would take approximately three years, while a mechanical unit should be installed and in operation within eighteen months.

We deem it unfortunate that the filtration plant should have been erected at Toronto Island. The ideal place for such installation would have been on Garrison Common, which is within a convenient distance of the main pumping station, and would have been the strategic point at which, if necessary, other than lake water could have been filtered.

However, the fact that upwards of $800,000 has been invested in the Island plant compels the retention of the Island as a filtration site, unless the present plant be abandoned, which we, of course, cannot advise.

The formation of the Island is such as to render it an undesirable location for permanent construction of this nature, and the very extensive dredging operations which the Harbor Commissioners purpose undertaking, may cause such changes as to imperil the present or any future installation which may be built thereat. This possibility may be remote, but is of sufficient moment to justify us directing your attention thereto.

The continuity of a filtered water supply for 365 days per year, is in our opinion the dominant factor in the consideration of this proposition. A shut-down during a storm period would entail the use of raw water by the citizens, at a time when it is usually most dangerous, least amenable to chlorine treatment, and liable to produce epidemic.

While the slow sand method shows, on a pumpage basis of fifty-five million gallons per day, a saving of $24,933 per year over the mechanical system, we, your officials charged with the duty of providing an absolutely continuous and safe supply of water, are, irrespective of cost considerations, forced to recommend the adoption of the mechanical system of filtration.

The report was signed by R. C. Harris, Commissioner of Works; Geo. G. Nasmith, Director of Laboratories, Department of Health, and Chas. J. Hastings, Medical Officer of Health, and was adopted by the Works Committee.

The International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology is to be held in London in 1915. Several preliminary meetings of the Organization Committee have already been held, and a decision arrived at that the sections of the Congress be divided into four groups as follows:—Group 1, mining; section A, coal mining; section B, metal mining; Group 2, metallurgy; section C, ferrous metals; section D, non-ferrous metals; Group 3, applied mechanics; section E, mechanical engineering; section F, chemical engineering; section G, electrical engineering; Group 4, geology.

THE INCREASING COMPLEXITY OF MUNICIPAL GOVERNMENT

INTERESTING HISTORICAL REFERENCE TO TORONTO'S DEVELOPMENT IN MUNICIPAL GOVERNMENT — A REVIEW OF THE EVER-WIDENING RESPONSIBILITIES WITH WHICH CIVIC AUTHORITIES DEAL.

By His Worship the Mayor of Toronto, H. C. HOCKEN, Esq.

THE subject which I have chosen for a brief paper is "The Increasing Complexity of Municipal Government."* It will be admitted, I think, by all who have anything to do, at the present day, with the government of our large cities that the contrast between the present and former days is a very striking one with respect to the range and importance of the matters which are dealt with in our municipal administration. In earlier days the administration was simple; in the present day it is complex, and is increasing in its complexity.

The Toronto *Globe*, in its issue of June 11th, 1913, contained the following paragraph:—

> "When the late Dr. Goldwin Smith, a keen critic of public affairs, was asked why he did not take an active part as a municipal representative, he said he had to confess his lack of ability. He went on to point out that while honesty and common sense were sufficient in a small municipality, the great city's management called for special knowledge in a multitude of problems in such matters as finance, engineering, sanitation, hydraulics, transportation, and traffic management."

In these words the difference which exists at the present time between the government of a small municipality and that of a large one is very succinctly stated; and also, I think, the difference between the government of a large city in earlier days and that of the present day.

By way of illustration, let us consider the City of Toronto, which I have the honor to represent. The earliest printed financial statement of Toronto which I am able to find is that for the year 1858. The ordinary expenditure for that year may be set down under the following principal headings:—

Public hall, public markets, weigh houses; street watering, lighting, and repairing; fire protection, by a volunteer brigade; education—common schools and grammar school; police protection, and administration of justice; health protection—in a small way, including, it may be remarked, care of "cholera shed"; care of insane; public walks and gardens; care of poor, principally by the House of Industry; construction of sewers.

The financial statement for 1880 does not differ much in its scope from that of 1858. The principal changes are the substitution of a permanent fire brigade for that of a volunteer force, a larger proportionate expenditure for street watering and repairing, and in the interval the transfer of the care of insane persons to the provincial government. Parks in 1880 were given more attention, street cleaning formed a more important item, and there was some expenditure for a smallpox hospital and for vaccinations.

An examination of the estimated expenditure for the year 1913 reveals a vast difference in character and scope as well as in the magnitude of the figures. Under the headings "Works" and "Health" the change is a striking one. In former days the expenditure for protection of health was insignificant; to-day it is large. The Health Department, with a skilled and leading member of the medical profession at its head, is one with a large staff, combatting diseases of a contagious and infectious character, maintaining an isolation hospital and a smallpox hospital, and vaccinating people free. It tests milk and regulates its sale to see that the business is carried on under clean conditions. It sends its inspectors out to the country to examine the dairy farms and enforces compliance with sanitary regulations. It fights the white plague by sending out nurses to the houses of the poor to direct the care of those suffering from tuberculosis and to prevent others from being infected. It has a dental clinic which does a large work principally in treating the teeth of school children. It has a laboratory for contagious diseases, for testing milk, and for making a daily and continuous analysis of our city water. Plumbing construction and appliances are regulated and inspected, and house drains are supervised and regulated. In addition, a vast system of inspection is carried on to suppress insanitary conditions in houses and premises, and to prevent the growth of slum conditions. Food offered for public sale is also inspected, and the conditions surrounding its display, its handling, and its delivery are regulated. Perhaps in no department of civic government is the change so marked as in that of the care of the public health. It would be nearer the truth to say that this branch of our municipal government is altogether new. It has arisen out of the great advance made of late years in sanitary science and preventive medicine, and I think that in its detection of contagious diseases, in its limitation of them, and in its prevention of epidemics with attendant enormous loss of life and trade, the board of health is a paying insurance.

The people demand free libraries, and one was established in Toronto in 1883. The maintenance of our public library board takes one-quarter of a mill in the dollar of our annual taxation. Not only is there a large central library, but the residents of the outlying sections demand branches which are provided and maintained. Skilled and trained officials are in charge.

Children's aid societies, industrial schools for boys and girls, and a juvenile court for the discriminating and sympathetic treatment of boys and girls who commit offences which bring them into the hands of the police are among the new institutions of recent years with which we have to deal. The system of dealing with juvenile de-

*Read at the 13th Annual Convention, Union of Canadian Municipalities, July 15, 16 and 17, 1913.

linquents is largely preventive, and on the whole it is successful.

An industrial farm has been provided to which to send prisoners from the city jail, in order that regular and healthful work may restore them to physical vigor and enable them to overcome their craving for drink. Incidentally, they earn the cost of their maintenance.

A few years ago we established a public bath house. This has been so successful in a central location that baths have been demanded for other sections of the city.

The people call for band concerts in the public parks in the summer as well as free bathing facilities at the Island, and in the winter they call for skating rinks and toboggan slides in the parks.

We are establishing a public abattoir at a large expenditure for building and equipment.

In connection with street cleaning, the great area to be cleaned and swept, and the extensive system of garbage collection require the erection and equipment of incinerator plants at different points in the city, and a reduction plant outside the limits of the city where garbage is to be reduced and by-products utilized. The initial expenditure for all these plants will total about one million dollars.

Education is widening out. To the former common and high schools are added those for technical instruction, with a very large expenditure for building and equipment.

Public ownership of public utilities is the new order of the day. It began with the acquisition of the waterworks. It has extended to the establishment of a municipal electric lighting and power plant in close affiliation with the hydro-electric system of the province of Ontario, and the construction of street car lines by the municipality, and my hope is that before long we shall have ownership and control of street railway transportation and electric power distribution on every street and in every part of our city.

Main drainage, sewage disposal, storm overflow sewers, bridges and viaducts, waterworks problems and extensions, are all subjects which require careful thought and the employment of skilled engineers and experts. These are important matters with which the municipal rulers of earlier days were not required to deal.

All this increasing complexity of municipal government demands the service in the Council of men who have had some special training in municipal administration. It must be apparent to any thinking person that a man cannot approach this work, and render substantial service until he has had a chance of making a study of at least some of the problems with which a large city government has to deal in these days.

This ever-widening range of responsibility will compel the men who are elected to administer the affairs of the great cities, to specialize in the different departments of civic government. It is only by special application to particular problems on the part of a group of men sharing this responsibility that the best results can be attained.

When Toronto was a city of under 100,000 people, thirty-five years ago, one man was city commissioner and health officer. He inspected works in course of construction, and had charge of health, street cleaning, street watering, public markets, public halls, and other miscellaneous work. No city in Canada of a population of 100,000 would dream to-day of putting such a load on any official, because the duties of each branch have been so amplified that it would be a physical and mental impossibility for the official to carry the responsibility.

The people demand that our municipal government shall protect them and their property against criminals and fire. They ask for protection against disease, whether it comes from diseased persons or from food or water. They ask to be cleansed by public baths, and to be amused in summer and winter. They ask also to be provided with books and periodicals to read. In short, they ask to be guarded at almost every point, and as in the last analysis, they rule as well as provide the funds, their demands must be complied with. The experience of Toronto is, I believe, similar to that of other cities.

NEW HIGHWAY BRIDGE AT LYTTON, B.C.

The accompanying illustrations refer to a proposed structure to cross the Thompson River, just above its junction with the Fraser, at a site between the present bridge which is also shown, and the crossing of the Canadian Northern Railway. The new bridge will carry the main highway from Hope and Lytton in the direction of Lillooet and other northerly points.

The sub-structure is of concrete, and steel is being used in the superstructure, the whole resting on a good rock foundation.

Fig. 1.—Bridge at Lytton, B.C., Which is Being Replaced.

There will be 209 feet of timber trestle approach with a similar length of grading on the southeastern bank of the river. Over the bridge the roadway will be 16 feet in width, and will be constructed of 4-in. plank protected on either side by a 4-foot hand railing with posts 7 feet 7⅛ inches apart. The roadway plank will be supported on 6-inch joists of varying depth, according to camber, on steel I-beam stringers. A crowning one inch thick will be applied to the top of the floor.

The bridge itself will consist of a 250-foot truss span, 35 feet deep, together with two 70-foot plate girder spans, one on either side and an additional 50-foot plate girder span carried on steel bents and concrete abutments. The large truss span will rest upon concrete piers seventy feet above low-water, while the distance of the resting surface of the truss above the extreme high-water level will be 7½ feet.

The bridge is designed to carry a live load of seventy-five pounds per square foot on the 250-foot truss, and one hundred pounds per square foot on the shorter spans, together with a concentrated load of a 16-ton road roller.

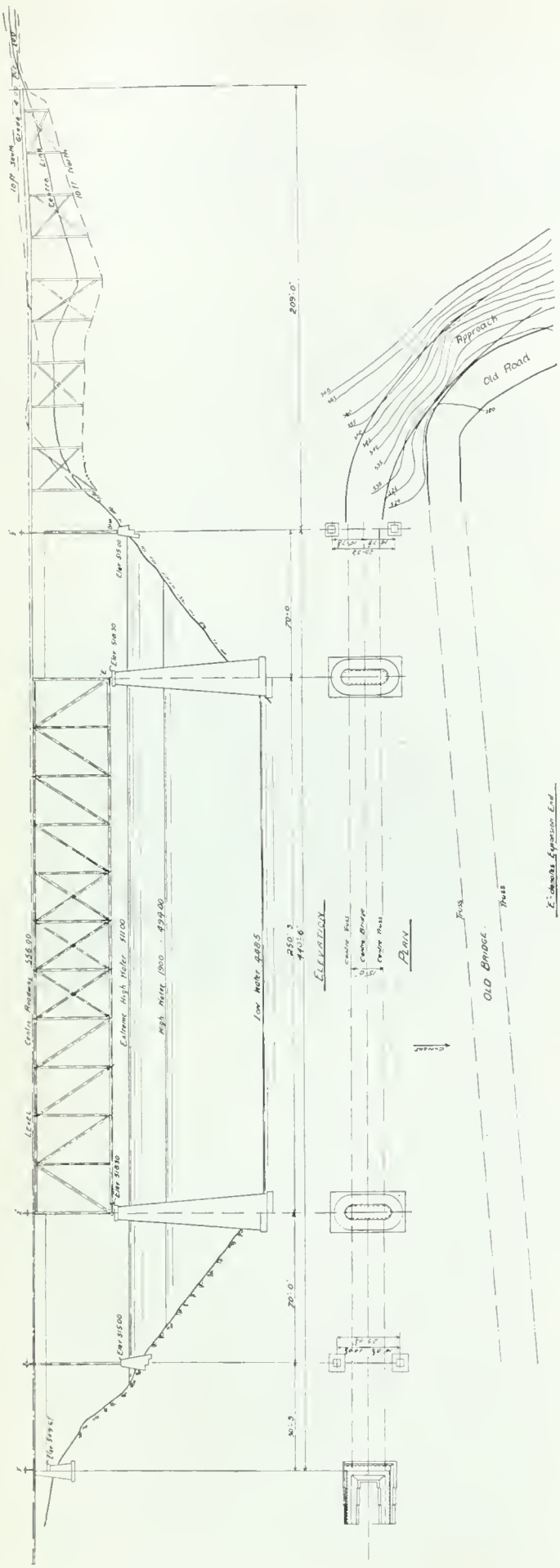

Fig. 2.—General Plan of Proposed Bridge Over the Thompson River at Lytton, B.C.

The level of the new bridge will be forty feet higher than that of the present structure, which is illustrated in Fig. 1. The 215 tons of steel will be fabricated by the Canadian Bridge Company, while the 2,000 yards of concrete, erection of steel, and the other work at the site will be carried out by the Graff Construction Company. The bridge is being built by the Provincial Department of Public Works, J. E. Griffith, chief engineer, and was designed by E. A. S. Stone, M. Can. Soc. C.E., M. Inst. C.E., consulting engineer, Vancouver.

Fig. 3.—Sections at Abutment and Trestle, Lytton, B.C.

COPPER CLAD WIRE LITIGATION DISMISSED.

Important litigation in regard to copper clad wire which has been contending in the United States Court in Pittsburgh, Pa., for the past two and a half years between Duplex Metals Company of New York, complainant, and the Standard Underground Cable Company, Pittsburgh, Pa., defendant, was virtually decided June 25th, when the case came before the Court on motion made by complainant to dismiss the bill in respect to patent infringement. The bill as originally filed charged infringement of the patent and infringement of a trade mark. The motion made by complainant was to dismiss without prejudice; that is to say a dismissal leaving the complainant in a position to renew the suit at its pleasure. The motion was opposed, defendant contesting that the bill should be dismissed in this regard and a dismissal should be on the merits of the question. The Court so ordered, the order reading:—

"Complainant having admitted that defendant's product referred to in the proofs herein does not infringe the Monnot Patent in suit No. 893932, it is ordered and adjudged and decreed that the bill of complaint herein, in so far as it is based on alleged infringement of said patent be, and the same hereby is dismissed on the ground that defendants have not infringed said patent."

The Order of the Court directs that the complainant pay the costs. The only portion of the suit not thus disposed of is in regard to the right to use the trade name "Copper Clad" and which is expected to go to a hearing in the early fall.

ROAD RESOLUTIONS ADOPTED BY THE 1913 CONGRESS

CONCLUSIONS ARRIVED AT BY THE VARIOUS SUB-SECTIONS—THE NINE ROAD QUESTIONS AND FINDINGS RELATING TO EACH—A SUMMARY OF THE WORK OF THE THIRD INTERNATIONAL ROAD CONGRESS.

THE resolutions adopted as a result of the careful study relating to the nine questions before the International Road Congress are given below. The Congress included two sections, each of which were further divided into two sub-sections. The first section's investigation pertained to construction and maintenance. Sub-section A dealt with the roads outside of larger towns and cities, while Sub-section B had before it the consideration of roads in cities and large towns. The second section, on traffic and administration, consisted of Sub-section C, dealing with traffic and vehicles, and Sub-section D, on administration, finance and statistics. The discussions of each section were distinct from those of any other, and each had its own executive committee. In a number of instances, however, two sub-sections sat together.

First Question.—Planning of Streets and Roads.—This was dealt with by Sub-sections A and B combined. When the discussions were summarized the following resolutions were adopted:—

1. As a general principle, it is better that new main roads be constructed to pass outside rather than through towns, and that, where an existing main road passing through a town is unsatisfactory for through traffic, it is often better in preference to widening an existing narrow main road through the centre of a town, new roads should be planned according to the principles of the science of town planning.

2. Gradients on new roads should be as easy as possible, having regard to the physical character of the country through which they pass, and they should be easier where there are curves, trams, or a preponderance of heavy traffic.

3. The radii of curves in roads used by fast traffic should, where practicable, provide the best possible and an unobstructed view, and that where this is not possible, the curve being of too short a radius, means should be provided whereby the approach thereto is in some way clearly indicated.

4. Except where it is possible to provide special reserved spaces, tram tracks are best placed in the centre of the roads, and that where so placed it is desirable to provide space on either side for two tracks for vehicles.

5. The main traffic roads should be so designed that spaces are provided for tram tracks, fast and slow traffic, and standing vehicles; and in such a way that they can proceed without unduly intermixing. In fixing building lines along what may ultimately become main roads, regard should be paid to ultimate requirements. Adequate space should be provided between the buildings, and powers for enforcing this should be held by all authorities who decide the widths of roads.

6. That the planning of main road communication outside towns should be at once undertaken; it is a matter of national importance in regard to which some initiative should rest with a Central State Authority, and the action of Local Authorities should to some extent be regulated or supervised by Central State Authorities.

Second Question.—Types of Surfacing to be Adopted on Bridges, Viaducts, etc.—Sub-sections A and B sat conjointly concerning this question also, and the following are the resolutions which were passed:—

1. The choice of road surfacing for bridges depends on the nature and intensity of the traffic, the local conditions, such as permissible first cost, kinds of material readily available, and climate. For light bridges the choice is largely influenced by the weight of the surfacing. Public safety and convenience should be first regarded rather than questions of comparative cost.

2. On short bridges in town or country, it is desirable than the surfacing should be the same as that on the adjoining streets or roads.

3. In forming the roadway on bridges, special care should be taken to secure proper drainage, and to prevent the harmful percolation of water. With longitudinal gradients of at least 1 in 50, the cross section of the surface may be made nearly flat and the dead load thus reduced.

4. As a general rule, the surfacing of a bridge should be waterproof, capable of resistance to wear, durable, and of a weight appropriate to the structure of the bridge; it should also be as smooth as possible without being slippery.

5. Plank surfacing on bridges is light, and its first cost is low. Its cost of maintenance is, however, excessive, except where the traffic is light. Its extreme liability to damage by fire is a serious disadvantage. It should not be adopted, except in remote districts in which there is an abundance of cheap timber, and where a more desirable form of surfacing is not easily obtainable. Single plank floors are only suitable for very light traffic. For moderate or heavy traffic, two layers of planking, the lower of which is creosoted or otherwise protected from rapid decay, should be used.

6. Macadam, or ordinary broken stone surfacing, on timber planking, is not always satisfactory on account of its great weight and its permeability. Macadam is, however, quite satisfactory for massive bridges in rural districts, if the substructure has a proper damp course.

7. Macadam, bound with tar, or other waterproof and elastic material, is useful and economical for the surfacing of rural bridges with moderate traffic, when the spans are short or the structure is massive.

8. Wood paving block, 3 to 5 inches thick, is an ideal surfacing for bridges in most cases. It is light and durable and can be laid on concrete, or, when weight must be minimized, on a timber subfloor, which should be creosoted. Special care should be taken in the selection, treatment and laying of wood blocks for bridge paving, to avoid troubles due to expansion and contraction of the blocks or of the metal structure.

9. Asphalt, in various forms, is an excellent surfacing material for bridges with easy gradients,

on which the traffic is not confined to definite lines or very heavy.

10. Stone paving, carried out either with ordinary hand-dressed setts or with small setts (Durax; Kleinpflaster), laid on concrete and bound with cement or pitch, makes excellent and economical surfacings for bridges with heavy traffic. However, it is only suitable in cases where questions of the weight of the surfacing or of noise are of no importance. The thickness of the layer of sand interposed between the setts and the foundation will be decided in the same way as with an ordinary carriage-way, in town or country, as the case may be.

11. For movable bridges, and for non-rigid suspension bridges, the surfacing should be light and easy to attach to the bridge platform. The trials made in France and Belgium with old mine cables, or other fibrous substances of even less cost, and with such materials impregnated with tarry, bituminous or asphaltic materials should be encouraged.

Third Question. — Construction of Macadamized Roads Bound with Tarry, Bituminous or Asphaltic Materials.—Sub-section A dealt with this question and arrived at these resolutions:—

General Conclusions.—By the use of bituminous, including tarry or asphaltic binders, we may obtain a number of different forms of road crust, which may be employed with advantage, according to the various conditions of the road as regards traffic, locality, and climate.

The exact value and duration of life of these various road crusts, taking into account traffic, climatic conditions, and the methods of construction, remain to be determined.

For this purpose it is advisable to draw up a uniform system of tests, measurements and records, under the following headings:—

1. Physical and local conditions. (Plans, cross-section, slopes, camber foundations, subsoil.)
2. Materials employed, petrological analysis, dimensions, composition of the binding agent.
2a. Method of construction, date of construction.
3. Census of traffic on the section under review.
4. Climatic conditions affecting the road.
5. Periodical measurement of wear.
6. Periodical examination of the state of the road crust.
7. Actual cost of the road crust: (a) As regards cost of construction. (b) As regards maintenance cost.

The standard form in which the information is to be furnished will be drawn up by the Permanent Commission.

Particular Conclusions. — I. Foundation and drainage.

Confirming the conclusions adopted in 1910 by the second Congress (Brussels, 2 Question), which called attention to the advantages of a dry foundation and a sound subsoil, the Congress especially insists upon the great importance of efficient foundations in the case of road crusts bound with bituminous (including tarry or asphaltic binders) for the following reasons:—

(1) The road crust being expensive, it is important to give it a base which will increase its life.

(2) As the weight, speed and intensity of the traffic continually tend to increase on roads considered worthy of such a crust, it is best to provide a foundation which has been so constructed as to secure for the crust the best possible conditions of resistance to wear.

II. Dimensions and shape of metalling.

(1) When an ordinary macadamized road crust is constructed with a view to being tar-sprayed, it should be constructed of hard metal, with sharp edges, and broken as nearly as possible to a cube of the dimensions of from 4 to 6 c/m.

(2) In the case of bituminous including tarry or asphaltic macadam, carried out by the mixing process, the dimensions of the metal may be so selected and graded as to form a compact road crust with the fewest possible voids. The dimensions of the largest metal may vary according to the nature of the stone and of the traffic. When the process of construction employed requires more than one layer of material, the upper layer or wearing crust may be formed of smaller metal.

(3) In respect of bituminous including tarry or asphaltic road crusts constructed by the penetration process, the trials and tests now being carried out in various countries should be continued, taking care only to employ metal of as cubical a shape as possible, and with sharp edges, at any rate, for the portion of the road crust nearest the surface.

(4) It is understood that further experiments will also be carried out in the use of the other methods, and especially 1 and 2.

III. Employment of partially used metal.

By carefully eliminating all particles of mud and organic matter, it is possible to successfully make use of partially worn materials, on condition that they are not employed for the surface of the road crust.

IV. Relative importance of patching.

It is agreed that it is absolutely necessary to carry out repairs, in the case of all bituminous including tarry and asphaltic road crusts, immediately the necessity for them arises.

V. Permissible wear.

The complete renewal rendered necessary by wear must be carried out immediately the depth of the road crust is below a given limit of safety, or when its waterproofing qualities have become so poor that the road will unduly suffer from climatic conditions.

VI. Various means of employing tarry, bituminous and asphaltic materials.

In using these materials, both in the penetration method and the mixing method:—

(a) It is preferable to use dry stone in order that it may adhere well to the binder. In the mixing method the stone must always be dry, and if necessary it must be heated.

(b) One must never lay a top crust upon a soft or damp foundation. One should preferably carry out the work in fine weather.

(c) One must never employ too much binder, but only a sufficient quantity to bind the portion of the road which is being rolled.

(d) One must never employ road rollers which are too heavy.

VII. Tests and chemical analysis.

The advantages of analyses and methodical laboratory tests, and their necessity in the case of bituminous binders, are unanimously recognized.

It would be of advantage to obtain uniformity—

(1) As regards the specification of the principal characteristics of these binders.

(2) As regards the methods of testing for drawing up these specifications. The Permanent International Commission will be entrusted with the work of enquiring into the best way of standardizing the above.

VIII. Climatic effects.

It appears to be generally agreed that certain tarry, bituminous or asphaltic road crusts (as is also usually the case with all smooth and waterproof road surfaces) may become slippery under certain conditions of weather.

This may be remedied by strewing the surface with coarse, sharp sand; and in most cases a good cleansing of the surface will usually prevent the carriage-way becoming slippery.

IX. Effects on public health, etc.

Sufficient information is now available to enable engineers to select and specify bituminous binders which will have no prejudicial effect upon public health, fish life, or vegetation; but which, on the contrary, will conduce to conditions of considerable hygienic advantage.

X. Cleansing and watering.

It is recognized that carriage-ways properly treated with bituminous including tarry or asphaltic materials require less sweeping and watering than ordinary water-bound macadamized roads, and that they allow of considerable economy being effected under this head.

Fourth Question.—Wood Paving.—The resolutions which were adopted by Sub-section B are the following:—

1. Where gradients permit, wood block pavement is very suitable for streets where the traffic is great, but is not of the exceptionally heavy character usually existing on streets near docks or similar centres of industrial traffic. It should be used where a noiseless pavement is desirable.

It is of great importance that a concrete foundation should be laid of sufficient strength to carry the traffic passing over the pavement.

2. Great care is necessary in the selection of the proper timber for the purpose, and all soft wood blocks should be thoroughly impregnated with a well-proved preservative before being laid.

3. In view of the varying results given by wood pavements, according to local circumstances, it is desirable that further investigations and laboratory experiments should be carried out in connection with the selection of the timber and of the impregnating preservative.

4. Every precaution should be taken in laying the blocks to prevent, so far as possible, the entry of water through the joints.

4a. Hard woods give varying results according to local circumstances, and it does not appear desirable to recommend them for roads with intense traffic in large cities, unless some means are devised to effectively prevent the rapid destruction of the joints and the resulting destructive effect on the concrete below. If these woods are employed, it is desirable not only to prevent the percolation of water through the joints to the foundation, but also to consolidate the blocks as far as possible, so that they may not become rounded at the edges.

Soft woods obtained from suitable kinds of trees, and especially from resinous species, are equally suitable for roads with a comparatively heavy and intense traffic as well as for roads with a light and infrequent traffic. In the latter, however, the blocks are liable to rot if they have not been suitably pickled. It is also desirable to make the joints as small and watertight as possible. On the other hand, their comparatively rapid wear on roads with great traffic should encourage one to make exhaustive investigations into the best means of treating them, so as to increase their strength without prejudice to their elasticity.

5. Subject to certain precautions, such as impregnating of the wood, waterproofing of the joints and surface, frequent cleaning of the roadway, etc., there is no objection to wood pavement from the sanitary point of view.

6. The spreading of gritting is necessary under certain conditions and in certain weather (especially on hard wood paving) to prevent the surface becoming slippery, but the gritting should be done with suitable small gravel chippings or sharp sand, so as to avoid, as far as possible, any injury to rubber tyres.

Fifth Question.—Methods of Lighting Public Highways and Vehicles.—This was considered by Sub-sections C and D combined, and the following resolutions unanimously adopted:—

The section adopts the following resolution unanimously:—

I. For the purposes of a general determination of methods of lighting, highways may conveniently be divided into three classes as follows:—

(1) Important streets in cities, towns or other urban areas in which the traffic after dark is considerable in volume.

(2) Important suburban roads in the vicinity of large towns.

(3) Rural roads in open country, and having regard to modern conditions of traffic, it is essential that adequate lighting by means of fixed lights should be provided in classes 1 and 2.

II. As a general principle in the lighting of all highways which require to be lighted by means of fixed lights, the method of lighting to be adopted should be such as will provide an illumination as uniform and free from glare as possible. The amount of illumination and the position of lamps must be determined with reference to local circumstances.

III. It would be impracticable to light rural roads in open country generally by similar methods to those adopted in urban streets or suburban roads, and the lighting of vehicles running or standing on rural roads at night is, therefore, of the highest importance.

IV. Every vehicle, whether standing or moving, should carry a light of sufficient power at night which can, except when specially authorized, be seen from the rear as well as from the front of the vehicle.

(2) Every motor car must carry after nightfall, two lighted lamps in front, and one at the back; if it is able to move at a high speed it must be fitted in front with a headlight of sufficient illuminating power to light up the road or path for at least 50 yards to the front. In inhabited places where the ordinary lighting is sufficient to allow motorists to see their way and to be easily seen, the light of the

headlights must be limited to that of the ordinary lamp.

V. It is desirable that all obstacles across a road, such as gates, and particularly gates at railway level crossings, should be painted white and in other colors in alternate parts, and illuminated by fixed lights which are lighted at dusk.

(2) It is desirable to paint white paint or indicate by some other method all danger signal posts, direction posts and other posts, milestones, wheel kerbs, bridge abutments, etc., or other special features, the indication of which would aid travellers, or conduce to the safety and convenience of the traffic.

VI. One and the same color should be universally adopted as the color for danger signals.

The meeting also adopted the following resolution:—

1. It is desirable that each Government should do away as soon as possible with colored lights on automobiles.

2. The Congress expresses the wish that regulations should be made to compel drivers of herds of cattle to make their presence known.

Sixth Question.—Observations noted since 1908 as to the Various Causes of Wear and of Deterioration of Roadways.—Sub-section C adopted these resolutions:—

1. Weather conditions are amongst the most powerful influences which cause deterioration of roads, and that the destructive effect of weather can be minimized by effective waterproofing of the road surface, with suitable drainage for the foundation.

2. Any considerable volume of traffic, consisting of either heavy motor vehicles or high-speed light motor cars has a seriously damaging effect on water-bound macadam roads. The damage caused is effected by the balancing of the motor; the ratio between propelling power and adhesive weight; the weight of unsprung portions of the motor; the progressivity of action of the brakes; the system of springing; the type of tyres employed, the diameter of the wheels, the width of the rims, variation of speed and adherence, and other factors.

3. The damaging effect of heavy motor vehicles can be minimized by the use of wheels of large diameter; tyres of a width properly adapted to the weight of the axle load; rubber or elastic tyres and suitable springs, and that all reasonable means of reducing the damage to roads caused by such vehicles should be enforced.

4. Light motor car traffic does not cause serious or exceptional wear or damage in the case of properly made macadam roads which have been properly treated or bound with tarry, bituminous or asphaltic materials, except in sharp curves.

As regards horse-drawn vehicles, it is desirable also to study the relations between load, width of rims and diameter of wheels, and more especially the system of shoeing horses. It is also necessary that power should be given to Local Authorities to prevent the deposit of refuse from the fields and earth upon the roadway by the wheels of agricultural carts.

5. There is still a great lack of precise information in regard to the various causes of wear and deterioration of roadways, and that it is desirable to collect more information compiled on carefully devised scientific methods, standardized as far as possible for the purposes of comparison, and to make further systematic study of these causes.

Seventh Question.—Regulations for Fast and Slow Traffic on Roads—Sub-section C investigated existing regulations, and adopted resolutions as follows:—

1. That all regulations for the control of road traffic should be based on the principle of allowing the speed practicable for each different kind of vehicle consistent with public safety, general convenience, and the normal wear of the road.

2. That regulations for the conduct of fast and slow traffic should be as few and simple as possible, and should be such as can and ought to be universally adhered to and enforced.

3. That in all large cities there should be a Traffic Authority, on whom should be charged the duty of studying and dealing with street traffic problems, the powers of such authority and the co-ordination of such powers with those of other public authorities being matters of detail which must be settled by public authorities on consideration of the circumstances and conditions of each large city.

4. That there should be ample provision of traffic controllers (such as the police in London) with adequate powers to regulate the traffic, not only at congested points, but throughout the course of crowded streets.

5. That having regard to the increased danger which is necessarily created by the conditions of modern traffic it is important that drivers should be carefully and systematically trained, and that children should be specially taught how to provide against the dangers of the road.

6. That except where local circumstances render it absolutely necessary, no obstructions, such as lamp-posts, tramway standards, etc., should be placed in the centre of a road, except necessary refuges for pedestrians crossing.

7. No obstruction of the public highway should be permitted either by vehicles standing unreasonably, or travelling at an obstructing speed, or by things placed on the highway. Exception must, however, be made for depôts required for the work of maintenance or repair of the road, or for work being carried out by duly authorized and competent authorities, but in every case all necessary steps must be taken to ensure the safety of traffic.

The meeting unanimously adopted the following resolution:—

8. Regulations for roads and traffic must aim at defining the rights, duties, and responsibilities for each kind of traffic, in order to avoid the causes of accidents and damage and to ensure the maximum of order and liberty.

Eighth Question.—Authorities in Charge of the Construction and Maintenance of Roads. Functions of Central Authorities and Local Authorities.—Sub-section D passed resolutions concerning this question, which are as follows:—

The system of road administration in any country must be in harmony with the general system of government prevailing in that country, and the political genius of its people. It is impossible, therefore, to lay down any general rule of universal application as to the extent to which the road organization of any country should be centralized or decentralized.

In countries where maintenance of roads by local authorities has hitherto been the prevailing system, the modern engineering problems of road construction raised by the increased motor traffic are creating a demand for greater centralization in the belief that this will tend to greater expenditure on the roads, but in the opinion of this Congress it is not desirable that the maintenance of the roads should be vested in a central authority, but should be decentralized as far as is consistent with good administration, and that assistance should be given by the State contingent on the roads being maintained up to a prescribed standard.

In those countries where centralized systems of administration already exist, it is desirable that these systems shall be developed and perfected.

A principle that can be laid down as of universal application is, that the unit of highway administration shall be sufficiently large and command sufficient resources to employ and adequately remunerate a competent staff.

It is desirable that the engineering staff shall be organized on a national basis, and shall consist of:—

(a) Chief engineers, with powers of inspection, and report to the authority making grants.

(b) Divisional engineers in charge of administrative units.

(c) Assistant engineers, recruited by examination from engineering students who have received a practical training following upon a good general education, and an engineering education at some recognized engineering school or university. Promotion shall be by merit.

Ninth Question.—Finance of the Construction and Upkeep of Roads—Provision of Revenues.—Sub-section D decided as follows:—

1. The expenditure on the maintenance and improvement of:—

(a) The roads which serve as main routes of communication between important places in any country, or

(b) Roads which are used mainly by long distance traffic unless such expenditure is borne wholly out of the National Revenues under a system of State Administration of roads (which system is practicable and suitable in the case of some roads in some countries) should be mainly paid for out of National Revenues, whether or not such roads are locally administered and maintained, subject, where local administration prevails, to the supervision of a central government authority both as to efficiency and expenditure.

2. It is desirable to abolish, so far as possible, all tolls on public roads, but it is equitable that vehicles which, on account of their weight or weight combined with speed or any other exceptional circumstances connected with either the vehicle or use of the road, cause special damage to roads beyond the wear and tear of the ordinary traffic of any district, should be subject to special taxation, the proceeds of which should be earmarked for expenditure on roads.

3. Borrowing money for new road construction and for the periodic renewal of the surface coating of a road is consistent with sound financial principles, provided that the loan period in the case of loans for renewals, is kept well within the life of the surface coating.

HYDRO-ELECTRIC INSTALLATION, CITY OF TOKYO.

The unparalleled industrial boom Japan experienced during the last few years has brought with it an enormous increase in the demand for cheap electrical energy throughout the country and particularly in the city of Tokyo. In 1908 the Tokyo Electric Light Company completed their hydro-electric power station on the Katsura River about 100 miles from Tokyo, at this time the largest and most important power station in Japan. The total output of this plant was 27,500 H.P. developed by six Escher Wyss Francis turbines direct coupled to generators of Siemens make. One year later the company had sold the whole of the energy developed and a second plant of increased capacity had to be taken in hand. It was decided to develop a fall ten miles down stream on the same river, where 42,000 continuous horsepower could be obtained. The minimum flow of the river was measured to be 850 cubic feet per second, while the net head available varied from 368 feet to 396 feet maximum. By providing a reservoir of sufficient storage capacity the plant could deal with a peak load of 50,000 H.P.

With a total capacity of 75,000 H.P., not including the power required by the auxiliaries, this new installation is again the greatest power plant in Japan, comprising six main turbines of the same make, each of 12,500 H.P., including the oil pressure plant as well as the distributing piping with the necessary gate valves.

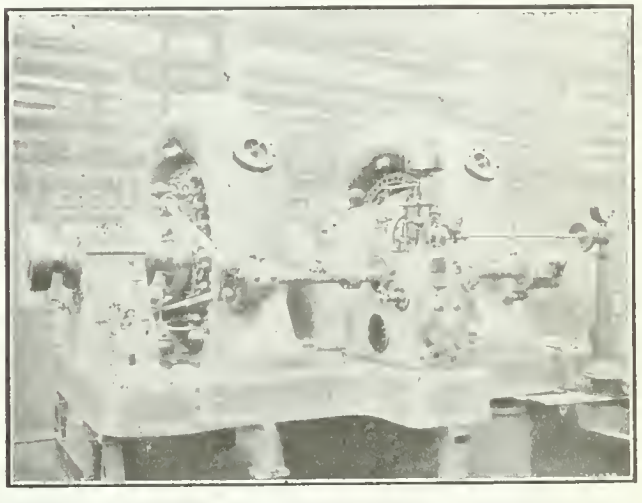

Fig. 1.—Turbines Used in Tokyo Hydro-Electric Plant on the Katsura River.

Regarding the layout of the plant it may be mentioned that the water is brought through a tunnel to the forebay and from there in six parallel pipelines of 700 feet length and 6 feet diameter to the turbines. Each turbine has its own pipeline, the exciter turbines being fed by a seventh pipe of smaller diameter.

The main turbines are arranged in two groups, each consisting of three units on both sides of the switchboard. The distributing pipes and valves are on the lower floor, thus leaving the engine room proper free and allowing for easy access and attendance. For the transformers and connections a second building is provided. The pipeline for each main turbine is connected by means of a conical pipe to a gate valve of 4 feet 7 inches diameter operated hydraulically by pressure water taken from the penstock. A cast steel Y piece and bend connect the turbines to the main gate valves.

The main turbines are shown in the illustration. They are Francis turbines of the twin spiral type with horizontal shaft running at 375 r.p.m., and are coupled direct to the alternators, the coupling flanges being forged on to the shaft. Each unit is mounted on a solid cast iron base plate grouted into the engine room floor. This arrangement ensures a very accurate and simple lining up on site, easy dismantling and remounting for repairs, and equal pressure on the foundations. The shaft runs in two ring lubricated bearings of ample dimensions mounted on pedestals. The bearing on the free end is fitted with thrust collars. The lower bushings of both bearings are hollow and water cooled. The runners are made in special bronze and screwed on to flanges forged on to the shaft. The spiral casings are made in cast iron reinforced by steel bolts and guide ribs cast in. The guide apparatus is arranged outside the turbine casing, thus making all links and bolts accessible. The guide rings and covers in contact with the water have cast steel linings, which are easily interchangeable in case of wear. To reduce the distance between the bearings the draft chest has an elliptical form on the bottom. An intermediate pipe connects this draft chest to the wrought iron draft tubes.

The turbines are regulated automatically by oil pressure governors of Escher Wyss and Co.'s patent, mounted on the same bedplate as the turbine. The governor is the largest size of Escher Wyss and Co.'s standard type, fitted with speed changing device from the switchboard, further with quick closing device in case of falling off of belt, thus preventing the running away of the set. The servo-motor can be operated by hand instead of automatically, by means of a hand wheel regulating the access of the oil pressure to the one or the other side of the cylinder. The necessary pressure oil for the governors is supplied by an oil pressure plant.

To prevent dangerous pressure shocks in the pipeline under sudden throwing off of load of the turbines a relief valve is provided for operated direct from the governing gearing of the turbine. The relief valve works in such a way that when the governor closes the guide vanes to a certain amount, the corresponding area is opened in the relief valve. To prevent losses in water the relief valve closes automatically after a certain time.

The exciter turbines of 460 H.P. are coupled by means of flexible couplings to the exciters running at 600 r.p.m. The turbines are impulse wheels with two nozzles, each regulated by an oil pressure governor mounted on top of the casing.

The oil pressure plant consists of three pump groups, each group of sufficient size to feed four generator turbines and governors. Each pump is driven by a small impulse wheel of about 25 H.P. running at 80-100 r.p.m. Regulation is done by hand by throttling the pressure in the needle nozzle. All parts exposed to water pressure were tested to a test pressure of 350 lbs. per square inch.

The installation is working since October, 1912 and has been a great success in every respect.

George S. Rice, chief mining engineer of the United States Bureau of Mines has dedicated to public use a patent just issued by the Government for a hoisting cage which is primarily for use in rescue work, but can be used for other purposes. In describing his invention, he states that it has for its object the provision of a novel cage which shall have peculiar advantages in regard to portability and ease of assembling and disassembling. He adds that although not limited to such use it is of especial utility in mine rescue work as an emergency cage.

COAST TO COAST.

New Westminster, B.C.—Under an arrangement which the Provincial Government and the C.P.R. are upon the eve of entering, it is now proposed to have the new government highway bridge across the Pitt River finished many months ahead of the time originally set for its completion. The Provincial Government authorities are at present conferring with the railway officials with a view of securing the steel superstructure of the present railway bridge across the Pitt and placing it upon the concrete substructure of the new Government bridge, which will be located several hundred yards above the railway bridge and about where the ferry landings now are.

Vancouver, B.C.—In order to facilitate the work of protecting the forests from fire, the Provincial Government is building a number of trails through the danger spots, to aid in concentrating the forest guards in emergency. Work is going on at present on a trail from Gordon Pasha Lake to Powell Lake; a trail from Campbell Lake to Salmon River Valley, and a trail from Bond Sound to Kingcom Inlet. Cabins are being built along the trails at intervals to form resthouses for the firewardens, and supplies are being packed in over the trails, in order to prepare for emergencies. Superintendent George D. McKay has ready a supplementary list of fire guards who will be set to work as soon as the weather gives any indication of proving conducive to forest fires.

Toronto, Ont.—Toronto is to have the proposed auxiliary service to the waterworks pumping station, filtration plants and sewage disposal plant, in order to insure the necessary supply in case of interruption in the electrical transmission lines to the city. Chairman Ellis, Mayor Hocken and General Manager Couzens of the Toronto Commission had a conference with Hon. Col. Hendrie, Mr. W. K. McNaught, M.P.P., and Chief Engineer Gaby, of the Hydro-Electric Commission, and after a full and careful discussion of the joint report of the Provincial and city commission engineers regarding the proposed auxiliary plant it was approved. The report, which is signed by Messrs. Gaby and Couzens, does not assume to be comprehensive in character, and suggests two plans, part of which reads as follows:—"The power required for the civic requirements as outlined is over 14,000 H.P., and there are two broad lines on which a permanent auxiliary electric service to operate the plant can be dealt with:—(a) By the installation of generating plant within the city, to be given by steam, gas or oil engines; (b) connection with the system of the allied electric companies. A comparison of these two methods shows, in our opinion, the following among other advantages, in favor of the former under present conditions:—Greater rapidity in picking up the load; less delay in transferring the load after resumption of supply; greater reliability; the whole Toronto system would remain under the direct control of the Toronto Commission, and, therefore, under the general Hydro scheme; lower capital cost; economy due to utilizing the steam plant for the reduction of peak loads; ability to use the plant in cases of emergency in accordance with the terms of the agreement between the Provincial Commission and the city of Toronto; greater possibility of expansion in accordance with the requirements of the system and service. We, therefore, beg to recommend the adoption of scheme (a) in general principle, when the details can be carefully worked out and a report submitted to the Toronto Commissioners with a view to considering the vari-

ous commercial features which concern the undertaking under their control."

Montreal, Que.—Nearly seven million bushels more grain have passed through the Lachine Canal thus far in 1913, than for a similar period of last year. The exact increase is 6,911,919 bushels, or more than the total receipts for the month of May, 1912. Wheat, corn, barley, flax and oats are included in the shipments, which comprise a record for the Lachine Canal. The carriage of wheat alone is almost doubled this year, its total of something over ten million bushel being balanced against five million for 1912. Mr. Ste. Marie, canal revenue officer, predicts even a greater increase for the remaining months of the season. "The Fort William and Port Arthur elevators are not nearly exhausted yet," he said recently, "and the chief reason why shipments have not been even heavier than they have, is because Montreal elevators have not been able to cope with the onrush of grain that has been pouring into them since navigation opened late in April. When we have secured sufficient elevator accommodation at this port, Montreal will get all, or practically all, of the Canadian shipments from the West. The St. Lawrence route, besides being the shortest, is the most expedient for lake shippers, and we may expect to get more records broken when we supply facilities for handling the grain once it gets here."

Vancouver, B.C.—"The Burrard Inlet is a splendid place in which to locate a floating drydock. I should prefer a floating to a graving dock, which was in fashion forty years ago, but which has since grown too small or become unadaptable because the shipping centre has moved away. But Vancouver really needs a floating dock," said Mr. James Fowler, of Seattle, Lloyd's agent for the Pacific coast, to the sub-committee on harbor affairs of the board of trade when discussing Vancouver's requirements in the matter of docks. Mr. Fowler recommended the erection of a floating dock, 12,000 to 15,000 tons weight, for Vancouver harbor. It should be 600 feet long, and there should be at least 90 feet between the towers. Such a dock would satisfy the needs of this port for many years. A structure at Seattle, built for the Seattle Construction Company, approximately of this size, cost about $650,000. But it was built in sections, a method of which Mr. Fowler disapproved. "For Vancouver especially, where there is just now no centre of shipping, a floating drydock, which can be moved up the harbor as wharves are built toward the east, is vastly to be preferred to a graving dock," said Mr. Fowler. "It can be built in one-quarter of the time, and its proportionate cost is less. The vessels can be docked and undocked much more easily. Lloyd's will insure a floating drydock at rates as low as graving docks. The difference in cost of upkeep is offset by the additional advantages." Mr. Fowler also drew attention to the floating drydock being constructed by the Grand Trunk Pacific for Prince Rupert. This is to be 610 feet long with 110 feet between towers. The committee appointed the chairman, Mr. Stone, and Mayor Baxter to be a sub-committee to interview the authorities of Canadian Pacific Steamship Service and to ask what will be their share in the establishment of a drydock for Vancouver.

Montreal, Que.—The administration of the St Lawrence ship channel is likely to be attached to the inside service at Ottawa by legislation to be introduced next session. At present it is a part of the outside service. Sir George Murray in his report on the public service suggested direct control from Ottawa of the staff and works, upon which millions are being spent, and it is wholly probable that it will be followed out. There will also be legislation abolishing the pilots' corporation at Quebec, as was recommended by a commission which last winter investigated the pilotage system. Its report came too late to be acted on last session.

Ottawa, Ont.—The application of the Canadian Pacific Railway Company to the Government for authority to increase the company's capital stock by a further issue of shares to the par value of $60,000,000 is likely to be granted. The application has been before the Government since last August, but was not pressed last year in view of the alternative adopted by the company of issuing new stock last fall under the provisions of its charter legislation in regard to stock issues against branch lines. It is understood that the company does not wish to exhaust this method of further increasing its capital stock without recourse to Government sanction, and consequently authority for the next issue will be sought from the Government. Justification for such sanction is urged on the ground that the company is now carrying out a program for main line and general improvements aggregating $100,000,000. It is known that several members of the Cabinet are in favor of granting the application made by the company last August and which has never been withdrawn. Hon. Robert Rogers has frankly stated that he is in favor of Government sanction for the sixty million stock issue. He takes the ground that the greatest need of western Canada is better transportation facilities to keep pace with the rapid development of the country. If the C.P.R. wants to raise sixty million dollars more to spend on the road he sees no reason why the application should be refused.

Toronto, Ont.—A summary of the total expenditure on county roads for the year, according to W. A. McLean, Provincial Engineer of Highways, in his annual report, is as follows:—Road construction, $407,547.90; permanent bridges, $213,162.41; superintendence, $15,764.73; machinery, plant and equipment, $39,946.22; special county grants to townships, towns and villages, $18,821.26; toll roads, $16,830, making a total for the year 1911 of $712,072.52. Provincial grants of one-third of the total expenditure, in accordance with the Highway Improvement Act, amounted to $237,357.50, payment being made during the Provincial fiscal year 1911-12. County expenditure, or the remaining two-thirds, was $474,715. The roads graded, drained and metalled with broken stone and gravel amounted to 240 miles. The expenditure included the construction of 281 tile culverts, 155 other culverts of less than 10 feet span; and 113 bridges of more than 10 feet span. Culvert and bridge construction was all of a permanent type, using concrete tile and corrugated iron for small waterways; principally concrete for culverts of a larger size; and steel and reinforced concrete for bridges, piers and abutments being of solid concrete. Bridge and culvert construction largely proceeds in advance of actual road improvement, as in many cases, the immediate rebuilding of old and decayed wooden bridges on the designated county roads is imperative in the interest of public safety.

Traffic through the American and Canadian canals at Sault Ste. Marie for the 1912 season is recorded as follows: The total freight traffic of both the American and Canadian canals was 72,472,676 tons for the season of 1912, an increase of 36% over 1911. All items of freight show an increase when compared with the season of 1911, except coal, salt, copper and building stone. The total number of passengers was 66,877, a decrease of 13,074, and the passages through both canals numbered 22,778, a gain of 22% over 1911. Traffic through the American canal was 45% of the total freight, 55% of the total net registered tonnage, and 44% of the total number of passengers carried. Through the Canadian canal traffic was 55% of the total freight, 45% of the total registered tonnage, and 56% of the passengers carried.

CANADIAN PRODUCTION OF CEMENT.

The production of cement in Canada during the past few years, though all classed as Portland, has included an output of Puzzolan cement, made from blast furnace slag at Sydney, N.S., and a small production of "natural Portland," made at Babcock, Manitoba, 75 miles southwest of Winnipeg, on the Canadian Northern railway, according to the annual report of mineral production in Canada by John McLeish, B.A.

The total quantity of cement made in Canada during 1911, as per reports received from the manufactures, was 5,677,539 barrels of 350 pounds net each (993,569 tons), as compared with 4,396,282 barrels (769,349 tons) made in 1910—an increase of 1,281,257 barrels, or over 29 per cent.

The total quantity of Canadian Portland cement sold in 1911 was 5,692,915 barrels (996,260 tons), as compared with 4,753,975 barrels (831,946 tons) in 1910—an increase of 938,940 barrels, or nearly 20 per cent.

The total consumption of Portland cement in 1911, including Canadian and imported cement, was 6,354,831 barrels of 350 pounds net (1,112,095 tons) as compared with 5,103,285 barrels (893,075 tons) in 1910—or an increase of 1,251,546 barrels, or nearly 25 per cent.

The cement industry has been rapidly growing in importance, and its output is now exceeded in value amongst non-metallic products by coal and clay products only.

An average of 3,010 men were employed in 1911, the total wages paid being reported as $2,103,838.

The increase in annual production since 1905 has been nearly four-fold. The production per capita in 1911 was about 278 pounds, as against only 79 pounds in 1905. The approximate consumption per capita has increased during the same period from 115 pounds to 310 pounds.

A similar rapid increase in both production and consumption has taken place in the United States, where the annual production now exceeds 75,000,000 barrels.

PERSONAL.

Mr. A. N. BEER has been appointed assistant waterworks engineer of Ottawa, to succeed Mr. Storrie.

Mr. ALEXANDER LARIVIERE, who for some time has been connected with the Montreal Harbor Commission, recently resigned and has joined the staff of the Department of Roads, Province of Quebec.

J. T. HOWARD, B.A.Sc., has become associated with the F. W. Thorold Company, consulting engineers and contractors, as engineer. Mr. Howard is a graduate in structural engineering of the University of Toronto.

Mr. F. T. BOWRING, of Winnipeg, was a visitor at the office of *The Canadian Engineer* this week. Mr. Bowring is on an extended trip through the eastern provinces. He is a member of the municipal engineering firm of Bowring and Logan, Winnipeg.

W. CHASE THOMSON, M.Can. Soc., C.E., has opened an office in the new Birks Building, Montreal, as consulting engineer. Mr. Thomson will make a specialty of bridges and other steel structures. His experience in bridge and structural designing covers a period of twenty-three years, during which time he has spent three years with the King Bridge Company of Cleveland, Ohio; seventeen years with the Dominion Bridge Company, Limited, of Montreal; and the past three years as manager for Canada, with the Cleveland Bridge and Engineering Company, Limited, of Darlington, England. Mr. Thomson has contributed several articles to the engineering journals and has written two books: "Bridge and Structural Design" and "The Design of Typical Steel Railway Bridges," both of which are extensively used, both in colleges and engineering offices, throughout Canada and the United States.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.

The sixth semi-annual meeting was held at the Engineers' Club in Boston, Mass, June 25-28. Papers were presented on "The Power Plant," by Perry Barker, of Arthur D. Little, Inc.; "Relation of the Manufacturer to the Patent System," by Dr. W. M. Grosvenor; "Depreciation and Obsolescence," by R. K Meade; "Legal Control of Dangers to Health in Factories," by Dr. C. F. McKenna; "Some Peculiar Functions of the Retained Expert," by Dr. W. M. Grosvenor, and other papers.

COMING MEETINGS.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, J. W. H. Watts, R.C.A., Ottawa, Ontario.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Annual Meeting in Regina, September 16, 17 and 18, General Secretary, Major Drum, Ottawa; Local Secretary, Dr. Murray, Regina.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.C.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, Lo21 Brown-Marx Building Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

NATIONAL ASSOCIATION OF CEMENT USERS.—Tenth Annual Convention to be held in Chicago, Ill., February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Meeting to be held at Lethbridge, Alberta, on August 5th and 6th, 1913. Secretary, Norman S. Rankin, Calgary, Alta

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

19666—June 24—Authorizing C.P.R. to operate trains, engines and cars through the junction and over crossings, at Mile End, Que., without their first being brought to a stop.

19667—June 24—Authorizing C.P.R. to operate trains through junction, and over crossings, at South Junction, Que., without their first being brought to a stop.

19668—June 24—Authorizing City of Hamilton, Ont., at its own expense, to construct extension to Primrose Ave., easterly across spur, of T.H.&B., on Lot No. 6, Con. 2, Tp. Barton, now in City of Hamilton.

19669—June 24—Authorizing C.P.R. to operate trains over interlocking plant at swing bridge over Trent Canal, near Talbot, Ont., without their first being brought to a stop.

19670—June 24—Authorizing C.P.R. to operate trains over interlocking plant at swing bridge, at Couchiching Narrows, near Atherly, Ont.; provided that if distant semaphore is at "Caution," trains must stop and not proceed over it until the same is clear.

19671—June 24—Extending, until Dec. 31, 1913, time within which C.P.R. complete branch line, authorized to be constructed, maintained and operated under Order No. 17075.

19672—June 21—Directing that speed of all trains passing over crossing of Archabail St., St. Boniface, Man., be restricted to four miles per hour; no cars be left standing on S.W. side of crossing closer than main lead switch; and on first track south of main line, on east side of crossing, closer than 75 feet from board walk, on N.W. side of main line, known as Winnipeg Steel Granary Spur; sign posts be erected indicating points where cars must not be left standing outside of sidings, for guidance of those setting cars on tracks.

19673—June 23—Authorizing G.T.R. to construct siding for Collie-Cockerill Manufacturing Co., Ltd., on Lot 79, Con. 1, Tp. of Whitchurch, Co. York, Ontario.

19674—June 24—Amending Order No. 19536, dated June 10th, 1913, by striking out words: "Its appearing that the Railway Company has failed to comply with requirements of said Order No. 15780," in recital of said Order No. 19536, and substituting words, "what was submitted by the Railway Company."

19675—June 25—Approving proposed alterations in C.L.O. & W. Rly. Co.'s railway, so as to include within limits of right-of-way covered by location approved under Order No. 19196, portion of Lot 18, Con. 3, Tp. South Sherbrooke.

19676—June 25—Authorizing C.P.R. to construct switching lead to yard at Smith's Falls, Ont., across road allowance between Cons. 3 and 4, Tp. Montague, Co. Lanark, Ont., at mileage 133.0 from Montreal Jct., Smith's Falls Subdivision, Eastern Div.

19677—June 25—Authorizing C.P.R. to construct Bridge No. 95.6 over North River, Muskoka Subdivision, Ontario Div., Ont., near Lovering Station.

19678—June 25—Authorizing C.P.R. to construct Bridge No. 1.1 on Hamilton Subdivision, Ont. Division, Ontario.

19679—June 25—Amending Order No. 19489, dated June 7th, 1913, by striking out words "Belle Plain," in 4th line of operative part of order, and substituting therefor the word "Pense."

19680—June 24—Authorizing C.N.O.R. to divert public road between Lots 5 and 6, Con. 3, Tp. York, Co. York, Ont, and to construct across said road by means of structure carrying highway over railway.

19681—Juns 21—Directing C.N.R. to construct farm crossing on E. Good's farm on Lot 5, Con. 6, Tp. Nepean, Ontario.

19682—June 21—Amending Order No. 19227, dated May 9th, 1913, by adding following clause: "That the traffic of the Grand Valley Railway Company shall not be interrupted by the work authorized under this order."

19683—June 23—Rescinding Order No. 17386, dated Aug. 28th, 1912, in so far as it approves location of station at St. Gregoire, Que., and approving location G.T.R. station at St. Gregoire, Que., as shown on plan dated June 5th, 1913; said station to be completed on or before Aug. 1st, 1913.

19684—June 21—Directing that Central Ont. Rly. schedule train No. 3, leaving Trenton at 1.45 p.m., to arrive at Central Ontario Jct., to connect with C.P.R. No. 17 due at said Jct., at 3.13 p.m., etc., etc.

19685—June 24—Requiring Que. Oriental Rly. (1) to add to its equipment, not later than Dec. 31, 1913, two new locomotive engines capable of carrying at least 160 lbs. steam pressure to the square inch, and (2) if, after hydrostatic tests, boilers of its present locomotive equipment be found incapable of carrying steam pressure of 160 lbs., company purchase at least four additional boilers for its 17 x 24 inch class of locomotives capable of carrying such pressure.

19686—June 25—Authorizing C.N.R., at its own expense, to construct highway across its railway at McGee Townsite, in N.W. ¼ of Sec. 19-29-16, W. 3 M., Sask.

19687—June 25—Amending Order No. 18048, dated Nov. 11 1913, to provide that curve in road where latter makes right-angled turn just south of track, be constructed so that travelled way shall be 35 feet in width, and extending, until July 15th, 1914, time within which work required to be done under said order is completed.

19688—June 24—Refusing application T.H. & B. Rly. for authority to construct stand-pipe between its main tracks on Hunter St., City of Hamilton, Ont., immediately west of John Street.

19689—June 25—Authorizing Toronto Suburban Rly. to construct across Goderich Branch of C.P.R. a spur into Prison Farm, in Lot Cons. 1 and 2, Tp. Guelph, Co. Wellington, Ont., subject to and upon certain conditions; and rescinding Order No. 19171, dated May 5th, 1913.

19690—June 25—Directing Can. Nor. Que. Rly. to construct raceway and other openings under its railway, on approved location at the Jacques-Cartier River, Lots 79 and 80, Parish of Les Ecureuil Co. Portneug, Quebec.

19691—June 25—Authorizing G.T.R. and C.P.R. to operate trains over crossing on Weston Road, Town of Toronto Jct., Ont., without the first being brought to a stop.

19692—June 23—Approving and authorizing clearances as shown on C.P.R., plans showing clearances at C.P.R.'s new shops, at Ogden, Alberta.

19693—June 25—Directing Brockville, Westport & North Western Ry. Co. to renew ties on following bridges: (a) Just east of Lynn Station; (b) just west of Lynn Station; (3) at Corbett's Creek, new stringers under rails, and (d) over Rideau Canal at Newboro. 2. Company renew at least 30,000 ties on its line; whole line be ballasted; highway crossings be made to conform to Standard Regulations of Board. (3. Work be completed by Nov. 1st, 1913.

19694—June 26—Authorizing G.T.R. to construct branch line and spur therefrom for Beaver Companies, on Lot 48, Con. K, Tp. Thorold, Co. Welland, Ont., work to be completed within three months from date of this order.

19695—June 26—Extending, until Aug. 1st, 1913, time within which G.T.P. Rly. complete work of opening in fill at Cameron Bay, near Prince Rupert, B.C.

19696—June 25—Directing G.T.R., within 90 days from date of this Order, to install electric bell at crossing of John St., in Town of Port Hope, Ont., and thereafter maintain bell at its own expense.

19697—June 26—Authorizing Montreal & Southern Cos. to run trains and cars, with passengers, baggage, express and other traffic carried thereon, over line of Central Vermont Rly., between Montreal & Southern Co.'s Jct., at east end of its Southwark Yards, St. Lambert, Que., and Richelieu, Que., a distance of 12 miles, and to use Central Vermont Co.'s passenger and freight stations, station yards, and other facilities at and between said points.

19698—June 26—Amending Order No. 18997, dated April 8th, 1913, by striking out words and figures: "Calgary Lands Titles Office, on 22nd February, 1913, as Rly. 598," and inserting in lieu thereof words and figures: "Nelson Land Titles Office, on 4th June, 1913, as No. 524, c. 16."

19699—June 26—Authorizing, pending installation interlocking plant, C.P.R., to operate trains over crossing of G.T.R. at Tecumseth St., Toronto, on signals from switchmen; interlocking plant, be installed by August 20th, 1913.

19700—June 26—Authorizing Ansley Coal Co., Ltd., to connect its Ansley Spur Line with spur line constructed for Municipal Corporation of City of Medicine Hat by C.P.R.

19701—June 26—Authorizing C.P.R. to construct two (2) branch lines for Canada Malting Co., Ltd., on S.W. ¼, Sec. 12-24-1, W. 5 M., at Calgary, Alberta. Spurs be completed within three (3) months from date of this order.

19702—June 27—Approving one-way fares shown on page 4 of Montreal & Southern Co. Ry. Co.'s Local Passenger Tariff, C.R.C. No. 3, as maximum tolls to be charged on its line between Montreal and Richelieu and intermediate stations, in Province of Quebec, company to publish same, with copy of this Order, in at least two consecutive weekly issues of "The Canada Gazette."

19703—June 27—Authorizing C.P.R. to construct extension of existing siding along lane between its right of way and Caron Avenue, Windsor, Ont.; spur to be completed within three months from date of this Order.

General Order No. 106—June 27—Amending Order No. 14115, dated July 14, 1911, by adding after clause 5 of Order, following clause: "5a. Boilers equipped with superheated flues. On removal of ordinary flues and of as many of superheated flues as may be necessary for men to get inside of boiler to scale and inspect same, if it is found, upon inspection by mechanical officer in charge at each point where boiler work is done, that condition of superheated flues does not warrant their removal, they may be left in, if thoroughly scaled; said mechanical officer or inspector to be held strictly responsible as provided in clause 2 of the Order."

19704—June 30—Authorizing London Street Ry. and C.P.R. to operate cars and trains over crossing at Adelaide St., London, pending installation of half-interlocking plant—to be installed not later than July 15th, 1913—same to be flagged across by means of day and night watchmen, appointed by C.P.R., at expense of London St. Ry. Co.

19705—June 27—Directing C.P.R. at its own expense to provide and construct suitable crossing where it intersects and crosses Hall St., town of Renfrew, Ont.; said crossing to be constructed in accordance with Standard Regulations.

19706—May 16—Authorizing G.T.P. Branch Lines Co. to construct its Brandon branch across two (2) highways, namely:—1, Mileage 12.14, between Secs. 3 and 10, Tp. 11, R. 17, W. 1 M. and 2, mileage 12.76, between Secs. 3 and 4, Tp. 11, R. 17, W. 1 M.

19707—June 26—Directing that the hours of the watchman at north side crossing of Cherry St., by G.T.R., Toronto, Ont., be extended from 5 o'clock p.m., until 7 o'clock p.m.

19708—June 28—Directing that, upon R. V. MacCosham, Edmonton, Alta., undertaking to comply with Standard Spur Conditions of city of Edmonton, C.N.R. construct branch line, or spur, extending from lots 122 and 123 through lane dividing block 8, to lots 108 and 137.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING

in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Carlyle, Sask., waterworks and electric lighting	Aug. 1.	July 10.	86
Cochrane, Ont., buildings	July 22.	July 10.	84
Halifax, N.S., bridges and culverts	July 19.	July 10.	80
Hanover, Ont., public building	July 21.	July 3.	76
Kemptville, Ont., erection of drill hall	July 21.	July 10.	78
Lakefield, Ont., public building	July 21.	July 10.	78
Lloydminster, Sask., interior fittings for post office, customs and inland revenue office	July 25.	July 10.	78
Pitt River, B.C., dredging	July 23.	July 10.	78
Saskatoon, Sask., boulevard posts	July 21.	July 10.	86
Toronto, Ont., cutting pulpwood	Aug. 15.	July 19.	78
Victoria, B.C., concrete pipe and appurtenances	July 31.	July 10.	86
Victoria, B.C., steel pipe and appurtenances	July 31.	July 10.	84
Welland, Ont., gate lifter	July 29.	July 3.	84
Windsor, Ont., Incinerator	July 29.	July 10.	84
Winnipeg, Man., motor generator	Aug 9.	Jnly 10.	76

RAILWAYS—STEAM AND ELECTRIC.

Toronto, Ont.—The management announces that the Toronto and Eastern Radial line from Bowmanville into Toronto, will be ready for full operation early next spring. The grade between Bowmanville and Pickering will soon be completed, and nearly four hundred men will be set at work on the grade from Pickering west of Toronto. The steel is already laid from Bowmanville, half a mile west, and a large force of men are now to be placed on laying the steel between there and Pickering.

Vancouver, B.C.—The C.P.R. is making arrangements for the enlargement of the docks at Vancouver, and an extra two hundred feet has been taken over from R. V. Winch & Co. Mr. Peters, general superintendent of the railway, states that the company requires more room on the waterfront for the grain trade.

BRIDGES, ROADS AND PAVEMENTS.

+—Amherst, N.S.—The town council has awarded Mr. J. E. LUSBY the contract for laying cement sidewalks. The contract price was $1.19 per square yard with the town doing the grading and $1.20 per square yard for sidewalks and grading. Other tenders received were:—John Thornton, $1.40 per square yard with the grading and $1.25 a square yard with the town doing the grading; the New England Artificial Stone Company $1.20 a square yard with the town undertaking the work of grading.

+—Brockville, Ont.—The Town council has awarded the A. W. GODSON COMPANY, Toronto, the contract for paving on Perch Street.

▲—London, Ont.—Tenders will be received up till the 31st of July, 1913, for the construction of a highway bridge over the River Thames. Plans and specifications may be obtained from the city engineer, Wm. N. Asphlant.

Medicine Hat, Alta.—The ratepayers of this city have passed a by-law authorizing the expenditure of $75,653 on sidewalks. Mr. A. K. Grimmer is the city engineer.

+—Plairton, Pa.—The DOLARWAY PAVING COMPANY have been awarded the contract for the construction of 12,000 square yards of pavement here.

Ritchat, Man.—Tenders will be received up till the 21st of July, 1913, for the construction of roads in the municipality. Plans and specifications may be obtained from the Highway Commissioner, Winnipeg, and G. T. Landry, secretary-treasurer.

▲—Toronto, Ont.—Tenders will be received up till the 28th of July, 1913, for the construction of a 15-foot span concrete culvert with concrete abutments and reinforced concrete slab. Plans and specifications may be obtained from John Bryan, Esq., Laurel, Ont., and Frank Barker, Township Engineer.

+—Unionville, Ont.—The Highway Board has awarded the LEWIS CONSTRUCTION COMPANY the contract for the erection of the Eckardt bridge. The contract price is $1,466.

Windsor, Ont.—Tenders will be received up till the 29th of July, 1913, for supplying an automatic street flushing machine. Plans and specifications may be obtained from M. E. Brian, City Engineer.

LIGHT, HEAT AND POWER.

▲—Carlyle, Sask.—Tenders will be received up till the 1st of August, 1913, for the supplying power and lighting equipment. Plans and specifications may be obtained from the consulting engineers at Winnipeg and Calgary. F. J. Stent, secretary-treasurer.

+—Cananoque, Ont.—The town council has entered into a contract with the ELECTRIC LIGHT AND WATER SUPPLY COMPANY, for supplying the lighting for the town.

+—Medicine Hat, Alta.—The city has awarded the NORTHERN ELECTRIC COMPANY the contract for installing a fire alarm system. The contract price is $10,840. Other firms tendered as follows: Siemens', Limited, $11,284, (New York); Star Electric, $5,165, plus duty and freight.

+—Toronto, Ont.—The O'Keefe Brewery Company has awarded the TERRY STEAM TURBINE COMPANY, Hartford, Conn., the contract for supplying a 25-horse-power Terry turbine-driven pump.

+—Winnipeg, Man.—The Board of Control have awarded the FORT GARRY CONSTRUCTION COMPANY the contract for the extension to power station. The contract price is $35,800.

+—Winnipeg, Man.—The city has awarded MESSRS. VICKERS, LIMITED, Montreal, the contract for supplying three 5,000 k.w. generators and spare parts. The contract price is $96,318.

Tarvia

Preserves Roads
Prevents Dust~

Beaurepaire Road, Beaconsfield, Quebec. New macadam road treated with two coats of "Tarvia B."

A Splendid Tarvia Highway

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At a trifling expense, Beaconsfield thus secured a road surface capable of standing the traffic and needing very little maintenance. The saving in maintenance in itself will balance the cost of the Tarvia treatment. In winter or summer this road will give swift and easy traction. The Tarvia-bonded surface will shed water and the surface will afford good footing.

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ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

GARBAGE, SEWAGE AND WATER.

+—**Assiniboia, Man.**—The municipality has awarded THOS. JACKSON & SONS the contract for the construction of a sub-main from Conway Street to Oakdale Park.

▲—**Bassano, Alta.**—Tenders will be received up till the 15th of August, 1913, for the construction of a sewage disposal works. Plans and specifications may be obtained from the John Galt Engineering Co., Ltd., consulting engineers and Geo. B. R. Bond, secretary-treasurer.

+—**Bowmanville, Ont.**—The town council has awarded Mr. JOHN F. CONNOLLY the contract for a sewage disposal works.

▲—**Carlyle, Sask.**—Tenders will be received up till the 1st of August, 1913, for construction of waterworks. Plans and specifications may be obtained from the consulting engineers at Winnipeg and Calgary. F. J. Stent, secretary-treasurer.

+—**Montreal, Que.**—The city has awarded the JOHN R. McDOUGALL COMPANY the contract for supplying two pumps having a capacity of 12,000,000 gallons. They will cost about $24,000 each. This will bring the pumping capacity of the water department up to about 80,000,000 gallons a day, or about 24,000,000 gallons a day over average requirements.

New Liskeard, Ont.—At a recent council meeting it was decided to call for tenders immediately on the laying of water main extensions and sewers throughout the town and all estimates are now prepared. Nearly 4,000 feet of water main extensions are to be laid during the summer months, while 3,000 feet of sewer will also be installed.

Orillia, Ont.—Dr. J. W. S. McCullough, chief health officer for the province, has notified this town to instal a mechanical filtration plant to treat the supply of water taken from Lake Conchiching.

Oshawa, Ont.—Tenders will be called for in the near future for a turbine pump, 100 horse-power, electrically-driven, 800 gallons per minute. Frank Chappell, Town Engineer and Superintendent of Waterworks.

Oshawa, Ont.—Orders have been recently placed with the Neptune Meter Company, New York City, for additional supply of meters for the town of Oshawa. The metering system of Oshawa has proven very successful. The daily consumption of water has been reduced to 65 gallons per capita. Among the meters used are those manufactured by the Neptune Meter Company, Buffalo Meter Company, Union Water Meter Company, Hersey Manufacturing Company, Gamon Meter Company, Glenfield and Kennedy, National Meter Company, etc.

Point Grey, B.C.—Mr. F. L. Fellowes, city engineer of Vancouver, and Municipal Engineer Johnston, will prepare a joint estimate of the two routes of the partnership water pipe line.

Port Dalhousie, Ont.—The village council plans to install a waterworks and sewerage system. The estimated cost will be $150,000.

+—**Regina, Sask.**—The City Council has awarded the McMANUS CONSTRUCTION COMPANY the contract for laying 12-inch, 10-inch, and 8-inch pipe for the high pressure system.

Toronto, Ont.—Works Commissioner Harris will recommend that tenders be called for the installation of a mechanical filtration plant at the Island, of 60,000,000 gallons capacity per day, in his report that he will make to the city shortly.

Toronto, Ont.—The Department of Works are taking borings to ascertain the geological nature of the bed of Lake Ontario opposite Victoria Park and hydrographic soundings are being prosecuted regarding depth, current, etc., preliminary to the establishment of a filtration plant there.

▲—**Toronto, Ont.**—Tenders will be received up till the 22nd of July, 1913, for the construction of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

▲—**Toronto, Ont.**—Tenders will be received up till the 29th of July, 1913, for supplying portable sewage pumping engines. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

Toronto, Ont.—Tenders will likely be called for by next spring for approximately 2,000 feet of riveted steel pipe to connect the south tunnel shaft with the new mechanical filter plant to be built at the Island.

+—**Victoria, B.C.**—The city council have awarded the following contracts in connection with the northwest sewer system: The GEO. A. POWELL & CO., the contract for supplying 1,500 feet of 2-inch black iron pipe; to MESSRS. E. G. PRIOR & COMPANY, the contract for supplying 3,000 feet of 12-lb. rails and fasteners; to MUSSENS, LIMITED, the contract for supplying 1,000 feet of 8-inch galvanized pipe. These were the lowest bids submitted.

▲—**Victoria, B.C.**—Tenders will be received up till the 31st of July, 1913, for the fabrication and laying of about 10¼ miles of 36-in. riveted steel pipe and appurtenances on the line of the Sooke Water Supply. Plans and specifications may be obtained from C. H. Rust, Water Commissioner.

▲—**Victoria, B.C.**—Tenders will be received up till the 31st of July, 1913, for the laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit. Plans and specifications may be obtained from the Sooke Water Supply office, and C. H. Rust, Water Commissioner.

+—**Wingham, Ont.**—The town council has awarded T. J. McLEAN AND COMPANY the contract for storm sewers for the town.

BUILDINGS AND INDUSTRIAL WORKS.

Amherst, N.S.—Tenders will be received up till the 22nd of July, 1913, for the construction of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

Battleford, Sask.—Tenders will be received up till the 31st of July, 1913, for the erection of a public building. Plans and specifications may be obtained from Mr. J. E. Cyr, Winnipeg; Mr. W. T. Mollard, Regina, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Blackstock, Ont.—Tenders will be received up till the 24th of July, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

Brampton, Ont.—Tenders will be received up till the 24th of July, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

+—**Calgary, Alta.**—The School Board has awarded Mr. J. A. McPHAIL the contract for the erection of the Balmoral school. The contract price is $160,000 and the plumbing and heating will be installed at a cost of $28,545.

+—**Calgary, Alta.**—The Sherwin-Williams Paint Company has awarded the CARTER-HALLS-ALDINGER CO. the contract for the erection of a warehouse and store.

▲—**Cochrane, Ont.**—Tenders will be received up till the 22nd of July, 1913, for the erection of an ice house, store house, freight house, and two tool houses. Plans and specifications may be obtained from Mr. Gordon Grant, Ottawa, and Mr. T. S. Armstrong, Cochrane, and the Commissioners of the Transcontinental Railway. P. E. Ryan, secretary.

+—**Collingwood, Ont.**—The Dominion Government has awarded the C. S. BOON DREDGING AND CONSTRUCTION COMPANY the contract for the dredging required here. The contract price is $49,550.

Dalhousie, N.B.—Tenders will be received up till the 21st of July, 1913, for the dredging required here. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—**Fort Carry, Man.**—MESSRS. CARTER, HALLS AND ALDINGER have been awarded the contract for the construction of a swine barn at the new agricultural college. The contract price is $12,718.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire Machine Banded
WOOD STAVE PIPE
CONTINUOUS STAVE PIPE
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For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

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MANNESMANN STEEL TUBES

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WELDLESS TUBES up to 12 inches diameter, in lengths up to 40 feet.

Laying Mannesmann Pipes in Argentina.

LAP-WELDED TUBES from 12 inches up to the largest diameters.

MANNESMANN TUBE COMPANY, LIMITED

51 VICTORIA SQUARE, MONTREAL

Galt, Ont.—Tenders will be received up till the 5th of August, 1913, for the construction of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy-Minister.

Galt, Ont.—The B. F. Sturtevant Company, with head offices at Boston, Mass., will locate a plant in this city. The company manufactures blowers and engines, and is practically the largest industry of its kind in the United States.

+—Kamloops, B.C.—The city has awarded Mr. GEO. McBETH the contract for the agricultural building at the exhibition. The contract price was $10,400. Other tenders received were H. J. Davies, $10,300; R. McKay, $10,395; Fruitlands Building Company, $12,300

+—Lauzon, Que.—The Dominion Government has awarded MESSRS. M. P. and J. T. DAVIS the contract for the construction of the dry-dock. The contract price is $2,721,116.

+—Little Black River, N.B.—The Dominion Government has awarded MR. T. A. FOWLER the contract for dredging. The contract price is $11,095.

Millbrook, Ont.—Tenders will be received up till the 29th of July, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

+—Montreal, Que.—The School Board have awarded Mr. F. HENRI DEMERS the contract for the construction of the Longue Point school. The contract price is $196,000.

+—Montreal, Que.—The Robert Reford Company has awarded the PETER LYALL CONSTRUCTION COMPANY the contract for the erection of the new office building.

Napanee, Ont.—Tenders will be received up till the 30th of July, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

New Westminster, B.C.—On a pile-driver gaily decorated for the occasion, and especially constructed for the carrying out of the first unit of the important scheme, the first pile that marks the commencement of New Westminster's five-million-dollar harbor improvement was driven in place on July 4th.

+—Ottawa, Ont.—A new contract for the Prince Edward Island terminal of the Intercolonial Railway is being considered by the Minister of Railways, the Halifax Dredging Company having forfeited its $75,000 cheque for failure to go ahead with its original contract. It is understood that but one tender has been received and it is that of ALBERT MACKIE of Toronto, associated with M. J. O'Brien. He has the contract for the New Brunswick terminal. The cost of the Prince Edward Island part will be nearly a million.

+—Ottawa, Ont.—The Dominion Government has awarded the SOO DREDGING AND CONSTRUCTION COMPANY the contract for the dredging required at Bruce Mines, Halton and Walker River, Ont. The contract price is $8,832.

+—Ottawa, Ont.—MESSRS. BLACKBURN BROTHERS have been awarded the contract for the erection of a ten-story store and office building. The contract price is $600,000.

+—Ottawa, Ont.—The Dominion Government has awarded the contract for the new dock at Levis to M. P. DAVIS AND SON, Ottawa. The cost is approximately $2,600,000. The drydock will provide accommodation for the repair of the largest ocean liners, thus meeting a long-felt want in connection with the St. Lawrence route. Construction will begin at once, and it is hoped to have the dock in operation for the season of 1915

Ottawa, Ont.—Only one tender has been received by the Government for the new telescope for the Dominion Observatory, that of Sir Howard Grubb, of Dublin. Two sizes of reflecting lenses are under consideration, one of 60 inches and the other of 72 inches diameter, and the cost will be between $50,000 and $60,000. It will take about two years to complete the instrument.

Port Coquitlam, B.C.—Mr. J. D. Taylor, M.P., announced that within a few weeks a contract would be let that would result in a deep waterway up the Fraser River to this point, and that dredging would be finished on this work in time to allow the 200-foot ship now being built at that point to sail on her maiden voyage to the West Indies. As it is hoped to launch this vessel within the next two months the statement made by the member from New Westminster means that within that time the river will be open to ocean carriers as far as Port Coquitlam.

Prince Albert, Sask.—The Imperial Iron and Steel Company will locate a plant in this city. They will create an extensive Western market for scrap iron, while Northern iron properties will be the principal source of raw material.

Revelstoke, B.C.—Tenders will be received up till the 29th of July for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy-Minister.

Saskatoon, Sask.—Tenders will be received up till the 31st of July, 1913, for supplying a motor truck for the fire department. Plans and specifications may be obtained from the Board of Commissioners. F. E. Harrison, mayor.

Saskatoon, Sask.—A company known as the Anglo-Canadian Building and Construction Company, plans to spend $400,000 in the building of dwellings for occupation this fall. They will construct 200 this and 450 similar houses next year. The necessary money is already secured in England.

+—Sault Ste. Marie, Ont.—The Dominion Government has awarded D. JAMIESON AND SON the contract for an electric passenger elevator in public buildings here. The contract price is $11,100.

+—Schenectady, N.Y.—The MACARTHUR CONCRETE PILE AND FOUNDATION COMPANY, New York, has been awarded the contract for the foundation of the new 2,000,000 cubic feet gas holder for the Mohawk Gas Company. About 800 pedestal concrete piles are to be driven.

South Vancouver, B.C.—Public work estimated to cost $21,258 was recommended to the board of works recently by Municipal Engineer Clement, and was approved, subject to the condition that it be carried out under the arrangement whereby the ward expenditure does not exceed $5,000 a month.

+—St. Stephen, N.B.—The Dominion Government has awarded the MARITIME DREDGING COMPANY the contract for dredging. The contract price is $7,935.

▲—Toronto, Ont.—Tenders will be received up till the 25th of August, 1913, for the construction of a sea wall, breakwater, ship channel and retaining walls. Plans and specifications may be obtained from the District Engineer and the Harbor Commissioners, Toronto; H. J. Lamb, Windsor; J. L. Michaud, Montreal; and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Toronto, Ont.—The Dominion Government has awarded Mr. M. SULLIVAN Kingston, the contract for the construction of the new barracks. The contract price is $650,000.

+—Toronto, Ont.—The Canadian Pacific Railway has awarded DENNY BROTHERS the contract for two new steamers for the British Columbia fleet. Each of these is to be 380 feet long by 54 feet beam, and will be required to show a trial speed of 22½ knots. They are to be ready for service by the spring of 1915. They would be placed in service between Vancouver and Pacific ports and Alaska.

+—Vancouver, B.C.—The Rietmore Manufacturing Company have awarded Mr. A. MOIR the contract for the erection of a factory. The contract price is $150,000.

Vancouver, B.C.—Tenders will be received up till the 21st of August, 1913, for the construction of a wharf. Plans and specifications may be obtained from the following district engineers:—C. C. Harsfield, New Westminster; J. S. McLachlan, Victoria; J. L. Michaud, Montreal; and the district engineer, Toronto; the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Victoria, B.C.—Messrs. Rennie and Taylor have awarded MESSRS. PARFETT BROTHERS the contract for the erection of a three-story apartment block. The contract price is $12,000.

+—Victoria, B.C.—The Dominion Government has awarded MR. G. C. HURRELL the contract for the erection of a conservatory building on Gonzales Heights. The contract price was $11,900.

Victoria, B.C.—Tenders will be received up till the 5th of August, 1913, for the erection of eight residences. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffiths, Public Works Engineer.

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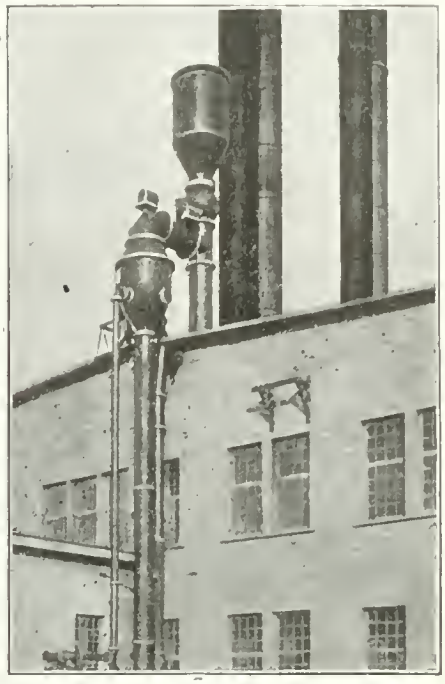
GREATER STEAM ECONOMY



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THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

The Hampton Sedimentation Tank

Used in connection with an electrolytic hypochlorite treatment, the process is **ABSOLUTELY ODORLESS** and the effluent is free from disease germs.

Nine years of operation in large and important installations in England have demonstrated that an effluent exceptionally low in suspended solids and as free from odor as the entering sewage may be obtained with The Hampton Tank.

The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction of the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

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Also engineers for the electrolytic treatment of water.

Variations in Water Head Recorded at a Distance

The Electric Hydro Chronograph

enables you to indicate and record in an office or power house the variation in level at the dam or reservoir that may be several miles away.

Designed especially for Power Plants, Surge Tanks, Municipal Water Works and Filtration Plants.

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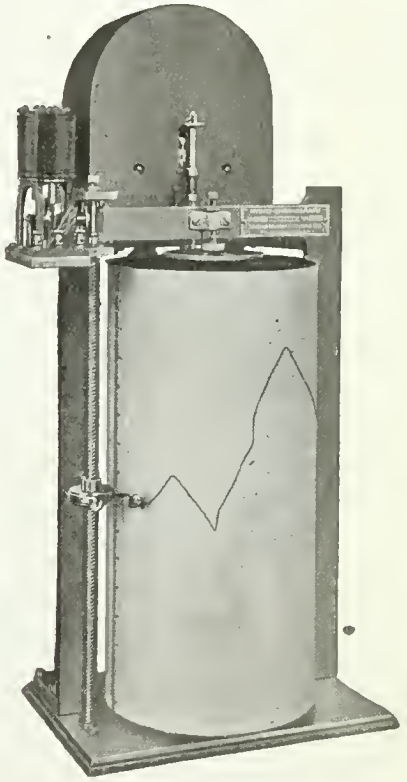


Long Distance Hydro Chronograph

Hydro Manufacturing Company

700 Bullitt Building Philadelphia, Pa.

▲—**Windsor, Ont.**—Tenders will be received up till the 29th of July, 1913, for the construction of an incinerator. Plans and specifications may be obtained from M. E. Brian, city engineer.

+—**Winnipeg, Man.**—MESSRS. CRANE AND ORDWAY have been awarded the contract for the plumbing, heating and ventilation system for the new law courts. The contract price is $119,000.

Winnipeg, Man.—Tenders will be received up till the 22nd of July, 1913, for the construction of a dairy barn, poultry building, etc. Plans and specifications may be obtained from the Department of Public Works, Winnipeg. G. R. Coldwell, Acting Minister.

Winnipeg, Man.—Tenders will be received up till the 22nd of July, 1913, for the construction of a residence. Plans and specifications may be obtained from the Department of Public Works, Winnipeg. G. R. Coldwell, Acting Minister.

+—**Winnipeg, Man.**—The Government has awarded THOS. KELLY AND SONS the contract for the erection of new Parliament buildings. The contract price is $2,859,750. Peter Lyall and Sons were the only other tenderers. The building when completed is expected to far surpass all other public buildings in the Dominion and will contain many interesting features. A million dollars in cut stone, will be used in the construction of the walls and towers, while the ground floor and corridors are to be finished in English Portland stone.

CURRENT NEWS.

Newcastle, N.B.—Newcastle is to be the Atlantic terminus of the Universal Radio Syndicate, which will establish a wireless service from Britain to this town as a link in an all-British world encircling service. Land connections have been secured from Vancouver to Montreal, and the company is negotiating for the purchase of existing lines. A Montreal concern has contracted to build and install the plant. The steel tower will be 500 feet high. It is being constructed in England and will be shipped out in sections. Round this central tower will be grouped six other towers, each one hundred feet high, connected by copper wire with the central tower. A dynamo to operate the plant will need a 250 horsepower engine to drive it. The Canadian Government's arrangement with the syndicate is for five years, at the end of which time the Government has the power to take over and operate the service as a Government work.

+—**Ottawa, Ont.**—One of the largest contracts of its kind ever let and one which illustrates the growing use of scientific methods in modern lumbering has been awarded by the MacLaren Lumber Company of Buckingham to VITALE AND ROTHESAY, forest engineers of New York, for a complete cruise and report on the firm's limits along the Lievre. The extent of the limits owned by the MacLaren Lumber Company along the Lievre may be realized when their size is given as between 2,600 and 2,700 square miles. About half of this is virgin timber, never violated by the axe or saw. Mr. Rothesay will make a complete cruise of the limits and will report, not only on the amount of lumber contained therein, but on its qualities of growth and the quantity of lumber which may be cut from year to year and still permit of reproduction. In the old days lumbermen in the Ottawa Valley were notable for their wasteful methods and lumbering was a process of cutting and slashing indiscriminately with no thought to the future. The timber merchant of the present is wiser in his generation and aims to farm his forest wealth, so that it will reproduce itself infinitely, like a crop. Mr. Rothesay, who will direct the work, is a graduate of Yale University and was a classmate of Mr. H. R. MacMillan, head of the British Columbia forestry service, and Mr. G. Piche, who holds a like position in the province of Quebec.

M. E. Storey, manager of the Goulds Pump Company of Canada, Limited, with offices in the Kent Building, Toronto, announces that the name of the company was changed on July 1st, 1913, to the Storey Pump & Equipment Company, Limited. The latter firm will represent the Morris Machine Works of Baldwinsville, N.Y., and Rumsey & Company, of Seneca Falls, N.Y.

NEW INCORPORATIONS.

Prince Rupert, B.C.—B.C. Salt Works, $125,000.

Hanceville, B.C.—Chilcotin Trading Co., $10,000.

Nelson, B.C.—Kootenay Explosives Company, $200,000.

Victoria, B.C.—Canadian Panama Timber and Logging Co., $100,000.

Ottawa, Ont.—Kildare Mines, $1,000,000. W. G. Bronson, J. W. Woods, E. Linton.

St. John, N.B.—Consumers Coal Co., $49,000. H. N. Stetson, G. McA. Blizzard. A. P. Barnhill.

Montreal, Que.—Dupuis and Poirier, $99,000. (Saw and planing mills). L. Dupuis, J. M. G. Poirier, J. Philippe.

Ottawa, Ont.—Amalgamated Nickel-Copper Mining Co., $1,000,000. W. C. Perkins. H. F. Meech, A. W. Fraser.

Vancouver, B.C.—Canadian Shultz Belting Co., $10,000. Electric Supply Co., $25,000. Reid Todd Construction Co., $10,000.

Black's Harbor, N.B.—The Sturgeon Cove Lumber and Land Co., $49,000. L. Connors, H. R. Lawrence, St. George. J. A. Thompson, Beaver Harbour.

Dalhousie Junction, N.B.—Restigouche Lumber Co., $75,000. R. L. Hicks, Dalhousie Junction; W. S. Smith, Dalhousie; A. McC. Hicks, Dalhousie Junction.

Vancouver, B.C.—Hatzig Shingle and Lumber Company, $100,000. Railway Utility Company of Canada, $50,000. Vancouver Island Coal Mines, $800,000. Vancouver Log Company, $25,000.

Edmonton, Alta.—Peace River Transportation Co., $50,000. Levien Motor Tyre Repairing Co., $10,000. Big Valley Collieries, $100,000. Gold Creek Mining Co., $100,000. Benjamin Construction Co., $10,000.

Vancouver, B.C.—de Moulin Laboratories, $10,000. Independent Brewing and Malting Co., $500,000. International Fisheries, $20,000. J. H. Vickers and Co., $50,000, (general contracting). Terminal City Motor Co., $75,000.

Winnipeg, Man.—The Reinforced Brickwork Co., Limited, $100,000. M. F. Sproule, H. F. Kidder, S. Lund. The Nelson Grain Saver Company of Canada, $100,000. J. D. Bacon, F. L. Goodman, A. J. Hunter, all of the city of Grand Forks, North Dakota.

Winnipeg, Man.—Consolidated Asphalt Corporation of Canada, $1,500,000. C. W. Field, J. B. Shaw, both of Edmonton, P. Ney. St. Vital Bridge Association, $5,000. R. Wilson, W. H. Walker, R. O. Taylor. Canadian Midlands, $100,000. C. A. Crawley, G. F. de C. O'Grady, H. Dunk. Winnipeg Gold Mining Company, $2,000,000. J. Thoms, P. C. Young, W. Wray.

Montreal, Que.—Drummond, McCall and Company, $1,000,0000. A. W. P. Buchanan. T. S. Owens, R. Wilton. Radio Electric Company of Canada, $200,000. C. A. Pope, G. Barclay, W. B. Scott. Canada Transportation Lines, $25,000,000. R. C. Smith, F. H. Markey, G. G. Hyde. Silverzone Chemical Company, Limited, $20,000. H. J. Trihey, P. Bercovitch, W. P. Kearney.

Toronto, Ont.—Canadian Foote Company, $40,000 (concrete machinery). F. B. Neeve, J. A. Simpson, A. A. Ridler. Ontario Commonwealth Gold Mines, $1,000,000. G. H. Sedgewick, A. G. Ross, A. G. McMillan. Consolidated Brick and Tile Company, $40,000. F. J. Foley, T. A. Silverthorn, J. H. Flett. General Power Corporation, $5,000. R. W. Hart, G. M. Miller, P. Stokes. Balsam Lake Quarries, $60,000. Mrs. E. Kirvan, M. Grahame, J. F. Verner. Crookston Stone Company, $50,000. J. A. Jelly, Shelburne, L. E. Allen, Belleville, R. Cooke, Harold..

Toronto, Ont.—Porcupine Crown Mines, $2,000,000. Z. Gallagher, Miss E. M. Wilson, G. T. Harrington. Channell Chemical Co., $40,000. A. T. Channell, G. H. Gray, J. J. Gray. Sherrill Porcupine Gold Mines, $1,000,000. G. H. Sedgewick, A. G. Ross, J. Aitchison. Boving & Co., of Canada, Limited, $1,000,000, (chemical, mining, etc., engineers). R. H. Parmenter, W. S. Morlock, N. B. Wormwick. Union Carbide Company of Canada, $2,000,000, (gas producing manufacture). W. A. J. Case, J. B. Taylor, G. C. Loveys. Canadian I. P. Morris Co., $40,000, (hydro-electric apparatus manufacturers). J. S. Lovell, R. Gowans, W. Bain.

Triple Expansion Pumping Engine

FOR WATER WORKS, MINE SERVICE, ETC.

THE Fairbanks-Morse Triple Expansion Duplex Outside Centre Packed Plunger Pumping Engine shown here is very economical in the consumption of steam. The economy of operation makes this Pump preferable to all others in many situations.

¶ The steam end is fitted with semi-rotative valves. The plungers being externally packed are always in sight and any leakage can be at once detected. All parts are easy of access. The stuffing boxes are large and deep, so that an ample allowance of packing may be used.

¶ This type of pump is heavily proportioned throughout in order to meet the demands of heavy service. It is designed to give long and satisfactory service at a minimum cost. It has a 24-inch stroke and a capacity of 2,500,000 gallons per 24 hours.

Complete detail specification sent on request. *Address our nearest Branch.*

The Canadian FAIRBANKS-MORSE Co., Limited

MONTREAL	ST. JOHN	OTTAWA
TORONTO	WINNIPEG	CALGARY
SASKATOON		VANCOUVER

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned and endorsed "Tender for Toronto Harbour Works," will be received at this office until 4 p.m., on Monday, August 25th, 1913, for the construction of a Sea Wall, Breakwater, Ship Channel and Retaining Walls at the City of Toronto, in the County of York, Province of Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of the District Engineer, Confederation Life Building, Toronto, Ont.; Harbor Commissioner's Office, 76 Adelaide Street West, Toronto; H. J. Lamb, Esq., District Engineer, Windsor, Ont.; and J. L. Michaud, Esq., District Engineer, Post Office, Montreal, Que.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to five per cent. (5 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, July 12, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—44297.

TENDERS FOR BRIDGE CONSTRUCTION.

Sealed Tenders plainly marked, will be received by the undersigned, up to NOON of MONDAY, JULY 28th, 1913, for the construction of a 15-ft. span concrete culvert with concrete abutments and reinforced concrete slab, opposite Lot 22, Con. VII., Township of Amaranth.

Plans and specifications and all necessary information may be seen at the residence of John Bryan, Esq., Laurel, Ont., or at the office of the undersigned, 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer.

Toronto, July 16th, 1913.

NOTICE TO CONTRACTORS

Sealed proposals will be received at the offices of the Water Commissioners, City Hall, until 12 noon, July 31st, 1913, for the fabrication and laying of about 10¼ miles of 36-in. riveted steel pipe and appurtenances on the line of the Sooke Water Supply pressure conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer for such construction, pursuant to the provisions of By-law No. 814.

Plans and Specifications can be seen, and Forms of Tender obtained at the Sooke Water Supply Office, 1414 Douglas Street, Victoria, B.C.

The lowest or any tender not necessarily accepted.

C. H. RUST,
Water Commissioner.

Victoria, B.C., June 27th, 1913.

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, July 22nd, 1913, for the construction of the following sewers:—

Leslie Street, Danforth Avenue to north City limits.
Hastings Avenue, Gerrard Street to Doel Avenue.
Fielding Avenue, Leslie Street to Jones Avenue.
Furniss Avenue, Leslie Street to Jones Avenue.
Fifth Avenue, Leslie Street to Jones Avenue.
Skipper Avenue, Leslie Street to Jones Avenue.
Butternut Street, Jackman Avenue to Ellerbeck Avenue.
Chatham Avenue, Greenwoods Avenue to 554 feet west.
Lark Street, Queen Street to Kingston Road.
Lockwood Avenue, Queen Street to Dixon Avenue.
Pendrith Street, 300 feet east of Shaw Street to 327 feet east.
Lane 1st South Bloor Street, Shaw Street to Roxton Road.
Lane 1st North Queen Street, Triller Avenue to Callender Street.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the Commissioner of Works, Toronto.

Tenderers shall submit with their tender the names of two sureties, or in lieu of said sureties, the bond of a guarantee company approved of by the City Treasurer.

The usual conditions relating to tendering as prescribed by City by-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, July 8th, 1913.

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, July 29th, 1913, for the supply of:—

Portable Sewage Pumping Engines.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the Commissioner of Works, Toronto.

Tenderers shall submit with their tender the names of two sureties, or in lieu of said sureties, the bond of a guarantee company approved of by the City Treasurer.

The usual conditions relating to tendering as prescribed by City by-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, July 7th, 1913.

(For further tenders see pages 86 and 88).

The fire risk

can be materially lessened —and by means that will likely more than pay for themselves through lower insurance rates.

Manufacturers are requested to let us make inspection—without cost—and suggest improvements that will add security against fire. Correspondence invited.

E. M. SELLON & CO.
LIMITED

INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

MIMICO
Trade *Mark*

Have you received your copy of our 1913 Catalogue ?

Round Pipe and Square Dealings

If not, write now. Is it worth while? Well, see what the editor of The Canadian Engineer says about it on page 90 of the issue of June 26th.

The Ontario Sewer Pipe Co.
LIMITED
MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24".

RENOUF PUBLISHING CO.

25 McGill College Ave.
MONTREAL

The Catskill Water Supply of New York City.

History, Location, Sub-surface Investigation and Construction. By Lazarus White, Assoc. Mem. Amer. Soc. C.E., and Division Engineer, Board of Water-Supply. 8vo, xxxii + 755 pages, profusely illustrated with 239 cuts, including figures in the text and full-page illustrations. Cloth, $6.00 net.

Contains a comprehensive view of the whole work and particularly emphasizes the advances and progress made in the design and construction as witnessed by one in close contact with the construction during the whole period.

SECOND EDITION, Revised and Rewritten.

THOMAS-WATT—**The Improvement of Rivers.**

By B. F. Thomas, United States Principal Assistant Engineer, Mem. Amer. Soc. C.E., and D. A. Watt, United States Assistant Engineer, Mem. Amer. Soc. C.E. 4to, 772 pages, profusely illustrated, including many figures in the text, and 83 full-page and folding plates. 2 volumes. Cloth, $7.50 net.

A treatise on the methods employed for improving streams for open navigation and for navigation by means of locks and dams.

RECKNAGEL — **The Theory and Practice of Working Plans.**

By A. B. Recknagel, B.A., M.F., Professor of Forestry, Cornell University. 8vo, x + 230 pages, illustrated, Cloth, $2.00 net.

A book which will assist you in becoming thoroughly conversant with the value and need, scope and sphere of working plans.

HAWLEY-HAWES—**Forestry in New England.**

By Ralph Chipman Hawley, M.F., Assistant Professor of Forestry, Yale University, and Austin Foster Hawes, M F., State Forester of Vermont and Professor of Forestry, University of Vermont. 8vo, xv + 479 pages, 140 figures, principally half-tones, and 2 colored maps. Cloth, $3.50 net.

The Camp-Fire Club of America has awarded to this work their Certificate of High Commendation "as a text-book of value to all interested in scientific forestry."

TENDERS CALLED FOR

THE COMMISSIONERS OF THE TRANSCONTINENTAL RAILWAY.

NOTICE TO CONTRACTORS.

TENDERS FOR BUILDINGS AT COCHRANE.

Sealed tenders addressed to the undersigned, and marked on the envelope "Tender for Buildings at Cochrane," will be received at the office of the Commissioners of the Transcontinental Railway, at Ottawa, Ont., until twelve o'clock noon of the 22nd day of July, 1913, for the erection of an Ice House, Store House, Freight House, and two Tool Houses at Cochrane, Ontario.

Plans and specifications may be seen and full information obtained at the offices of Mr. Gordon Grant, Chief Engineer, Ottawa, Ont., and of Mr. T. S. Armstrong, District Engineer, Cochrane, Ont.

Tenders must be made on the forms supplied by the Commission, and be signed and sealed by all the parties to the tender, and witnessed, and be accompanied by an accepted cheque on a chartered Bank of the Dominion of Canada, payable to the order of the Commissioners of the Transcontinental Railway, for a sum equal to ten per cent. (10%) of the amount of the tender.

The right is reserved to reject any or all tenders.

By order,

P. E. RYAN,
Secretary.

The Commissioners of the Transcontinental Railway.
Dated at Ottawa this 24th day of June, 1913.

Newspapers inserting this advertisement without authority from the Commissioners will not be paid for it.—44403.

TOWN OF CARLYLE, SASKATCHEWAN.

WATERWORKS AND ELECTRIC LIGHTING.

Sealed tenders, addressed to the undersigned, will be received up till 18 o'clock on Friday, 1st August, 1913, for the following contracts:—

1.—Construction of brick power house and concrete reservoir, and laying approximately 800 lineal feet of pipe in trenches, and relative works.
2.—Supply of Air-lift Pumping System.
3.—Supply of Duplex Steam Pump.
4.—Supply and erection of two H.R.T. Boilers and Stack.
5.—Supply and erection of compound vertical steam engine.
6.—Supply and erection of Generator, Exciter, and Switchboard.
7.—Supply of poles, arms, hardware, copper wire, transformers and meters.
8.—Supply of Series Tungsten street lighting apparatus.
9.—Erection of Pole Line.

Tenders must be accompanied by an accepted cheque for five per cent. of the amount of the tender, or alternatively by the bond of an approved guarantee company.

Plans and Specifications and other information may be obtained at the offices of the Consulting Engineers at Winnipeg and Calgary. A deposit of $25 will be required on Contract No. 1, which will be returned to bona fide tenderers on return of the plans.

The Corporation do not bind themselves to accept the lowest or any tender.

F. J. STENT,
Secretary-Treasurer,
Carlyle, Sask.

The John Galt Engineering Co., Limited,
Consulting Engineers.

TOWN OF BASSANO, ALBERTA.

SEWAGE DISPOSAL WORKS.

Sealed tenders, addressed to the undersigned, will be received up till 18 o'clock on Friday, 15th August, 1913, for all labor and materials (except filter distributors) necessary for the construction of sewage disposal works, consisting of tank and filter and relative works near the town of Bassano.

Tenders must be accompanied by an accepted cheque for five per cent. of the amount of the tender, or alternatively by the bond of an approved guarantee company.

Plans and specifications and other information may be obtained at the offices of the Consulting Engineers at Winnipeg and Calgary, on deposit of $25, which will be returned to bona fide tenderers on return of the plans.

The corporation do not bind themselves to accept the lowest or any tender.

GEO. B. R. BOND,
Secretary-treasurer, Bassano, Alta.

July 1913.
The John Galt Engineering Co., Ltd.,
Consulting Engineers.

TENDERS WANTED.

Sealed tenders addressed to the undersigned, marked Tenders for "Incinerator," will be received up till 4 o'clock in the afternoon of the 29th day of July, 1913, for supplying all labor, tools, and machinery for the construction of an incinerator of a capacity to dispose of at least 25 tons per day of garbage and refuse. Incinerator must also be capable of destroying all kinds of refuse, including night soil and dead animals.

Contractors must supply their own specifications and designs, including brick or reinforced concrete building.

A marked cheque for 10 per cent. of amount of tender must accompany each tender, made payable to the order of the City Treasurer, which cheque will be subject to forfeiture in case of failure on the part of the successful tenderer to enter into a written agreement and bond with the City of Windsor with approved sureties when called upon to do so.

Incinerator must be guaranteed for at least one year from date of operation.

The lowest or any tender not necessarily accepted.

M. E. BRIAN,
City Engineer.

Windsor, Ont., July 3rd, 1913.

EXTENSION OF TIME.

CITY OF VICTORIA, B.C.

Sealed proposals will be received at the offices of the Water Commissioner, City Hall, until 12 noon, July 31st, 1913, for the fabrication and laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer, for such construction, pursuant to the provisions of By-law No. 814, and adopted by the Council.

Plans and Specifications can be seen, and Forms of Tender obtained, at the Sooke Water Supply Office, 1414 Douglas Street, Victoria, B.C.

The lowest or any Tender not necessarily accepted.

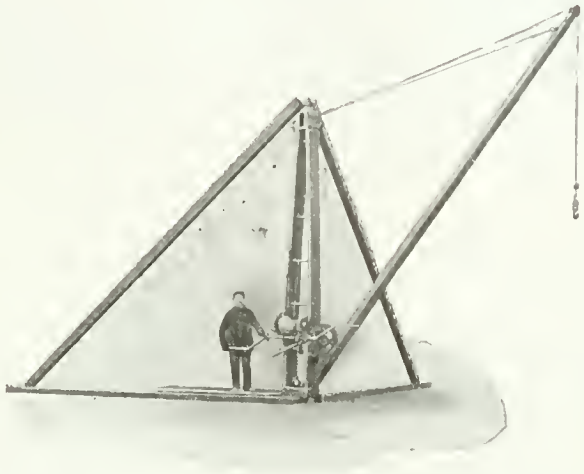
C. H. RUST,
Water Commissioner.

Victoria, B.C., June 14th, 1913.

(For further tenders see pages 84 and 88).

BEATH SCOTCH DERRICKS

Hand or Power



THE construction of Beath Scotch Derricks embodies several points of merit not found in other makes.

All stress parts are **steel,** not cast iron. Bottom Pintle Bearing is of ball and socket type and works in a bath of oil, thus ensuring an easy movement at this joint.

Beath Derricks are provided with self-oiling bearings, ensuring easy operation and reducing wear to a minimum.

We also make Jinniwink Derricks, Stiff Leg Derricks, Guy Derricks, and Steel Derricks for heavy service. Hand or Power operated.

Send us your enquiries for Derricks

W. D. Beath & Son, Limited

ENGINEERS AND MANUFACTURERS

20-30 Cooper Avenue, - Toronto, Canada

SECOND-HAND MACHINERY

Second Hand Contractors' Machinery

Why not use second hand equipment on the next job? We have a large stock of machinery ready for delivery

Nearly Good as New

Get the details on these items:—
1—24" x 24¾" x 30" "Ingersoll-Sergeant" compressor, Class A
1—20" x 20¾" x 24" "Ingersoll-Sergeant" compressor, Class A
1—14" x 14¾" x 18" "Ingersoll-Sergeant" compressor, Class A
1—No. 2½ "Smith" concrete mixer
1—No. 5 "Gates" gyratory crusher, style K
1—30" x 14" "Buchanan" crushing roll
1—35 H.P. "Farquhar" combined engine and boiler
2—No. 15 "Morris" centrifugal pumps with engines

L. F. SEYFERTS' SONS, Inc.
437 NORTH THIRD ST., PHILADELPHIA, U.S.A.

$400 WILL BUY a 30 H.P. gas engine and 30 H.P. gas producer; used less than two years on a chopping plant. Israel Brubacker, Elmira, Ont.

FOR SALE—almost new, differential tackle and track; carry two tons. Canada representatives, 193 Spadina Avenue, Toronto.

FOR SALE—almost new, two 700-gallon cypress wood tanks with fittings, and 4 one hundred-gallon tanks on castors. Canada representatives, 193 Spadina Avenue, Toronto.

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

FOR SALE at a snap: 60-H.P. Cowan and Co. engine and 80-H.P. Cowan and Co. boiler. Write for particulars, J. F. Barnard and Son, Spencerville, Ont.

WANTED.—A second-hand handing-up machine; state make, price and time used. Box 74, *The Canadian Engineer*, Toronto.

QUOTATION WANTED.—For steam boiler; delivered Norwood; twenty horse-power; steel, tubular, also firebox type; give dimensions. E. J. Laing, Secretary, Board of Education, Norwood, Ont.

WANTED.—Left-hand water wheel (flume wheel), to give 25- horse-power under twelve feet head; must be in good condition. Box 76, *The Canadian Engineer*, Toronto.

CORLISS ENGINE—16 x 36—new two years ago; very reasonable. Box 82, *The Canadian Engineer*, Toronto.

FOR SALE.—Lidgerwood cableway, capacity 10 tons on single line; 14-in. x 28-in., double reversing engine, three grooved drums 50-in. diameter, steel gears 72-in. diameter. Box 78, *The Canadian Engineer*, Toronto.

FOR SALE.—Quantity of steel pipe, four feet diameter, 1¼-in. thick, cut to any length to suit purchaser. In A1 condition. Address Box 80, *The Canadian Engineer*, Toronto.

Tenders Called For

CITY OF LONDON, ONTARIO.

Sealed proposals addressed to the "Chairman and Members No. 2 Committee," will be received at the office of the City Clerk, until 5 p.m., on Thursday, July 31st, 1913, for the construction of the necessary substructure for the proposed highway bridge over the River Thames at Wharncliffe Road, the substructure is comprised of two plain concrete piers, and two reinforced concrete winged abutments containing approximately 620 cubic yards of concrete, and 17,000 lbs. of steel reinforcement.

Plans, specifications and form of tender may be seen at and obtained from the office of the City Engineer.

Contractors must enclose a marked cheque for five (5%) per cent. of the amount of their tender.

The lowest or any tender not necessarily accepted.

B. W. BENNETT, Chairman, No. 2 Committee.
Wm. N. ASPHLANT, City Engineer.

For further Tenders see pages 84 and 86.

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES — IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

NEW INCORPORATIONS

Cobalt, Ont.—Adam N. Davis Coal Company, $40,000. W. Rodd, C. Hair, E. Armstrong.

Lefroy, Ont.—Innisfil Telephone Company, $12,000. E. Todd, W. J. Ralston, G. C. Allan.

London, Ont.—London Asbestos and Supply Co., $25,000. T. L. Partridge, J. Putherbough, E. J. Allen.

Victoria, B.C.—Vancouver Navigation and Towing Company, $1,000,000. North Arm Sand and Gravel Company, $100,000.

Sturgeon Falls, Ont.—Miville Manufacturing Co., $40,000, (manufacturing machinery). A. A. Aubin, J. E. Serre, G. Levesque, all of Sturgeon Falls.

Toronto, Ont.—Resilent Spring Wheel Co., $40,000. G. H. Sedgwick, A. G. Ross, J. Aitchison. Transcontinental Power Corporation, $10,000. R. W. Hart, G. M. Miller, P. Stokes. Kipawa Power Co., $100,000,000. W. A. J. Case, J. B. Taylor, D. D. Fish.

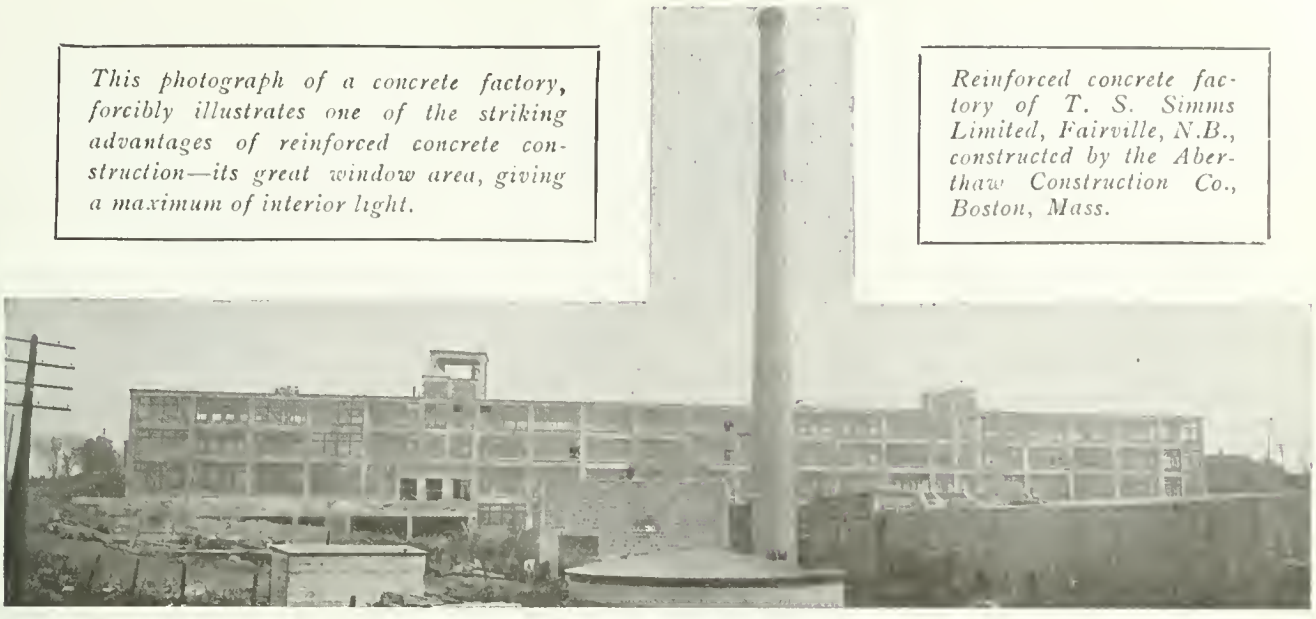
Montreal, Que.—International Valve Co., $50,000, (mechanical engineers). E. Languedoc, E. R. Parkins, W. Taylor. Ontario Steel Products Co., $1,500,000. L. Macfarlane, C. A. Pope, G. Barclay. Farnham Wood Manufacturing Company, $200,000. W. R. L. Shanks, F. G. Bush, G. R. Drennan.

Montreal, Que.—Theresian Sand and Gravel Company, $20,000. J. C. Poissant, E. H. Lanthier, G. Vandelac. Telegraph Publishing Company of Montreal, $500,00. F. H. Markey, W. W. Skinner, G. G. Hyde. Canadian Metal Manufacturing Company, $30,000. F. W. Montgomery, J. K. Wells, both of Boston, U.S.A., L. E. Urquhart.

Winnipeg, Man.—McCoy Process Refrigeration Company, $1,000,000. C. W. McCoy, A. J. Beatty, W. R. Rundle. Naidanac Builders' Corporation, $60,000. E. A. Hudson. J. McIntyre, G. A. E. Bury, Brandon. Grey and Davidson, $50,000, (contractors supplies). A. Grey, H. C. Davidson, W. P. Davidson. D. A. Chisholm Track Weeder Company, $60,000. M. G. MacNeil, T. Little, A. C. Miller.

This photograph of a concrete factory, forcibly illustrates one of the striking advantages of reinforced concrete construction—its great window area, giving a maximum of interior light.

Reinforced concrete factory of T. S. Simms Limited, Fairville, N.B., constructed by the Aberthaw Construction Co., Boston, Mass.



Concrete Factories are Most Efficient

The efficiency of a machine is the ratio of the amount of work a machine does, to the amount of work required to operate it. The output is equal to the input minus the work lost or wasted. The less wasted the greater the efficiency.
In the same way the efficiency of a factory may be defined as the ratio of output to input. Output, financially, is increased by reducing unnecessary expenses.

Concrete Stops Wastes

Concrete buildings are proof against fire, water and vermin. They give the maximum light and are sanitary. They resist vibration, and are permanent and durable.

Fire-proofness reduces insurance rates. Water or liquids used in certain processes will not leak through floors to destroy valuable goods below. Rats and other vermin find no place to live in a concrete building, thus eliminating losses from this cause. Maximum light and sanitary conditions increase efficiency of employees. Lack of vibration reduces wear and tear on machines. Permanency and durability reduce depreciation.

The way in which concrete stops these leaks is fully described in our handsomely illustrated 224 page book, "Factories and Warehouses of Concrete." It contains photographs and data of factories and warehouses for all classes of industries.

You can have a copy free if you will mention this advertisement.

CANADA CEMENT COMPANY
LIMITED
MONTREAL

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.

By the city of Port Arthur, Ontario, **competent Ontario Land Surveyor** to act as Corporation Surveyor. Permanent position for the right man.

Apply giving experience, references and salary expected.

L. M. JONES,
City Engineer.

WANTED.—Experienced detailer and checker on highway bridge work. Applications, care of Box 56, *The Canadian Engineer*, Toronto.

WANTED.—Superintendent for canal work. Must be experienced in steam shovel work, also four foremen. Address Box 84, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

GRADUATE CIVIL ENGINEERS of long and varied experience in this country and United States, desire work for spare time. Designing, detailing and estimating. Reinforced concrete structural steel a speciality. Box 46, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER.—Experienced designer, cost estimator and salesman, works supervision, all kinds of steam engines. Boilers, hydraulic pumps, air machinery and mining plants, seeks position with consulting engineers, contractors, manufacturers or agency business. Highest references, some capital. Box 48, *The Canadian Engineer*, Toronto.

MECHANICAL AND ELECTRICAL ENGINEER desires position in charge of plant, or in firm of contractors. Ten years' experience in shop and power station. Used to all classes of boilers, engines, and high and low tension plant. Manufacturing and commercial experience. Box 60, *The Canadian Engineer*, Toronto.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

WHO WANTS to employ a man who has finished his third year in civil department at University of Toronto? Box 86, *The Canadian Engineer*, Toronto.

ELECTRICAL ENGINEER with ten years' experience in design, construction and operation of electric light, power, street and interurban railways; desires position as engineer, superintendent or foreman. Good references. Change personal reason. Single. Box, 44, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 134430, granted on July 18th, 1911, to A. M. Bourke, of New South Wales, Australia, for insulator for telegraph and telephone wires, may do so upon application to the undersigned who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, 53 Queen Street, Ottawa, Canada; Russel S. Smart, resident.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 135649, granted on September 19th, 1911, to R. C. Crocker, of Largos dos Leves, Rio de Janiero, for seat for railway cars, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, 53 Queen Street, Ottawa, Canada; Russel S. Smart, resident.

NEW INCORPORATIONS.

Winnipeg, Man.—City Lighting Company, $20,000. Mrs. P. Scott, F. W. Scott, V. Winkler.

St. Catharines, Ont.—Dominion Foods, $1,000,000. W. J Brigger, C. H. Brigger, J. C. Brigger.

Toronto, Ont.—British America Nickel Corporation, $20,000,000. J. S. Lovell, C. D. Magee, W. Bain.

Brandon, Man.—Willows Company, $20,000 (building contractors). E. Willows, D. S. McNicoll, H. A. Short.

Dundas, Ont.—Canadian Abrasive Wheels, $500,000. H. E. Sherk, G. R. Harvey, both of Hamilton, M. T. Brown.

Bridgeburg, Ont.—International Color and Chemical Company of Ontario, $300,000. F. R. Humpage, A. S. Ramage, S. L. Callahan.

Dauphin, Man.—Reck-Clary Grader Company, $15,000 (metal merchants). R. J. Reck, F. H. Clary, both of Gilbert Plains, J. R. Kagle, Dauphin.

Calgary, Alta.—Marsh & Son, $10,000. Ontario Crushed Rock and Gravel Company, $15,000. P. Burns Coal Mines, $1,000,000. P. Burns, W. Corlet, F. S. Albright.

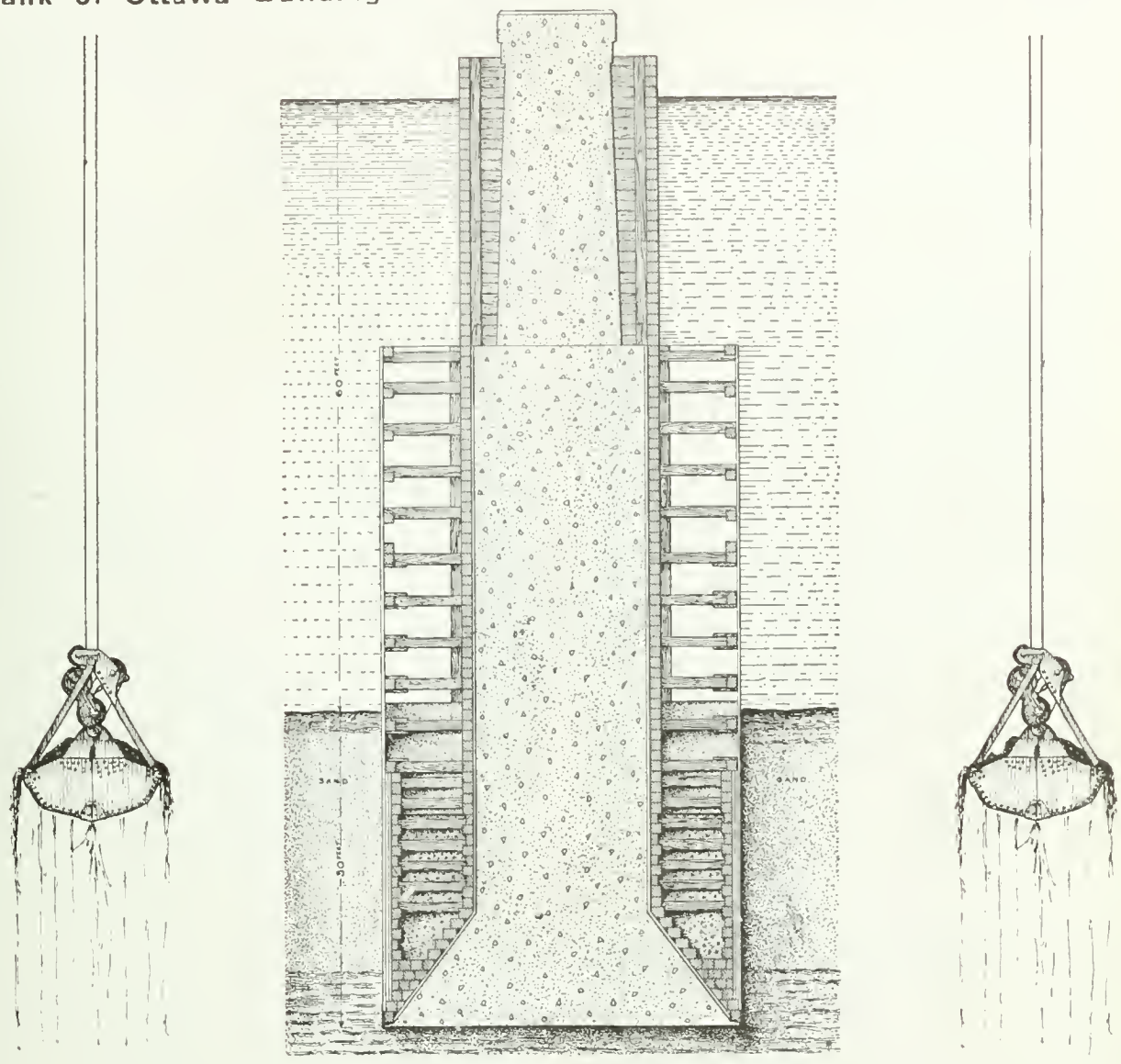
Haileybury, Ont.—Tough-Oakes Gold Mines, Limited, $3,000,000. T. H. Connor. E. W. Kearney, A. E. Cranstoun. Sylvanite Gold Mines, $2,000,000. T. H. Connor. E. W. Kearney, A. E. Cranstoun.

Toronto, Ont.—Calgary Brick and Supply Co., $200,000. W. Laidlaw, C. M. Johnston, G. R. Kappele. Caleta Silver Mines, $500,000. A. D. McMillan, Winnipeg; C. Maclean, New York; F. W. Maclean, Toronto. Mann Mines, £200,000. N. S. Caudwell, W. B. McPherson, M. D. Gray.

THE FOUNDATION COMPANY
LIMITED

MONTREAL
Bank of Ottawa Building

VANCOUVER
Dominion Trust Building



One Type of Pier

WE HAVE UNDER CONTRACT at the present time Substructures for

SEVEN BRIDGES

Extending across Canada from Newcastle, N.B., to Vancouver, B.C.

By reason of the different conditions existing at the several sites the construction of the piers embodies practically all the modern methods known to Engineering—Each type being adapted as a result of an exhaustive study of conditions at its location.

OUR EXPERIENCE of many years standing, combined with our up-to-date **PLANT** and our complete **ORGANIZATION** insures

SPEED EFFICIENCY ECONOMY

MARKET CONDITIONS

Montreal, July 12th, 1913.

Prices hold very steady, being again unchanged, as follows:—

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Copper.—Prices are 16¾c. Excellent demand.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c, and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dyoamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are: Queen's Head, $4.35; Colborne Crown, $4.25; Apollo, 10¾ oz., $4.25. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lead.—Prices are firm at $5.35.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft. x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is active and strong:—$36 for 6 and 8-inch pipe and larger; $37 for 4o-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per ceot. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 73½ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black and 63¼ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, July 16th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton. Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is higher at 16 to 16¼c., sheet copper case (16 oz. soft), 22¼ to 25¼c per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound, 1 to 0-case lots, 50 lbs to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 5c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 5c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable eoquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.50 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—23c. per lb

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.20; 22-24, $3.35; 26, $3.50; 28, $3.95; 29, $4.25; 10¾, $4.25 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 50 to 52c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6.50 to $8 per cwt.

Winnipeg, July 15th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c.; anvil and vise combioed, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ¾, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge Americao, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

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Contents of this issue on page 213

The Canadian Engineer

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SOME NOTES ON MACADAM ROADS AND PAVEMENTS

MODERN NECESSITIES FOR VARIED HIGHWAY TRAFFIC—NEW DESTRUCTIVE FORCES AND AGENCIES TO MEET THEM—PAVING MATERIALS AND THEIR CHARACTERISTICS

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Of paramount interest to any public body is the vital and far-reaching question of transportation. Next to transportation by rail and water, comes transportation by road—the one being the logical outcome and veritable necessity of the other. Railways are first in the early development of any country, but without a comprehensive system of trunk highways as feeders to the railways further development of the country is hampered and progress impeded. Recently there has been a revival of the road-building problem and the "Good Roads movement" is receiving the attention it deserves, not only from municipal bodies and provincial and federal authorities, but also from the general public. Good roads are essentially a business proposition; commercial, industrial, agricultural, and social conditions are all directly or indirectly benefitted by them. They are not only an index of, but also a means towards, a country's greatness and prosperity. They result in the cheapening of transportation, improved marketing facilities, increased land values, and the betterment and extension of social conditions and privileges. Much has been said about the indifferent agricultural conditions existing in the Fraser Valley districts. Obviously enough, the remedy lies in providing more and better transportation facilities by road. Railways and car lines, while materially assisting, do not, and cannot, in themselves supply the largely felt needs of cheap, speedy and effective transportation direct between our fruit and dairy farms and our towns and cities. Increase our mileage of roads, improve our existing roads, afford our farmers and fruit-growers an opportunity to compete on equal conditions with fruit-growers, and not only do we decrease the high cost of living, but we also prosper and populate our fertile fruit and farm lands. Assuredly development and progress will go hand in hand with the provision for better means of highway transportation. Due stress has been laid on *good* roads. The roads which were good enough a few years ago are now indifferent, some of them even bad. With the drastic change in traffic conditions the former methods of construction of arterial highways are either materially changing or fast becoming obsolete. The time is at hand when country roads will be subjected to as heavy traffic conditions and as severe usage as are city streets. Country roads, being generally narrow and highly crowned, the traffic is concentrated on the central portion of the roadway, whereas on the wide city street the traffic is scattered, conditions which are further aggravated by the greater speed allowed on country roads than on city streets. In view of such facts, and in the very force of circumstances, it seems natural to conclude that the same care, discretion and skill which is now exercised in the designing and construction of city pavements should also be extended to the planning and building of the much-travelled main highways. The problem at issue, therefore, appears to be the construction at a reasonable cost of a modified paved highway which will combine the utility and durability of the paved street and yet retain the aesthetic and attractive features of a rural road.

Few, if any, of us wish to see our rural highways converted into the stereotyped paved street, for apart from their mere utilitarian objects there is much that is naturally attractive and appealing to the motorist and pleasure seeker in the ordinary rural highway, with its straight, level stretches, joined by easy, graceful curves, succeeded by undulations peculiar to a rolling country. The conception and construction of the more modern highway should, therefore, be along lines both utilitarian and aesthetic. To develop a highway which will ultimately fulfil all of its requirements one should be governed by the following principles: (1) The building of a road in the best possible location as to line and level. (2) The macadamizing of the road of suitable width and depth. (3) The conversion of such road with a consolidated rock foundation into a bituminous pavement by hard surfacing. Desirable and necessary as paved roads may be, it is not financially possible for most municipal authorities to undertake at the outset a large mileage of permanent roads at a higher first cost. But arrangements can generally be made for the construction at reasonable cost of a good paved road in the above successive steps.

In commenting on roads and pavements, it is natural to first discuss the former and its relationship to the latter. Road or street construction has gone through a period of evolution—the modern paved street of to-day being the logical outcome of the roads of yesterday, just as the modern macadam road has replaced the trails of the pioneer and the prospector of earlier days. Increased traffic, the easy and economical transportation of heavy loads, consequent upon the settlement of the country, made necessary the convertion of the first rough trails blazed through the forest, into passable thoroughfares.

Passable thoroughfares stood the demands of traffic and served the immediate needs of the earlier settlers, but with the rapid development of the country, and the upgrowth of townships and communities, the need for better highways of communication became not only necessary but imperative. A district settled up just as fast as the means of communication were extended, and developments kept pace with the road improvements. In short, roads came before towns and cities, and not until the townships developed into cities by easy stages and through many vicissitudes, did the modern city street as known to us arise and become standardized. In short, good roads and streets and higher civilization go hand in hand, each being interdependent on the other.

Macadam Road Construction.—In treating of macadam roads it is necessary to distinguish between water-bound macadam roads and bituminous-bound macadam roads. The former have been in adoption for about a century, and although the present methods employed in building water-bound macadam roads are entirely different, owing to the introduction of labor-saving devices, the principles underlying their construction are essentially the same. The first requisites for macadam road construction, namely, drainage, compactness of sub-grade, selection and grading of materials and consolidation of whole, are the same to-day as they were in the pioneer days of road building. The scientific, though commonplace, principles underlying the successful construction of the water-bound macadam road are:—

(1) The compression and compacting by rolling of the different sizes and shapes of broken stone (varying from foundation upwards) by knitting together and interlocking the rough angular surfaces of the stones.

(2) The application thereto by further rolling and sprinkling of a binding course of suitable material to cohere the whole, reduce the voids to the minimum and rended the surface as wearing and as waterproof as possible.

Recognizing such fundamental principles it is not difficult to realize that the satisfactoriness and serviceability of a water-bound macadam road are principally dependent on the preservation intact, and as nearly as possible waterproof, of the wearing surface. The disintegration of water-bound macadam roads is, therefore, chiefly due to the ravelling action consequent upon long spells of drought which dries up the binding material, diminishes its cementing action and lays the aggregate underneath at the mercy of the destructive action of traffic.

The Effect of Speedy Vehicles.—The action of iron tires on slow-moving vehicles was not so severe on, and destructive to, such water-bound macadam roads, and with eternal vigilance necessary repairs could be made at comparatively small expense to keep such road in ordinarily good condition, and with further precautions of scarifying and resurfacing of such roads every two or three years they could generally withstand the ordinary wear and tear of traffic. The forces to which the roads were then subjected were strictly dead and live loads and of course impact, due to action of horses' hoofs and bumping of wheels in ruts and depressions. The speed at which vehicles then travelled being moderate, the live load on the roads was not then so appreciable and the impact not very high. Hence, water-bound macadam roads achieved their precious ends in successfully withstanding such physical forces. There was thus no immediate necessity for any better class of highway to accommodate the travelling public who were at that time generally satisfied.

But with the introduction of the automobile in the last decade, conditions entirely changed and engineers and authorities were confronted with the more serious problem of preserving the surface of the roadbed from the disintegrating and ravelling action of swiftly moving rubber-tired automobiles. The former methods of construction of water-bound macadam roads had necessarily to give place to the adoption of bituminous-bound macadam roads, the second stage in the evolution of the more modern hard-surfaced highway. Not only had the roads then to meet forces due to dead load, live load and impact and all these in a greater intensity, but also the more destructive and disintegrating forces of suction and shear.

Suction is the indirect result of the wind current and vacuum formed at the rear of the tires of a swiftly moving automobile. Such a force, or the resultant of such forces, tends to break the bond, loosen and disturb the binding particles in the surface of the road, and ultimately to disintegrate the roadbed.

Shear is caused by the tractive force exerted by the driven wheels of an automobile and naturally its intensity varies directly with the weight and speed of the automobile. Such a force has also a disintegrating effect on the surface of the roadbed. Since water-bound macadam roads have little or no resistance to the above action of suction and shear, it can readily be seen that it is imperative to build a road with binding material sufficiently strong and cohesive.

The more general use of the automobile also emphasized and increased the dust nuisance, so that attention had to be devoted to the dual problem of the preservation of the wearing surface, and the prevention or elimination of the dust. Various methods of applying different kinds of oils and emulsions, at different degrees of temperature, and under different conditions, have been adopted to bind together and consolidate the rock aggregate of the roadbed, and to abate, if not entirely eliminate, the dust nuisance. While many such preventive methods have met with a measure of success, they cannot be said to be generally and wholly satisfactory. While engineers and road experts are to be congratulated on the skill, ingenuity and resourcefulness, which they have adopted in their determined efforts to construct a bituminous macadam road, at low first cost, of passing serviceability, to meet the new problems associated with the changes of highways traffic, it cannot be justly maintained that the remedies, taking the all-important factor of maintenance into account, have been permanent.

Road Treatments. — The various "treatment" methods in vogue have afforded a temporary measure of relief, but as their ultimate success depends on frequent treatment, they are at the best only make-shifts, and costly at that. Referring to the oiling of roads, this was first adopted in California, where the local residual oils were used to counteract the destructive influences of the long drought on water-bound macadam roads, for while generally speaking water-bound macadam roads are not adapted to a humid climate, such as portions of the Pacific Coast, they are equally unsuited to such a dry climate as California. As already stated, a certain amount of moisture and dampness is necessary to keep the binding materials intact. The highest authorities agree that the best oil to adopt is a pure oil, unmixed with any other oils, and one having a natural asphaltic base. It is the asphaltic properties in road oils which, mixed with the aggregate or injected into the roadbed, binds the materials together and hold them in place, thus pre-

venting, or at least reducing, the ravelling of the roadbed. The best results are produced if a heavy road oil is used after the road has been partially rolled and previous to the laying of the binder course of fine rock or coarse sand. In this way the asphaltum in the oil gets thoroughly incorporated with the component parts of the roadbed which are bound together and interlocked. Successful results have also been achieved in mixing the rock and asphaltic oil together in an ordinary concrete mixture before laying it down. The application of from one-third to one-half gallon of road oil per square yard to the wearing surface of an old macadam road tends to preserve it from wearing action and renders the surface more even and waterproof and incidentally lays the dust. But such measures are merely palliatives and dust preventives, comparatively cheap to adopt (2 cents per square yard or $150 per mile for a width of 12 feet) and, moreover, a decided relief to the travelling public and householders during the summer months. With the approach of the wet seasons, however, the roads thus oiled are rendered muddier than ever, and the mud, being of a heavy, plastic nature, is more difficult and costly to remove. The results from surface road oiling are subsequently disappointing and there appears to be something in the contention that the oiling of roads, while preserving the surface in summer, tends to loosen and disintegrate the particles of the roadbed in winter when they are subjected to the trying alternating influences of rain, frost and thaw. Hence, after several seasons of experimenting with surface oiling with different conditions, such as sweeping the roadbed free of all dust and dirt, applying the oil by means of spraying machines under pressure, and in adopting every conceivable device to arrive at the most satisfactory results, the practice of road oiling has been abandoned by many authorities as being too costly.

In their determined efforts to preserve and lengthen the life of macadam roads and to combat the dust, nuisance engineers and authorities have been experimenting for several years back with coal tar in the building of tar-macadam roads. Refined coal tar from gas works, specially treated to remove the injurious constituents and yet to preserve the ductile and bituminous properties of the tar, has been generally employed in the construction of such roads. The methods adopted have varied considerably, but the general principles of construction involve the heating of the stone to drive out the moisture and the mixing by hand or mixer of the stone, and tar heated to a specific temperature. The chief drawbacks to the use of tar on construction of macadam roads are:—

(1) It is difficult to procure commercial tar of uniform quality.

(2) Great care is necessary in the heating of tar, for if heated too much it becomes brittle and loses its ductile properties upon which its virtue depends.

(3) The tar must be uniformly refined—if refined too little the light volatile oils and ammonia will disintegrate it, if refined over much it will be too brittle.

(4) The weather must be warm and dry to successfully use tar macadam.

(5) The roadbed must be perfectly clean and dry. Hence the use of tar-macadam is confined to the summer months.

(6) It is too susceptible to extremes of temperature, being soft and mushy in midsummer heat and too brittle and slippery in cold, frosy weather.

(7) It is not sufficiently dense and durable.

Better results appear to have been procured from tar-macadam roads in the Old Country, probably because of the more uniform and better quality of commercial tars which are there procurable, and also owing to more careful and scientific construction. In this country their adoption has been confined chiefly to eastern cities, where it has been found that, at an average cost of about 50% over the cost of ordinary water-bound macadam roads, fairly satisfactory and serviceable results have been procured for the first two or three years, but that after that period the wearing surface began to develop a mottled appearance and to disintegrate. Tar painting of such broken surfaces to seal the pores and preserve the surface has been tried but without the desired results, and consequently recourse has been had to covering such tar-macadam roads, on which the foundation is good, with a sheet asphalt or some other asphaltic mixture preparation. Hence, owing to the varibility of the results produced, and the shortness of the life of even the best tar-macadam roads, their further adoption has been generally abandoned in favor of some more durable bituminous pavement of greater first cost. The general failure of the use of commercial coal tar led to much experimenting and the result has been the production of a specially distilled coal tar preparation known as "Tarvia." But while its use, when confined to park roads and boulevards, has met with a measure of success, it cannot be maintained that the results produced on its adoption to much-travelled highways has justified its additional cost. As applied to the road surface as a dust preventive, its average cost is 10 cents per square yard, or about $825 per mile for a 14-foot roadbed, and while further treatment can be applied at a correspondingly less cost, taking the cost of periodical treatments into account, it cannot be said to be economical in the long run. Briefly, the process consists in applying to the ordinary macadam formation, under a pressure of about 50 lbs., heavy asphaltic oil containing about 85% of pure asphalt and heated to a temperature of about 220°. The macadam is laid and rolled in two courses; the first course consisting of about 6 inches of 3-inch sized rock, and the second course varying in size from 1-inch to 2-inch rock. To this latter course is applied the heated asphaltic oil, which penetrates throughout the whole of the macadam. On top of this oil is spread a layer of granite screenings varying from ¼ inch to ¾ inch, from which the dust and dirt have been eliminated and the whole mass is then thoroughly consolidated by rolling. Another treatment of oil is then applied, and further granite screenings about 3/16 inch spread and rolled. Judging from results, such an asphaltic treatment appears to produce a compact, elastic roadbed, with a smooth surface of beautiful appearance. While the experiment has only been of comparatively short duration and it remains to be seen whether or no its durability will be proved, the additional cost of about 25% over the ordinary water-bound macadam road fully justifies its more general adoption. It is estimated that such an "oilcrete" road would wear well for about five years, and as it eliminates the need for yearly oiling of an ordinary macadam road, whose life at the most is three years, there is much to be said in its favor.

It will serve no purpose to discuss further any of the other oils, bitumens and special preparations which the ingenuity of engineer and manufacturer have devised in their endeavor to meet the special requirements of this automobile age. Although each manufacturer or inventor claims his particular preparation to be the panacea of road construction, their compositions are all very similar and the methods of use and application vary only slightly.

Reference, however, should be briefly made to an entirely different product, known as "Roc-mac," a solution which has recently been adopted with considerable success in this country after having withstood satisfactory tests in Great Britain. In use it differs essentially from other binding materials inasmuch as its action is purely chemical, whereas the action of the others is more physical. Roc-mac solution is a patented substance which unites chemically with limestone screenings to form a carbonate compound of good binding and adhesive qualities. No heating of any of the materials is required, nor is any special plant necessary for its use. It can be laid during almost any kind of weather and is not greatly affected by extremes of temperature or by weather conditions.

Reference to the above preparations shows that engineers and road experts have been fully alive to the situation, and are confronted with problems which, although seemingly more commonplace than the design and construction of bridges and other structural works, are yet more complex and difficult of solution. In road construction it is a vital matter these days to change with changing circumstances; for instance, road builders had scarcely adjusted themselves to the changed conditions brought about by the swiftly moving automobile, and made what was then considered adequate provision for their requirements, when the motor truck was introduced to further complicate the problem of the construction and maintenance of roads. They are now face to face with a situation which demands not merely remedial measures, but some more or less permanent cure. The motor truck has come and come to stay; the number is certain to increase and multiply, particularly in interurban districts, and the type of road which their heavier and more rumbling loads and their greater impact necessitate, must be built, and built to wear. Neither water-bound nor bituminous macadam roads will, for any length of time, withstand the intensive and irregular stresses produced by heavily loaded and moderately speeded motor-trucks. While the foundation of the ordinary macadam roads, particularly where they have been gradually built-up with periodical resurfacing, is likely to be sufficiently strong and rigid, it is imperative that such a foundation be kept intact from the impounding action of motor trucks by means of a sufficiently thick, durable and waterproof surface. Road authorities are consequently turning their attention to the construction of a modified form of city pavement for use on the principal highways.

Advantage of Pavements.—That good street pavements are essential to the highest development of the commercial, sanitary, social and educational life of any city cannot be disputed. To any city or town they are an asset which cannot be computed in mere figures. The hall mark of any city is its good pavements, which attract and impress not only the casual visitor, but the manufacturer or investor bent on introducing industries or investing capital. Pavements are part and parcel of the everyday life of the merchant, the manufacturer and the private citizen—all of whom are affected financially and otherwise according as the pavements are good, bad or indifferent. The beneficent and far-reaching influence of pavements upon the social, aesthetic and commercial life of any community cannot be enlarged upon within the scope of this paper, but briefly the principal advantages derived from the construction of pavements are:—

(1) Tractive power is diminished and the cost of transportation correspondingly decreased—benefits accruing alike to commerce and business.

(2) The fixing of a permanent grade and building line permitting of permanent and uniform improvements to buildings, residential and commercial, fronting on the street—chiefly private benefits.

(3) Increased efficiency of fire protection afforded by the better transportation of fire-fighting apparatus—benefits to the community at large.

(4) Enhanced values of property abutting on streets.

(5) The beautifying of the street through having a regular and uniform appearance as to lines and levels—chiefly aesthetic benefits.

(6) The more efficient sanitation and cleanliness and resultant healthfulness, the dust and mud problem being to a great extent eliminated—sanitary benefits.

(7) The furtherance of pleasure driving and thereby the promotion of social intercourse—community benefits.

In short, on business streets, good pavements are an indispensable necessity to good business and commerce; on residential streets they naturally add to the comfort, pleasure and health of the community. Reference was made to *good* pavements as it cannot be contended that any or all classes of pavements confer the above benefits on the life of public and private citizens. The next important question is, therefore, the selection of a type of pavement which will meet with the special requirements of the location and be suitable for the purposes to which it is to be more particularly put. This selection of a pavement is a contentious matter upon which divergent opinions obtain, depending upon whether they are looked at from the standpoint of the individual property owners, the manufacturers or promoters of the pavement, and last but not least the standpoint of the engineer in charge. As the bulk of the paving work in cities is done under local improvement, the determination of the kind of paving material to be used lies almost wholly with the property owners, the opinion of the majority of whom must prevail. This system is, therefore, open to criticism and tends to abuse of privileges as it means that the whims of property owners are assented to and a class of pavement laid on an objectionable layout which is frequently not suitable from an economic or engineering standpoint —being cheap in first cost, or entirely unsuited to the grades of the street. Utilitarian, not sentimental, principles should be given first consideration. The adoption of a type of pavement best adapted to the city as a whole or to any particular kind of street is frequently entirely overlooked. No particular type of pavement is equally adapted to meet the requirements of all cities, nor is any one kind of pavement suited to all the streets in the same city. The needs of each city should be specially studied, just as the needs of each street in any city should receive particular attention. The present and prospective uses of the street, the relative location to existing pavements, the traffic conditions, present and probable, the nature and kinds of materials available, the nature of the subsoil, the cross and longitudinal grades—all these are highly important factors to be considered in determining the best pavement to be adopted for any particular street. Commonplace and commonsense as are all of such matters, infrequently they are either wholly or partially disregarded.

The most important factors which should govern the design of city pavements, are those affecting the health and comfort of the citizens in eliminating, as far as possible, the nuisances arising from dust, noise, odors and slipperiness. While it is generally conceded that the best, most durable and latterly the most economical type of pavement to lay on steep grades of business streets is

rough granite or whin block, its use is limited to such physical conditions on account of its noise and its roughness to automobiles and pleasure vehicles, and its destructive effects on horses' hoofs. Asphaltic mixture pavements, on the other hand, are noiseless, practically dustless, and afford easy and pleasant locomotion, but in wet and frosty weather many types of this pavement are slippery, particularly on average grades, and are therefore unsuitable for heavy teaming traffic.

Such instances emphasize the need for care and discretion in the selection of a class of pavement to be adopted in any city street—conditions which at best only require the exercise of commonsense judgment.

Width of Pavements.—This is an important feature of pavements, which is frequently lost sight of in designing city streets. Neglect of fundamental principles in the adjusting of the width of the pavement often gives rise to subsequent widening and reconstruction at heavy expense. Purely residential streets and business streets should be treated on their own merits and semi-residential streets destined to become business streets should have special consideration. Traffic conditions present and prospective should always be duly considered, as not infrequently an important street will subsequently be selected because of its preferable grades or location for a car line and unfrequented thoroughfares may become business streets owing to the location of works or factories, or railway and dock terminals. An excessively wide pavement on a residential street is an unnecessary and extravagant expense inasmuch as it is expensive to maintain and clean, while a narrow pavement on, say, a car line street is a source of danger and tends ultimately to congestion of traffic, and resultant financial loss to the travelling and business public. In residential streets primary attention should be paid to aesthetics; in business streets the study of traffic conditions should have first consideration.

Construction of Pavement.—Next in importance to the selection of type of pavement is its construction. The permanent value of any pavement, be it of the poorest type, depends to a very great extent on the discriminating selection of the materials which form the component parts of the pavement, and the care, efficiency and thoroughness used in the grading or mixing of materials, and in the actual laying down of the pavement. In paving, as in any other class of construction, the greatest stress should be laid on the studied and systematic attention to the all-important details, and the necessity for taking pains, as close, careful and scrutinizing inspection is necessary right from the drainage and preparation of the subgrade to the finishing touches on the wearing surface. Instances are known to us all of the best types of pavement turning out poor and unsatisfactory just because of carelessness in construction, or laxness and indifference in inspection, while many comparatively poor types of pavement often stand the test of time and traffic because materials and workmanship employed thereon were of the best procurable. For instance, bituminous pavements which appear to be best adapted for this climate have been laid under similar conditions, but have produced dissimilar results, chiefly due to defective materials and more defective construction. Again, wood block pavement, which has been so much condemned in this neighborhood, is one of the best pavements to be seen in most European cities and in Australia, because the blocks used and the methods of construction are entirely different to those in vogue in most American cities.

Brick, concrete, dolarway and the various asphaltic mixtures are the chief pavements upon which the attention of engineers has been concentrated of late. The adoption of the various types for highway construction obviously depends on the varying conditions and circumstances—the location and grades on which they are to be built, and the particular use to which they are likely to be put. A brief reference to each type of pavement may suffice to demonstrate their demerits and merits and their usefulness or otherwise, particularly as applied to main rural highways.

Brick.—The adoption of a brick pavement necessitates the use of an unyielding concrete foundation upon which their stability and durability so greatly depend. The high cost of a concrete foundation, particularly in districts where transportation facilities are not good, and the excessive cost of the bricks, renders this class of pavement heavy in first cost. The objects aimed at in their adoption are the furnishing of a double wearing surface, which will have the minimum of traction resistance and the maximum of wearing resistance. The cheaper ordinary brick, which figured so much in earlier construction, has now been supplanted by the more expensive vitrified brick. The principal advantages of brick pavement are:—

(1) The sure foothold they afford for horses.

(2) Their special adaptability to heavy grades.

(3) The comparatively little dust and mud which they yield.

(4) The ease and expedition with which they can be repaired.

(5) Their durability under moderate traffic.

The principal disadvantages are:—

(1) Their excessive first cost.

(2) The lack of uniformity in the quality of the bricks, some bricks being softer and more porous than others.

(3) The lack of evenness and regularity in the wearing surface.

(4) Their disagreeable noise under team traffic.

Finally, as laid on a rural highway, they appear to be out of all harmony with the remainder of the road and are, therefore, of little or no aesthetic value. However, with the perfecting of a more uniform and properly vitrified brick and the improvement in the modes of construction, there is little doubt that this form of pavement will shortly be more in general adoption on arterial highways.

Concrete.—Until quite recently the use of concrete in the construction of pavements was wholly confined to the foundation, but pavements entirely composed of concrete are now being more generally adopted, not only in city streets but also on rural highways. As in every type of composite pavement, their success depends upon the proper grading of the best procurable materials, and on the workmanship being of the highest order. The advantages claimed for such roadways are:—

(1) The low first cost. It is contended that they cost little more than the bare cost of the foundation used for other composite pavements.

(2) The pavement is a monolith, and therefore the wearing surface cannot separate from the foundation as in other composite pavements.

(3) The surface can be made rough or smooth as desired to meet different conditions.

(4) They require no subsequent coating of material to protect them from the wear and tear of traffic.

(5) They are impervious to injurious oils and gases which affect bituminous pavements in particular.

(6) They strengthen with age.

(7) As they contain no joints, no dirt can collect on the surface and they are therefore easily cleaned.

(8) All the materials are easily procurable.

(9) They are durable under ordinary traffic.

Against these qualifications are set the following disadvantages:—

(1) The noise produced under team traffic.

(2) The cracking and consequent disintegration due to their expansion and contraction under extremes of temperature.

(3) Their injurious effects on horses' hoofs.

(4) The difficulty of maintenance, it being hard to perfectly join up new concrete with old concrete which has been set for some time.

(5) It is not sufficiently resilient and elastic.

(6) Its rigidity is not calculated to withstand the constant blows of horses' hoofs or the heavy impact of motor trucks.

When, however, some of the above drawbacks have been overcome or minimized there is no doubt that concrete roads will be a more marked feature in highway construction in the near future. "Hassam" is a patent form of concrete pavement from which it differs principally in that the rock aggregate of the pavement is laid and rolled instead of being mixed along with the cement, etc., and the cement grout poured into the stone until the voids are filled. When confined to streets with light traffic, where there is no vibrating and impounding action of street cars, etc., it appears to give fairly satisfactory results, but unfortunately it has been laid on business streets of which he subgrade is chiefly composed of "made" ground and therefore has been unable to withstand the heavy compressive, as well as tensile, stresses to which it has consequently been subjected.

Dolarway.—As in other matters, so in pavement. Necessity has been the mother of invention. Dolarway was invented or the idea conceived of applying a thin layer of liquid bitumen to a concrete surface, and sprinkling coarse sand thereon. Such a precaution is alleged to reduce the contraction and expansion common in ordinary types of concrete pavement, by protecting it from the alternating influences of temperature. This so-called wearing surface also reduces the noise, presents a better and more beautiful appearance, saves the horses' hoofs and tends to add to the life of the pavement. The effective results of such treatment are, however, very questionable, the bituminous layer being too thin to afford the necessary elastic, resilient and durable surface, particularly on streets with heavy mixed traffic.

Asphaltic Mixture Pavements.—Under this head are included "bitulithic," "asphaltic concrete" and "sheet asphalt." The latter pavement, not being generally adaptable for rural highways, need not be discussed.

Bitulithic and asphaltic concrete pavements can be laid either on a concrete base or a rock base, the typical bitulithic being chiefly laid on the rock base. The composite parts of the wearing surface of both pavements are very similar, being stone, sand and bitumen. But they are dissimilar in that the sizes of the stone used and the grading of the stone vary greatly. In the case of bitulithic the crushed stone is carefully graded in predetermined proportions, scientifically and mechanically mixed in special paving plants, and the mixture spread on the rock or concrete foundation and carefully rolled to afford a compact wearing and waterproof surface. Asphaltic concrete is similarly prepared with different sizes of crushed stone and similarly applied to the foundation. Although the results produced are not quite alike, the objects aimed at in both classes of pavement are closely akin, and while the typical bitulithic pavements have been in longer use than the generality of asphaltic concrete pavements, the latter are becoming more popular and acceptable because they are unpatented and are, therefore, cheaper in first cost. Now that portable or semi-portable paving plants are in vogue, the use of such pavements has been generally extended to the construction of bituminous concrete roads in rural districts. As such pavements approach nearest to the theoretical and practical conception of a first-class pavement and are particularly adapted to country highways, they are destined to be more adopted than brick, concrete or dolarway pavements. Such bituminous pavements appear to meet the urgent demand for special highway construction, not excessive in first cost, of great durability, and of pleasing appearance, made imperative by the general adoption of automobile and motor truck traffic. As they have met with very favorable results when laid on a rock foundation, an existing macadam road which has proved to be no longer serviceable for the traffic it has to withstand can be readily and easily transformed into a fairly permanent paved highway at comparatively less cost than other types of pavement laid on a concrete foundation. The modus operandi in converting a macadam road into a paved highway chiefly consists in scarifying the existing roadbed, to reduce the crown and afford a bond for laying of additional medium sized rock. The new foundation thus created is consolidated by careful rolling and coated with bituminous paint, upon which is applied usually a 2-inch wearing surface as mixed in the paving plant. Provided always that the materials, mixing and workmanship are all equally good, asphaltic mixture pavements are claimed to be the best adapted for general city work and for use on rural highways. While the perfect pavement to suit all conditions and circumstances has not yet been devised, bituminous pavements approach nearest to the theoretical and practical type of pavement, inasmuch as all the ingredients used therein are natural mineral products, to the grading and mixing of which all the available skill of the laboratory has been applied. Briefly, such pavements possess the following advantages: Durability, resiliency, elasticity, noiselessness and dustlessness. They have a good appearance, are sanitary and can be easily cleaned. In most circumstances they afford good foothold for horses. As regards cost, they are cheaper than most pavements and, taking the cost of maintenance into account, they are cheaper than almost any type of pavement.

The American Society of Municipal Improvements will assemble in Wilmington, Delaware, October 7-10, 1913. The society has for its purpose the dissemination of information concerning municipal departments and municipal works construction and the promotion of improved methods in management.

The question of the disposal of refuse is dealt with in a vigorous and popular way in an illustrated pamphlet, now in course of publication by the Commission of Conservation. The commission is asking the co-operation of the medical health officers in the various towns and cities throughout the country in distributing this pamphlet, and it is hoped the demand for it will be as large as the importance of the subject merits. Pamphlets may be secured gratis by all bodies or persons interested, by applying to the secretary, Commission of Conservation, Ottawa, Ont.

ACTION OF VARIOUS SUBSTANCES ON MORTAR

By Richard K. Meade.

THE following results on the action of various substances on cement mortars were obtained from experiments begun some five or six years ago, and were undertaken to ascertain the action of alkaline waters on concrete, to find out if destructive action really did take place, and also to determine which of these salts ordinarily found in ground water were the cause of such disintegration. The report was published in the form of a paper presented before the convention of the American Society for Testing Materials, at Atlantic City, on June 26th.

The salts usually found in the so-called "alkali waters" of the West are also those which occur in seawater and are those present in largest amounts in many spring and river waters. They are sodium chloride, magnesium sulphate, calcium sulphate, sodium sulphate and sodium carbonate. In order to test the effect of solutions of these substances on cement mortar, a sample of normal Lehigh Valley cement was selected and from it a large number of sand briquettes were made.

Analysis and tests of the cement are given in Table I.

Table I.—Analysis and Tests of the Cement Employed.

ANALYSIS

Silicia, per cent.	20.20
Oxide of iron, per cent.	2.50
Alumina, per cent.	6.96
Lime, per cent.	62.40
Magnesia, per cent.	3.01
Sulphur trioxide per cent.	1.60
Loss on ignition, per cent.	2.38

PHYSICAL TESTS

Soundness

Steam	O. K.	Cold water	O. K.
Boiling	O. K.	Air	O. K.

Fineness

Passing No. 100	94.3 per cent.
Passing No. 200	77.8 per cent.

Setting Time

Initial set	2 hr., 15 min.
Final set	6 hr., 30 min.

Tensile Strength, lb. per sq. in.

	Neat	Sand
1 day	315	...
7 days	765	245
28 days	875	340
3 months	885	415
6 months	885	435
1 year	890	510

All briquettes were made from a mixture of one part cement and three parts standard Ottawa sand. They were allowed to harden 28 days in air and then immersed in a solution of the salt. The briquettes were piled in such manner that the solution had access to almost their entire surface.

The solutions in all cases except that of the calcium sulphate, which was a saturated solution, were made up of one part of the salt to 100 parts of water, to form practically a 1-per cent. solution. At first the solutions were changed every few days, but after the first month the solutions were changed weekly and after the first year less often. The results obtained are given in Table II.

First it should be remembered that the 28-day strength of briquettes kept in air is much less than that of those kept in water. As will be seen from the results given in Table II., the sulphates have a marked action on concrete, which seems to be most apparent in the case of the magnesium salt. The action of magnesium sulphate on cement mortars has been discussed quite voluminously of late and I will not go into it to any length in this paper beyond stating that we carefully analyzed the affected portion and the unaffected portion of a sand briquette which had been stored in a solution of magnesium sulphate. These analyses are given in Table III.

Table II.—Action of Various Salts on Cement Mortars.

	— Tensile Strength, lb. per sq. in., after immersion in —					
Age in Soution	Magnesium Sulphate	Magnesium Chloride	Calcium Sulphate	Sodium Sulphate	Sodium Chloride	Sodium Carbunate
0 days†	219	219	219	219	219	219
7 days	268	245	227	257	236	225
28 days	272	300	300	334	268	277
3 months	287	315	334	354	299	324
6 months	196	202	314	378	287	320
1 year	*..	115	209	271	310	337
2 years	...	*..	*...	141	325	360

* Disintegrated.

† The briquettes were aged 28 days in air before immersion.

Table III.

	Before Immersion	Unaffected Portion	Affected Portion
Silica, per cent.	75.12	73.96	60.40
Oxide of iron, per cent.	0.52	0.60	0.30
Alumina, per cent.	1.15	1.30	0.64
Lime, per cent.	14.80	14.50	14.21
Magnesia, per cent.	0.70	1.66	3.64
Sulphur trioxide, per cent.	0.33	0.83	5.78
Loss on ignition, per cent.	7.02	7.14	14.97

The large increase in the magnesia and sulphur trioxide and the decrease on the oxides of iron and alumina indicate the elements which react with each other. The loss in silica may be due to chemical action also, but as the surface of the briquettes was very much attacked and the sand grains could be scraped away with the finger, I am inclined to think that the lower silica in the disintegrated portion was probably due to mechanical causes rather than chemical action. It will be noted that in almost all cases the first effect of the solution was to increase the strength of the briquettes and that signs of disintegration in no cases became evident until after a period of three months in the solution.

Some of the briquettes were even boiled in a 5-per cent. solution of magnesium sulphate for several days, and in all cases the briquettes were much stronger after boiling than they were before and fully as strong as briquettes boiled in pure water, showing how slow the action of the sulphates is.

The briquettes which failed were considerably swollen and presented much the appearance of a baked potato which has burst its jacket.

Various authorities have proposed at different times the use of divers ingredients in concrete exposed to seawater, with a view to their reacting with the salts of the latter to form insoluble compounds which would protect the concrete. Most persistently suggested of these are the salts of barium, which form with soluble sulphates insoluble barium sulphate. I tried both barium chloride and barium carbonate. These were ground very finely and mixed with the cement. I employed 2 per cent. of barium chloride with the cement, and also 2 per cent. and 5 per cent. of barium carbonate. Sand briquettes were made from these mixtures and the test pieces stored in a magnesium sulphate solution containing 10 grams of the salt to the liter. The results are given in Table IV., and, as will be seen, none of these compounds arrest the destruction.

Table IV.—Action of Magnesium Sulphate on Cement Mortars Containing Barium Compounds.

Age in 1 per cent. Solution of Magnesium Sulphate	Strength, lb. per sq. in. of briquettes containing— 2 per cent. of Barium Chloride	2 per cent. of Barium Carbonate	5 per cent. of Barium Carbonate
0 days*	181	115	166
7 days	...	221	257
28 days	213	246	346
3 months	306	311	346
6 months	265	204	274
1 year	146	Disintegrated	Disintegrated

* The briquettes were aged 14 days in air before immersion.

Some years ago an English chemist suggested the use of finely ground, burnt red brick as an admixture for concrete which was to be used in sea-water. After reading this paper it occurred to me that the resistance to sea-water claimed for high-iron cements might be due to the presence of oxide of iron in the cement. I therefore had sand briquettes made up containing oxide of iron in various forms and conditions, namely, red or ferric oxide, magnetic oxide of iron, venetian red (an impure oxide of iron made from low grade iron ores, so-called "paint ores" of the Lehigh district), and finely ground red brick, using of these 5 per cent. of the weight of the cement in each case and placing the briquettes in a 1-per cent. solution of the magnesium sulphate. The results are given in Table V. As will be seen, the additions of iron compounds are in no way beneficial to cements to be employed in sea-water.

Table V.—Action of Magnesium Sulphate on Cement Mortars Containing Iron Oxides, Etc.

Age in 1 per cent. Solution of Magnesium Sulphate	Tensile Strength, lb. per sq. in., of briquettes containing 5 per cent. of— Ferric Oxide	Magnetic Oxide	Venetian Red	Brick Dust
0 days*	218	225	165	170
7 days	275	280	225	220
28 days	310	340	300	275
3 months	355	340	345	310
6 months	310	280	215	205
1 year	125	105	Disintegrated	Disintegrated

* The briquettes were aged 14 days in air before immersion.

I next tried waterproofing the mortar on the theory that if the circulation of water through the pores of the mortar could be stopped no chemical action could take place. I employed for this purpose both a high-calcium and a magnesium-hydrated lime, road oil (as recommended by Page), a mixture of silicate of soda solution and fish oil (a well-known waterproofing compound), and lime soap (the basis of many waterproofing compounds). I also tried dipping the briquettes first in a hot solution of soap and then in one of alum (Sylvester's Process). The results of the tests of sand briquettes made from these mixtures and stored in magnesium sulphate solution (10 grams to the liter) are given in Table VI.

Table VI.—Action of Magnesium Sulphate Solution on So-Called Waterproofed Mortars.

Age in 1 per cent. Solution of Magnesium Sulphate	Tensile Strength, lb. per sq. in., of briquettes containing— 15 per cent. of Hydrated Lime (Calcium)	15 per cent. of Hydrated Lime (Magnesian)	10 per cent. of Road Oil	2 per cent. of Lime Soap	2 per cent. of of Oil Silicate Soda	Treated with Alum and Soap
0 days*	215	215	165	185	160	220
7 days	215	225	200	210	200	235
8 days	315	320	210	250	245	275
23 months	245	260	260	275	260	265
6 months	200	245	210	230	225	215
1 year	120	105	140	180	165	185

* The briquettes were aged 14 days in air before immersion.

It will be noted that, while the disintegration is evidently taking place in these test pieces, all of these compounds seem to arrest it to some extent at any rate, and in the case of the lime soap and Sylvester Process this is quite marked.

I also investigated the action of magnesium-sulphate solution on cements high in silica. For this purpose samples of commercial cement, one high in silica and low in alumina and one low in silica and high in alumina, were selected; sand briquettes were made of these and immersed in a solution of magnesium sulphate containing 20 grams to the liter, or practically a 2-per cent. solution. The cements selected had the following analysis:—

	Low-Alumina Cement	High-Alumina Cement
Silica, per cent.	23.24	19.86
Iron Oxide, per cent.	2.25	2.56
Alumina, per cent.	5.03	7.60
Lime, per cent.	63.55	63.12
Magnesia, per cent.	3.05	3.10
Sulphur trioxide, per cent.	1.51	1.66

As will be seen from Table VII., the low-alumina cement resists the action of magnesium sulphate much better than the high-alumina one.

Table VII.—Action of Magnesium Sulphate Solution on High and Low-Alumina Cements.

Age in 2 per cent. Solution of Magnesium Sulphate	Tensile Strength lb. per sq. in., of— High-Alumina Cement	Low-Alumina Cement
0 days*	242	225
7 days	318	307
28 days	404	430
3 months	402	476
6 months	230	472
1 year	Disintegrated	500
2 years	...	425

* The briquettes were aged 14 days in air before immersion.

In the above experiments, both cements were commercial cements; but the high-alumina cement when received was not quite so finely ground as the other one, so it was ground to practically the same degree of fineness in a small jar mill (or to 86.2 per cent. passing the No. 200 sieve), so that the fineness of the two samples might in no way influence the results. Both these sements were made from cement rock and limestone.

In connection with the use of concrete for mine props, where it is often exposed to the action of dilute solutions of sulphuric acid, the following experiment was tried. Sand briquettes were allowed to harden 28 days and then were placed in a solution containing 250 grains of sulphuric acid (H_2SO_4) to the gallon. The solution was changed frequently and the briquettes broken at regular intervals. The disintegration of concrete by such acid water is shown by the following:—

Age in Solution	0 days	7 days	28 days	3 mos.	6 mos.	1 year
Tensile Strength, lb.	226	299	300	280	176	Disintegrated

Several years ago the question of the action of oil on concrete was brought up at one of the meetings of this society in connection with a paper by Professor Carpenter. In his experiments, oil was mixed with the concrete. In the discussion which followed the reading of the paper, a number of gentlemen suggested that what was needed most was information relative to the action of oil on concrete which had already hardened, in view of the employment of concrete for machinery bearings, engine room and factory floors, etc., where it is subjected after being fully hardened to the oil which leaks from the bearings of the machinery. I went home from this meeting and had a number of sand briquettes made and allowed them to harden two weeks in air. These were stored in air, in engine oil, in cylinder oil, and in black oil, and broken at stated periods. The results are given in Table VIII.

It will be noted that the engine oil and the cylinder oil have practically no effect upon concrete. One would think that as the latter has a considerable proportion of

animal oil in its composition it would be apt to appreciably affect concrete exposed to it. On the other hand, the action of the black oil seems strange in view of the

Table VIII.—Action of Lubricating Oils on Concrete.

Age in Oil	Tensile Strength, lb. per sq. in., of briquettes kept in Air	Engine Oil	Cylinder Oil	Black Oil
7 days*	218	252	235	234
28 days	233	240	273	222
3 months	287	251	221	181
6 months	303	232	209	131
1 year	293	231	203	Broke in clips

* The briquettes were aged 14 days in air before immersion.

fact that it is a straight mineral product. All of these briquettes had absorbed considerable oil, the actual gain in weight of each set at the end of the year being as follows:—

In engine oil ..... 10.6 per cent.
In cylinder oil..... 10.0 per cent.
In black oil ..... 12.0 per cent.

The briquettes in the black oil had not swollen perceptibly and seemed merely to be weak.

The experiments given above were all made upon very small test pieces and hence the action of the solutions upon them were much more rapid than they would be upon a large mass of concrete.

The paper was followed by lengthy discussion, Dr. Allerton S. Cushman, of the Institute on Industrial Research, Washington, stating that his experiments largely corroborated those of Mr. Meade. As a probable cause for the disintegration of concrete in alkali waters, discussion tending to show that chemical changes cause undue expansion, and that the best protective methods of preserving concrete where used in localities having black alkali waters, as is the case in many parts of the west, were by the use of coal tar oil. Experiments have also shown that briquettes tempered with copperas have never shown signs of rupture nor have they cracked when submerged in alkali water, and that after having been submerged in this water, they get very hard. Others have shown that concrete in waters carrying sulphates almost invariably change the calcium hydroxide to calcium sulphate, and that this chemical change, demanding more room for increased expansion, disrupts the concrete, and in but a comparatively short time causes disintegration. Tests also showed that in using black oils for waterproofing, trouble might be caused and disintegration follow if the oil used contained even a trace of sulphuric acid. The author of the paper stated that the oil used in the tests as referred to in his paper was a residual oil as used only for the lubrication of very heavy machinery, and that the very slight flaking or sloughing off was on the surface of the foundation only, and did not continue into the concrete, although considerable oil was absorbed by these foundations.

Reference was made then to a method of waterproofing cement used in construction in sea-water. This method is credited to Arthur Rea, of France, and consists of adding a small percentage of gypsum, say, 5 to 20 per cent., to accelerate action, and to add to the concrete finely crushed marble. So far as is known, this method has proven very satisfactory in that country, although experiments made along these lines in Boston harbor, using six representative brands of cement, showed various results with these different cements. At the end of six months all briquettes tested had been slightly reduced with the exception of those made of one brand of cement. In adding waterproofing materials, it was stated in this discussion that the action of a solution of some salts, if added while plastic, will cause the concrete to expand unusually, while one or two others may show no such effect, but when added after the concrete has set, some of these solutions may cause the concrete to disintegrate. Many cases are in existence where concrete in sea-water along the Atlantic coast shows clean sharp edges after having been subject to this water for five years.

AMOUNT OF CEMENT FOR CONCRETE.

Mr. Stanley Macomber, city engineer of Centralia, Wash., in an article in the the Iowa "Engineer," states that a number of engineers in Washington are using clauses similar to the following in connection with their specifications for concrete work:—

Every cubic yard of concrete 1:3:6 mixture shall contain at least 4 sacks of cement.

Every cubic yard of concrete 1:3:5 mixture shall contain at least 4½ sacks of cement.

Every cubic yard of concrete 1:1:1 mixture shall contain at least 12 sacks of cement.

Every 2 cu. ft. of top mixture 1:2 shall contain at least 1 sack of cement.

For cement over this amount nothing will be paid the contractor.

For every sack of cement under the above amount the regular price shall be deducted from the total sum due to the contractor.

The contractor to figure on the above amounts rather than on the direct mixture.

Arrangements must be made with the city engineer for the proper inspection of the amount of cement used.

It is also stated that during the day the inspector tries to keep the mix as near correct as possible, and at night the empty cement sacks are counted and a material slip filled out, signed by the inspector and the contractor. A copy is given the contractor and a copy put on the file in the office. When it comes to final settlement these slips are taken as receipts for the amount of cement used. The amount of cement hauled on to a job is also kept in this manner as a check.

The area and mileage of street paving of various classes in the city of Philadelphia is given as follows in the annual report of the Bureau of Highways, of which Wm. H. Connell is chief:—

Character.	Sq. yards.	Miles.
Granite block	6,653,532	352.99
Asphalt (sheet)	6,959,656	472.35
Asphalt (block)	72,532	7.49
Vitrified brick	2,376,224	163.63
Cobble	162,775	14.02
Rubble	93,182	6.69
Slag block	78,071	8.13
Cement and granolithic	54,242	11.03
Wood block	121,505	4.06
Totals	16,571,719	1,040.39
Bituminous macadam roads	312,104	29.01
Waterbound macadam roads	3,035,429	261.31
Total macadam roads	3,347,533	290.32
Grand total (improved pavements and macadam roads)	19,919,252	1,330.71
Earth roads	.....	179.06

THE DESIGN OF CENTRAL HEATING SYSTEMS

PART II

THE PRODUCTION OF HEAT THE OBJECTIVE TO BE KEPT IN MIND—TYPES OF MACHINERY—TUNNELS, PIPING SYSTEMS, AND OTHER ACCESSORIES.

By A. G. CHRISTIE, M.E.,
Assistant Professor of Steam Engineering, University of Wisconsin.

The Design of the Heating Station.—The central heating plant should be so designed that the production of heat is its prime objective. The heat, however, may be developed with high pressure on the boilers, and this pressure may be reduced by passing a portion or all of the steam through engines. A portion of the heat is thus converted into work, and may be utilized to drive electric generators. Any further heat demand may be met by passing high-pressure steam through a suitable reducing

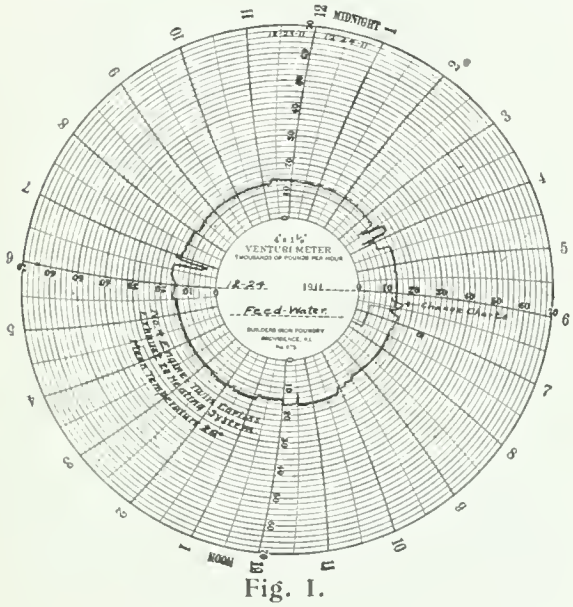

Fig. 1.

valve. In other words, the station should be so designed that heat is the main output and electricity a by-product. This condition is secured when the demand for steam by the engines driving the generators is entirely submerged by the average demand for heat during a greater portion of the heating season. It is possible with this arrangement to select boilers of capacity proportional to the heating loads, and to keep in service the proper number of boilers to most economically meet the demands for heat, which will vary almost directly with the outside temperature. There are, then, no extreme peak loads during the day in the boiler-room, and consequently no fires are kept banked between peaks.

Fig. 1 shows a typical chart from the Venturi meter on the boiler feed-line of the Capitol Heating Plant at Madison, Wis., where the steam demanded by the power load shown on Fig. 2 is entirely submerged by the heating load, which, as the chart shows, is uniform for the twenty-four hours.

When a plant is run primarily for generating electricity and the exhaust steam is a by-product and required to the amount represented by the average load on the plant, there will be peak loads at certain times of the day, and at such times exhaust steam will be wasted. Boilers must be kept with banked fires to meet these peak demands for steam, and, on account of these stand-by losses, operation must necessarily be less efficient than when the steam demand for heat predominates, and, owing to the nature of the service, is practically uniform.

Many of the older heating systems were installed with the idea of using exhaust steam as a by-product and with no real value. In consequence, they have been financial failures on account of inefficient plant operation. In some other cases the overhead plant charges were not equitably distributed between the electric services and the heating system, resulting in ridiculously low heating rates.

Several utilities which supply cities with hydro-electric power find it necessary to maintain auxiliary steam plants in the city, especially when the power has to be transmitted for some distance from its point of generation. Frequently fires are banked under the boilers of these auxiliary plants at all times for either emergency or peak-load service. Under such conditions a heating system should prove a valuable addition to such service, not only from an operating, but also from a financial standpoint.

It can thus be seen that there is considerable justification for the assertion that the heating plant must be primarily for heat and not for power. This fact is now recognized by all leading heat engineers, as instanced by an abstract from a recent address of Mr. C. R. Bishop, in which he states: "To secure maximum results, the demand for steam for heating should be slightly in excess of the *maximum amount* of exhaust steam available at all times."

The detail design of every central station presents a new set of problems, so that no specific rules of design can be laid down. The size of the plant is dependent on the extent of the proposed service. The character of the units to be installed is determined by the fuel cost at the plant. If coal is cheap, it would not be profitable to install expensive equipment. But where coal is dear, consideration should then be given to the most efficient equipment that is on the market, and additional special apparatus may be installed to secure economical operation. It is, therefore, advisable to determine as closely as possible the probable future cost of coal before the designs are made, and to be guided thereby in the selection of equipment. When purchasing engine equipment for a central station, those types or combination of types should be selected which will serve throughout the whole year, and will, therefore, not involve overhead charges with no returns during the summer season.

The plan of the station should always provide for future extensions when such are contemplated. A usual arrangement is to place the engine and boiler-rooms side by side, and with the backs of the boilers towards the brick wall separating the two rooms. The engines may be placed on a higher level than the boilers, and the basement below the engine-room will serve as a pump

and heater room, and also as a distributing centre for the heating system.

When a heating station is located in a district where real estate is extremely high, it may be desirable to make the plant double-decked, i.e., the engines are placed on a second floor directly above the boiler-room. This construction is feasible when steam turbines are used. However, when these engines are run condensing, this arrangement is not desirable, as it is not economical to raise water for cooling purposes to such a height. This objection does not hold when the units generally operate non-condensing.

A large storage of coal, either in bunkers or exterior to the power plant, is absolutely essential to guarantee a supply of heat in case of such emergencies as strikes on the railroads or in the mines, or freight blockades cutting off the coal supply. Except at the lake ports, all Wisconsin's coal supply comes from Illinois, and is hence subject to blockades and snow troubles. When land is dear, coal bunkers for storage should be built in the plant itself, in which case coal-conveying machinery must of necessity be installed. In other cases, the size of the plant and the cost of labor will be factors in deciding the advisability of installing coal and ash-handling systems. Regarding the disposal of ashes, many utilities have found that building contractors and others will remove all well-burned ash and clinker for use in concrete construction and for filling in.

When the plant contains only a few boilers of small size, hand-fired furnaces will give the best economy, provided these furnaces are properly designed and are handled intelligently. Furnaces of the Dutch oven type or with overhead brick arches should have a preference, as they aid materially in reducing the smoke nuisance.

The cost of labor is paramount when considering the question of hand-fired furnaces or mechanical stokers. In general, one fireman can attend to coal, water and ashes on 300 horse-power of boilers in a hand-fired plant. With automatic stokers, overhead bunkers and down-spouts, one fireman can easily take care of 2,000 horse-power, or even 3,000 horse-power, depending on the size of the boilers, and at the same time maintain a high and uniform degree of efficiency. It will generally be found economical to install stokers where three or more boilers of 300 horse-power or over are continuously in service, especially when screenings or slack are burned.

By abstracting part of the waste heat from the flue gases from the boilers economizers aid in the further recovery of the heat generated in the furnace. Such apparatus is sometimes desirable where coal is expensive. The scale-forming properties of the water used in the economizer will determine to a large extent the expense involved in cleaning. In hot water systems the water is frequently circulated through an economizer before being pumped back into the system. By cooling down the flue gases, the draft on the boilers is reduced by economizers when chimney draft only is used. Hence, a higher and more expensive chimney or a mechanical draft apparatus must be employed. Some engineers prefer to install more heating surface in their boilers than to use economizers. At best, economizers are expensive and require considerable care to be kept in good working order.

The piping system of a heating station cannot be specified by any set of general rules. However, all such piping should be in simple systems, and valves should be easily accessible at all times. Engineers should insist on high-grade pipework throughout the plant.

It is always advisable in plants of sufficient size to warrant the expense to install Venturi meters on the boiler feed-line of a steam plant or on the delivery line of a hot water plant. This enables reliable records to be kept of the heat output of the plant and provides a means for checking the efficiency of the heating system.

The selection of prime movers for generating electricity will be influenced by the nature of the electrical service, the amount of the heat demand and the first cost of equipment. If it is desired to keep the electrical load submerged in the heating load at all times, and if the demand for steam for such service is almost equal to that of the heating system, then it will pay to put in the most economical engines obtainable in order to get the best results from the steam available. High-priced single or compound engines of the Corliss or four-valve type would be installed. If vertical compound engines of the high-speed English types were available, these would deserve consideration, both with respect to low first cost and high efficiency. In some plants compound condensing engines are installed which can run

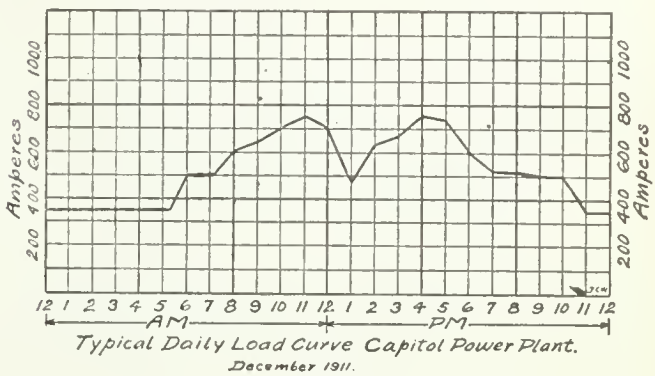
Amperes
200 400 600 800 1000
12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
AM
PM
Typical Daily Load Curve Capitol Power Plant.
December 1911.

Fig. 2.

during the heating season either as simple engines, or a quantity of steam can be withdrawn from the receiver for heating. During the summer season such engines are run condensing. However, in view of recent developments in low-pressure steam turbines, it would seem more advisable and less expensive to install such units to utilize the excess exhaust steam over heating requirements during peak loads on warm winter days and in summer.

Many improvements have been made on non-condensing steam turbines in recent years, so that these should be given careful consideration in selecting plant equipment. Bleeder types of turbines, which provide for the extraction of a portion or all of the steam after it has passed through the first stage, have become standard for heating purposes and are now being installed quite generally instead of steam engines. Steam turbines are adapted to the design of heating stations on account of their low first cost, small weight and cheap foundations. As there is no internal lubrication, oil troubles are avoided in the exhaust heating systems.

A 750 K.W. 60-cycle non-condensing steam turbine operating at 150 pounds pressure and 5 pounds back pressure above atmosphere will have a steam consumption of about 40 pounds per K.W.H. A 1,000 K.W. 60-cycle machine will have about 1 pound per K.W. better water rate at full load. On both of these machines the steam consumption at half load will be about 2 pounds per K.W.H. higher than at full load. A standard 750 K.W. condensing turbine will have a steam consumption at full load of about 19.5 pounds per K.W.H., and at half load of about 22.5 pounds. The 100 K.W. condensing turbine would have a steam consumption of about 19.0 pounds per K.W.H. at full load and 21.0 pounds at half load.

If these condensing turbines are provided with automatic bleeding devices to take steam for the heating system at 5 pounds pressure above atmosphere, it will be possible with 150 pounds steam pressure and 28 inches vacuum to extract a maximum of 15,000 pounds of steam per hour from the 750 K.W. turbine at half load, with a total flow of steam at the throttle of about 16,000 pounds. At full load the maximum extraction would be

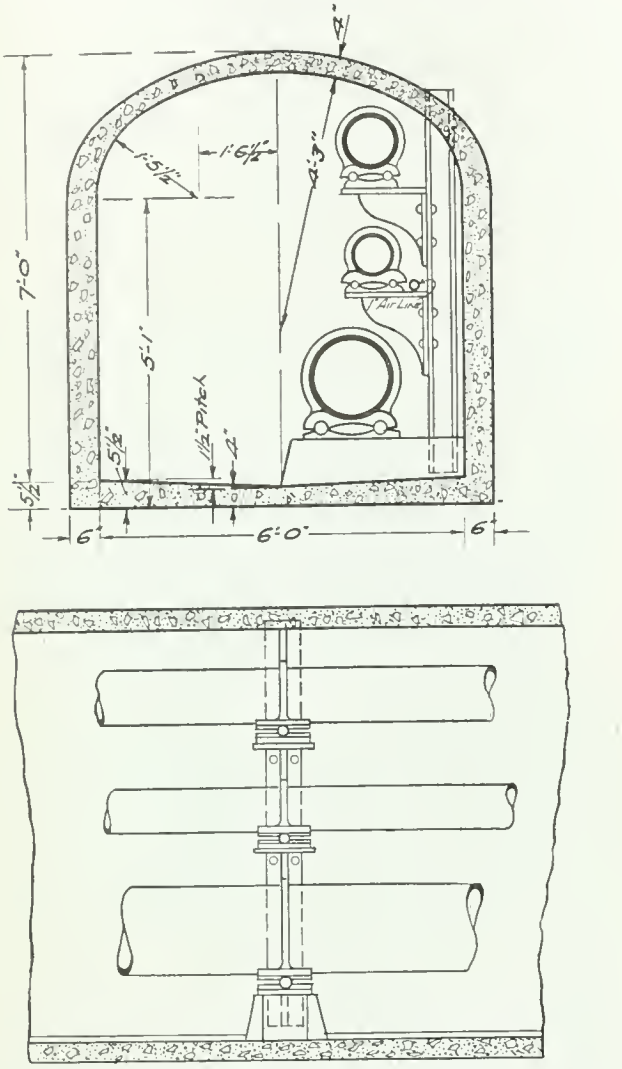

Fig. 3.—University of Wisconsin—Standard Heating Tunnel.

about 28,000 pounds with a total flow at the throttle of about 29,000 pounds. The 1,000 K.W. condensing turbine under similar conditions will have a maximum bleeding capacity of about 19,000 pounds per hour at half load, with a total flow at the throttle of 20,000 pounds. At full load it is possible to withdraw 37,000 pounds per hour with a total flow at the throttle of 38,000 pounds.

This data, from a leading manufacturer, is presented to show the results that can be expected from such type of turbine. The advantage of the bleeder type lies in the fact that it may be operated condensing entirely during the summer months, and thus high efficiency may be maintained.

There has been considerable information published relative to the bleeder type of turbine. Further data on this question can be found in a paper by A. H. Kreusi on "Heating in Connection with Steam Turbines," read before the National District Heating Association at Detroit in June, 1912, and also a paper by E. D. Dreyfus on "Notes on an Economic Survey of Combined Central Heating and Electric Plants," presented at the same meeting. The latter paper presents some interesting graphical diagrams showing the results obtained with Westinghouse bleeder turbines.

In many plants it has been found more desirable to install separate condensing units than to attempt to adapt one type of engines to all conditions of operation. These condensing units can be used on the peak loads. Occasionally storage batteries are also provided to improve the load factor by helping out on peaks.

The boiler feed-pumps in a large central station should be of the turbine driven type, although in small plants duplex steam pumps with automatic governors are generally used.

The circulating pumps in hot water heating systems are now generally of the centrifugal type, driven by non-condensing steam turbines, which exhaust into the heaters. Sometimes these pumps are motor driven, though this is not common.

Pipe Lines and Conduits.—The most important portion of the district heating equipment is the underground transmission system. For economy in operation this should be made of the very best possible construction, and should be easily accessible for repairs at all times. On the other hand, too high first cost results in high fixed charges on the service rendered. The conduits, pipe lines and auxiliary service must be designed so as to provide the most economical system in operation that can be installed with the capital available.

The franchise or permit of the heating company allows it to make use of the streets and alleys of the city. The plan of the city will show at a glance whether it is possible to use the alleys for conduits. The choice between streets and alleys depends on two things: (1) The relative cost of street and alley construction; and (2) the location of the buildings to be served relative to the streets or alleys. It has been authoritatively stated that, other things being equal, alley construction will cost 15 to 30 per cent. more for labor than street work, owing to the difficulty of working in the narrow space. An important factor affecting street construction costs is the amount of paving that has to be torn up and relaid. The heating companies are obliged in most cities to bring their service pipes to the curb line in a street and to the property line in an alley. This item of expense should not be overlooked in choosing between street and alley construction, for on wide streets the extra cost for service lines will more than eat up the saving in labor effected by street construction.

The form of conduit to be employed in any given installation will be dependent on local considerations. When a large main or a number of pipes, such as high-pressure steam, low-pressure steam, condensation return or other piping must be laid for some distance in one direction before branching off for distribution, it is probable that a reinforced concrete tunnel would be most satisfactory. However, it will generally be found that the greater portion of all heating systems are laid in some form of underground conduit.

Piping tunnels allow joints to be watched and repairs and alterations to be made with comparative ease. Their first cost is high, but they never need opening up if properly built. Fig. 3 shows a section of standard piping tunnel used at the University of Wisconsin. The pipes are carried by saddles with ball bearings resting on brackets fastened to vertical I-beams, which are imbedded in the concrete. Any section of pipe can be readily removed with this construction. Anchors and expansion joints are provided at proper intervals. Tunnels need

to be well underdrained, and should be provided with air-tight manholes at proper intervals. The radiation losses from piping in tunnels can be reduced to comparatively small amounts if covered to a sufficient depth with first-class moulded insulation materials.

If the distribution mains are too large for the service connected up, the per cent. loss will be unreasonably large, while if the capacity is increased to its ultimate limit, the line losses will become a very small percentage of the heat transmitted. Thus a line designed for 200,000 square feet of radiation will show a line loss of 10 to 20% of the heat supplied when only 50% of the service is connected. But when the whole ultimate load is applied the loss would become only about 4%. The normal condensation from radiation should then not exceed 0.05 pound per square foot per hour.

The requisites for good construction and efficient operation of pipe conduits are as follows:—

1. Drainage must be provided to remove all water accumulations from possible contact with pipe lines.
2. There must be adequate provision for expansion.
3. Drips and traps must be provided at intervals to remove condensation from radiation.
4. The pipe insulation must be efficient.
5. The conduit itself must be of good mechanical construction.

Drainage must be provided to keep both conduit and insulating materials dry at all times. This drainage is usually secured by first laying a tile drain in the bottom of the trench. Then a layer of coarse crushed stone is laid above and around this tile. The conduit can now be placed so that there is a filling of crushed stone on either side of it as high as its top. This enables the water percolating through the soil above to find an easier path to the drain than through the conduit itself.

Expansion joints must be provided at frequent intervals along the mains to take up the expansion and contraction from changes in temperature. A form of expansion joint which can be packed under pressure is shown in Fig. 4. This was designed by Mr. J. C. White, and has been in use for several years with entire satisfaction on both the Wisconsin State Capitol heating system and the University of Wisconsin heating system. The main body of this expansion joint is of cast-iron, and is bored out for the stuffing-box and threaded to receive the retainer ring as shown. The telescoping or slip section of pipe is made of tobin bronze, turned up and polished on the outside. The four packing rings, marked "a," and the two clamp rings, "b," are also of tobin bronze, and are all split in a similar manner to piston rings. The bull ring "c" has four holes at right angles to each other which connect the inside annular space with the outer annular ring, which in turn connects to the ¾-inch blow-off pipe on the lower side of the cast-iron body. The retainer ring "d" is of cast-iron, and is screwed in place by a special socket wrench. The packing may be of any "soft" variety, and can be withdrawn at will with steam on the line by simply opening the blow-off valve to the atmosphere. It is surprising how little steam leaks past the packing-rings even when the blow-off valve is open. This joint has been equally as satisfactory on high-pressure lines as on low-pressure. This form of expansion joint has proven the most satisfactory of any using soft packing. Goose-neck bends have been used occasionally, but are not suitable for conduit work.

There are several forms of expansion joints giving satisfactory service on low-pressure lines, and which employ copper diaphragms to take up the expansion and contraction of the piping. They are placed usually about 100 feet apart, with anchors midway between. A service outlet to customers is generally provided at the top of the cast-iron body of these expansion devices, and also at the anchor, fitting so that dry steam only passes out of the main.

Manholes must be provided above these joints, and also above any valves or other equipment that may need adjustment or inspection. However, manholes are a source of great heat loss, and hence as few should be used as is consistent with efficient operation of the lines.

The radiation loss from piping is dependent largely on the character of its insulation, the depth underground that the piping is placed, and, as already pointed out, the dryness of the conduit and its insulating material. Some insulating materials deteriorate with age. Gifford, in his book on "Central Station Heating," gives the following formula for finding this radiation loss:—

$$H = A \times C$$

where H = pounds of steam condensed by radiation, A = square feet of outside surface of piping, fittings, service connections, expansion joints, etc., in the heating mains, and C = a constant for each class of covering as shown in the following table:—

Table 3.—Coefficients for Radiation Losses.

Description of insulation and construction.	Value of C* steam at 5 lbs.	water at average temperature.
Hemlock lumber, three 2-in. thicknesses, paper and shavings 1st year	0.03	0.02
Same . . . . . 3rd "	0.05	0.03
Same . . . . . 5th "	0.08	0.06
Same . . . . . 8th "	0.10	0.07
Hemlock lumber, two 2-in. thicknesses or three 1-in. thicknesses, no paper or shavings...1st year	0.05	0.03
Same . . . . . 3rd "	0.07	0.05
Same . . . . . 5th "	0.09	0.06
Same . . . . . 8th "	0.10	0.07
4-in. segmental wood log, tin-lined, well under-drained—first year and as long as in good condition....	0.04	0.025
4-in. concrete conduit, 1-in. covering	0.08	0.06
4-in. concrete conduit, 1½-in. covering	0.05	0.03
4-in. concrete conduit, 2-in. covering	0.04	0.025
4-in. brick conduit, 1-in. covering.	0.08	0.06
4-in. brick conduit, 1½-in. covering	0.05	0.03
4-in. brick conduit, 2-in. covering.	0.04	0.025
4-in. partition tile conduit, 1-in. covering	0.07	0.055
4-in. partition tile conduit, 1½-in. covering	0.04	0.025
4-in. partition tile conduit, 2-in. covering	0.034	0.02
Two 1-in. thicknesses lumber with 3-in. concrete envelope	0.05	0.03
Tunnel construction 2-in. covering	0.045	0.03

*Values of C are given in pounds of steam. Multiply these values by 1;000 to get the approximate heat units.

It is very difficult to obtain any figures of actual tests or other records showing line losses in actual plants.

Mr. C. R. Bishop, of the American District Steam Company, states that with their standard wood-log construction the transmission loss of a low pressure steam system averages about 0.044 pounds of steam per hour per square foot of surface of underground mains, to which must be added a small percentage to equal unaccounted-for steam due to meter inaccuracies, leaky air vents, etc. Gifford, in his book on "Central Station Heating," states that the radiation loss in a steam system equals 0.05 pounds of steam per hour per square foot of underground main. The superintendent of one of the largest heating systems in Illinois, in a personal communication, stated that the loss in their mains is equal to 6% of the total steam leaving the station. This system includes 1,800 feet of 18-inch main installed in a brick tunnel and covered with a 2-inch covering of asbestos sponge felt, the remainder of the system has wood-log conduits.

The materials used for insulation will be discussed later in connection with conduit construction.

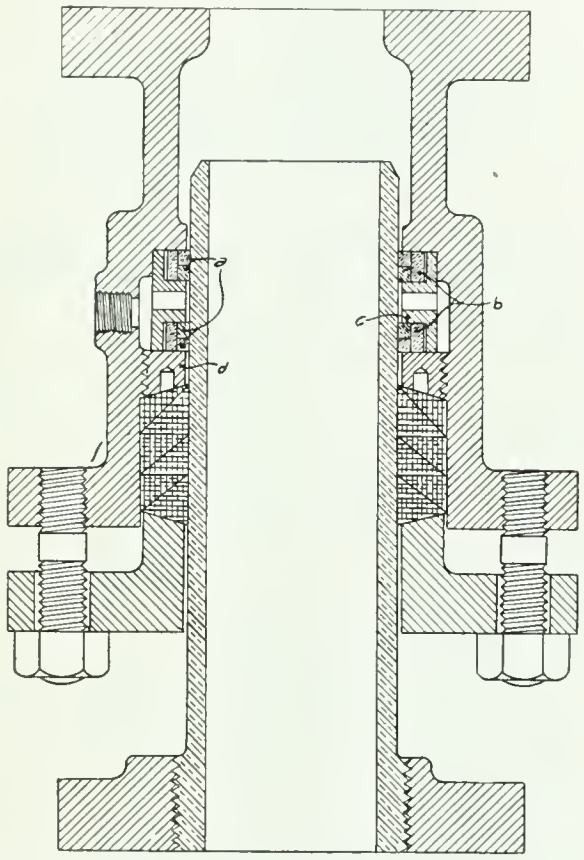

Fig. 4.—White's Expansion Joint.

The question of materials for pipe lines is naturally one of considerable importance. The American District Steam Company, who have probably had more experience with heating systems than any other concern in this country, have always maintained that strictly wrought iron pipe with long recessed couplings was far more durable than steel pipe. However, recent tests on steel pipe tend to show that there is not so much difference between the two classes of pipe as is claimed. Besides, it has become almost impossible to procure strictly wrought iron pipe except at prohibitive prices.

The proper size of the pipe lines to be installed is determined by their ultimate capacity and by the allowable drop on the lines. This will be determined with exhaust steam by the back pressure which can economically be permitted on the engine or turbine. With hot water, the designer must select such a pipe size that the sum of the losses in pumping due to friction, and in radiation, is a minimum. These calculations must be based in each case on the ultimate capacity of the pipe line.

The friction losses in heating mains must be carefully calculated before the final sizes are selected. A compromise has usually to be effected between the piping system with the least friction drop and that with the least heat losses. In general, however, the system must be so designed that a pressure of at least one pound above atmosphere must be maintained at the radiators at the extreme end of the system without requiring at the station too high a back pressure in the case of low pressure steam or too high a head to pump against in the case of hot water.

The allowable pressure drop depends largely on the pressure that is to be maintained at the station end of the system. For instance, the friction loss with 10 pounds pressure could be about double that of a system with 5 pounds pressure at the plant. There is a considerable mass of data on hand for calculating the sizes of steam mains for known pressure drops, but much of this is of a conflicting nature. For instance, Mr. C. R. Bishop states that in designing large low pressure steam systems with a maximum initial pressure of 5 pounds above atmosphere, the friction loss should not exceed one-quarter pound per square inch per 1,000 lineal feet of main. Gifford, in "Central Station Heating," gives sets of curves for allowable pressure drops for both hot water and steam. Values taken from these curves are very much in excess of those quoted by Bishop, and it would seem, therefore, that they are not very applicable to large heating systems.

Professor H. V. Carpenter gives a series of curves for the flow of steam through pipes in Power, December 17, 1912, but these curves are principally applicable to high pressure mains, as the lowest pressure drops plotted are one pound per square inch per 1,000 lineal feet of main. These diagrams, however, could be easily replotted for use on low pressure steam work. They are based on the formula of Unwin, which was confirmed later by tests made by Professor R. C. Carpenter and G. H. Babcock, and are probably correct enough for ordinary conditions.

$$W = 87.5 \sqrt{\frac{PYd^5}{L\left(1 + \frac{3.6}{d}\right)}}$$

$$\text{or } P = 0.0001306 \frac{W^2 L\left(1 + \frac{3.6}{d}\right)}{Y d^5}$$

where W = weight of steam delivered in pounds per minute
P = drop in pressure in length L
L = lineal feet of pipe
d = diameter of pipe in inches
Y = mean density of the steam in the length of pipe under consideration in pounds per cubic foot.

Mr. Konrad Meier, in his book "Mechanics of Heating and Ventilating," reviews the various formulas proposed for the loss in pressure from friction on the flow of steam through pipes, and deduced the following formula for low pressure steam:—

$$P_f = 0.0257\ Y \frac{v^{1.97}}{d^{1.18}}$$

where P_f = pressure drop per foot of pipe
Y = mean density of the steam
v = velocity of the steam in feet per second
d = diameter of pipe in inches.

These exponents apply to steam at pressures slightly above atmosphere. The author also presents charts for use in solving these equations, but the values apply more directly to isolated plant construction than to central station mains.

The friction loss in hot water mains can be approximated closely by applying the well-known formula of hydraulics

$$h_f = \frac{a\,L}{D} \cdot \frac{v^2}{2\,g}$$

where h_f = feet of head lost in friction, a = friction factor which, for wrought iron or steel piping, may be taken as equal to 0.02, L = length of pipe in feet, D = diameter of the pipe in feet, and $2g = 64.4$. This formula may be applied when all the water entering one end of the pipe passes out at the other. When the water is all taken off at intermediate tappings and the velocity at the extreme end is zero, the loss will be about one-third of this amount. For hot water systems in service the actual conditions lie somewhere between these extremes and so the actual loss must be assumed in the proportion to the amount drawn off. Hoffman, in his "Handbook for Heating and Ventilating Engineers," suggests using two-thirds of the value of h_f for hot water service mains with the usual customer's connections.

(To be continued.)

WATER WASTE PREVENTION IN NEW YORK CITY.

By I. M. De Varona,
Chief Engineer, Department of Water Supply, Gas and Electricity, New York City.

TO avert the threatening danger of a serious shortage of supply for Manhattan and The Bronx in 1912, and, later, to avoid, if possible, the large expense attending the development of additional sources of supply for Brooklyn, which would otherwise have been required to adequately provide for the consumption in that borough until the Catskill water was available, the Department of Water Supply, Gas and Electricity of New York City instituted a vigorous campaign to reduce waste. This undertaking forms the basis of a paper read by Mr. I. M. De Varona at the recent American Waterworks Association convention at Minneapolis, of which paper this article forms a part. The intended purpose was fully and most satisfactorily accomplished in both the above-mentioned cases. The crisis of 1912, in Manhattan and The Bronx, was tided over, and Brooklyn may now safely await the introduction of the Catskill supply without further developing its watershed.

The estimated daily reduction in consumption in Manhattan and The Bronx reached a maximum of 71 million gallons in August, 1911, averaged 65 million gallons for the last 6 months of 1911 and almost 50 million gallons for the year 1912, while the total reduction since the beginning of the work in the fall of 1910 to April 1, 1913, aggregated over 39,700 million gallons. In Brooklyn the maximum reduction of 34 million gallons daily was effected in February, 1913, and the average daily reduction since August, 1912, the commencement of the house-to-house inspection, to April 1, 1913, amounted to 25 million gallons, while the total saving since the beginning of the pitometer work in July, 1910, to April 1, 1913, aggregated over 9,000 million gallons. This reduction in consumption in the borough of Brooklyn was such that the average daily consumption for the month of January, 1913, would give a per capita consumption of only 73 gal., which is the lowest per capita consumption for any January since 1894, or for the last 19 years.

The aggregate value of the water thus saved, if figured at meter rates, $133 per million gallons, would be nearly $6,500,000 and the total cost of the work done to effect this saving was about $167,000, which would be reduced to $131,000 if the amount for fines imposed (i.e., $36,000) were deducted.

The per capita consumption for New York City for 1910 (111 gal.) was lower than that of the next five largest cities in the United States, i.e., Chicago, Philadelphia, St. Louis, Boston and Cleveland, for the year 1912; and this in spite of the fact that in New York a floating population of many thousands, not included in the census, is housed, and that there are an equally large number who live outside the limits of New York City, but who work in the city, also left out of the census. If this transient population were considered, the per capita consumption in New York would be materially reduced. Compared with other American cities, New York, therefore, is economical in the use of water, even if we include our waste.

Preventable Waste.—For the purpose of this report, "waste" shall be considered as the quantity of water drawn in excess of that required for the uses already specified, and will be designated as "preventable" when the value of the water wasted is greater than the cost of the methods required to save it, whence it follows that it would be considered non-preventable when the reverse conditions obtain, so that "it will not pay" to save the water, these designations being based exclusively on practical and economical considerations. For "value" must be understood not simply the normal money cost or selling price of the water, but also the increase or decrease due to the condition of the supply at the time. The author has held before that under existing conditions in New York it would not be advisable in making a safe estimate, to assume a larger permanent saving in consumption from the work to prevent waste, than from 15 to 20 per cent., and the results recently obtained seem to bear out these figures.

Reducing Waste.—The following methods are generally employed:—

1. Calling to the attention of consumers the need of checking waste, either for economical considerations or to prevent a threatened shortage on account of inadequate supply, or for both reasons.

2. House to house inspection to detect and repair leaks.

3. Examination for leaks outside of the buildings, in service pipes as well as distribution mains and appurtenances, to locate and repair underground leaks.

4. Metering of all connections where the cost and existing conditions of the supply warrant this measure.

The fourth method cannot under existing legislation be generally applied in New York, nor was it available for the work under consideration. Under the existing legislation, the water department can compel the installation of meters by property owners only in buildings

where water is used for commercial purposes, so that out of a total of 365,000 services, only 86,000 or less than one-fourth, are metered, and of this number 60 per cent. are in the Borough of Manhattan.

Public and Individual Notices.—Public attention was repeatedly called, through the press, to the inadequate supply available in those boroughs in which existing conditions warranted such a statement, the requisite data being also given in support thereof and the imperative need shown of preventing waste in order to avoid a threatened shortage; while a notice printed in English, Italian and Yiddish was delivered at all premises requiring consumers to stop all leaks in their fixtures, advising them at the same time that the department would impose a fine if after the first inspection leaky fixtures were not promptly repaired. These notices, forwarded about the middle of June, 1911, met with instant and efficient response, so that a large reduction in consumption resulted at once.

House to House Inspections.—The larger portion of waste in the city of New York is due to defective fixtures within the buildings, and especially to the water lost from roof and toilet tanks, and leaks from the latter are also the most difficult to detect, as the escape of water is not always apparent to the eye, although the noise made is sufficient, as a rule, to enable the occupant of the premises to detect the leak. Next to leakage of tanks is that from faucets, due either to their being carelessly left open or to need of repairs usually resulting from wearing out of washers.

The Board of Estimate and Apportionment having approved the issue of $100,000 revenue bonds to pay for a house to house inspection, a force of about 100 inspectors was placed in the field in June, with the necessary clerical force to handle the inspection reports, notices of leakage, etc., this force operating under the direction of the water registrar. The Engineering Bureau determined the amount of water consumed before and after house to house inspection, and for this purpose 18 districts were laid out in the borough of Manhattan. The flow into these districts was determined by pitometer measurements, and a record of the reduction in leakage resulting from the inspection was thus obtained. The house to house inspection was continued with full force until September, when the reduction in consumption, together with the increased rainfall, made it unnecessary to prosecute the work as vigorously as in the early part of the summer. At least two inspections were made in each building where leaks were found.

The results of the work done are shown by the following table of consumption, in which the reduction has been approximately apportioned between the work done in stopping leaks in mains and the work done in stopping leaks and waste in buildings:—

	Consumption in Manhattan and Bronx, million gallons per day		Estimated consumption assuming increase of 3 per cent. equivalent to rate of increase in population	Estimated reduction in consumption, million gallons daily		
Month	1910	1911	1911	By stopping underground leaks	By reducing leakage and waste in buildings	Total
January ..	335	334	345	4	7	11
February .	336	331	346	4	11	15
March....	327	327	339	6	4	10
April	326	320	336	6	10	16
May.....	326	310	336	8	18	26
June	329	286	339	9	44	53
July.....	342	287	352	9	56	65
August ..	336	275	346	9	62	71
September	335	277	345	10	58	68
October ..	332	278	342	11	53	64
November	321	271	331	11	49	60
December	333	283	343	11	49	60

Due attention was given to the measurement of flow in pipes and mains outside of buildings, to locate and stop leaks. As investigations made in 1910 had shown some large leaks, especially in mains laid under the East River, and as there was great likelihood of leaks along the river that discharged into it and therefore did not show on the surface, careful measurements were made of the flow of water in various parts of the city to locate these underground leaks, particular attention being given to the river front, and a special division for this class of work was formed, to which were assigned men who had experience in similar work in this and other cities. Broken mains were also found where the loss of water was very great. In one instance, where the broken main lay at the bottom of the East River, the loss amounted to over 3 million gallons per day.

The underground leakage stopped was about 10 million gallons daily, which, if valued at meter rates, would amount in a year to nearly $500,000, while the cost of this work, covering a period of about two years, was $19,000, or say $9,500 per year.

Results Obtained.—The average daily consumption of Manhattan and The Bronx was 331 million gallons in 1910, giving a per capita consumption of 120 gallons. On the basis of the consumption figures for 1910, assuming an increase of 3 per cent. annually due to increase in population, the average daily consumption would increase to 341 million gallons in 1911 and to 352 million gallons in 1912. By the work to check waste, however, the average consumption for the year 1911 was reduced to 298 million gallons daily, or 105 gallons per capita, but the actual reduction was really greater than shown by the above average, as the effect of the water waste work did not show great results until July, 1911, when the reduction reached 65 million gallons daily and was thus maintained on average up to January 1, 1912.

While there was a natural increase in the consumption for the year 1912, the average daily consumption was only 303 million gallons, corresponding to a per capita consumption of 104 gallons. The consumption for the month of December, 1912, averaged 297 million gallons daily, which is less than the average daily consumption for the year 1904. On the basis of the estimated consumption for 1911, 1912 and 1913 some 39,000 million gallons have been saved, which if valued at meter rates, $133 per million gallons, would amount to about $5,187,000, at a cost to the city of about $100,000, exclusive of the fines imposed for leaky fixtures during the time of house to house inspection. The per capita consumption has been reduced from 120 gallons, which was the average for these two boroughs in 1910, to 101 gallons, which is the per capita consumption for the first quarter of 1913.

Through the large reduction in waste effected in Brooklyn, it will be possible to meet all the demands of consumers in that borough up to the time of the introduction of the Catskill supply, without the construction of additional works, and also to furnish several million gallons daily for the supply of Queens, where water is now purchased from private companies.

In Manhattan and The Bronx the per capita consumption has been reduced to 100 gallons, which is lower than the average per capita consumption of every city in this country having a population of half a million or more.

The largest bridge ever exported from England and the largest but one ever built, having a total length of 5,325 feet, is being constructed for use in India.

The Canadian Engineer

ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Hamilton's Railway Problem 213
An Advance in Electrical Illumination 213
Revised Fire Regulations for Railways 214

Leading Articles:

Some Notes on Macadam Roads and Pavements 197
Action of Various Substances on Mortar 203
The Design of Central Heating Systems, II. .. 206
Water Waste Prevention in New York City... 211
Fineness of Cement and Rate of Hydration ... 215
Wood Block Pavements 217
Public Construction Contracts 222
Mechanical and Electrical Equipment of the Windsor Hotel, Montreal 223
The Robb Water Tube Boiler 224
Maintenance of Pure Water in Saskatchewan by Provincial Bureau 225

Coast to Coast 226
Personals 228
Coming Meetings 228
Railway Orders 75
Construction News 76
Market Conditions 92-94
Technical and Municipal Societies 94

HAMILTON'S RAILWAY PROBLEM.

The civic authorities in Hamilton have to deal with the opposition of the Toronto, Hamilton & Buffalo Railway in the matter of removing its line from the southern and residential section of the city to a more desirable strip along the bay front. The continual noise and smoke which has been associated with the Hunter Street station has developed an agitation which apparently will not subside without gaining its end. The city is desirous, furthermore, of concentrating all its railways, i.e., the G. T. R., the T., H. & B. (C.P.R.), and the proposed C.N.R. to a common route now used by the former along the water front.

The argument of the T., H. & B. is based upon the likelihood of the change being detrimental to its patronage. It appears that nearly 80 per cent. of the passenger traffic uses the Hunter St. station in preference to the Stewart St. station, while with the union station, which the authorities purpose building on a site near the latter, the patronage would probably be more equally distributed. In consideration of this, however, the city has offered the railway $1,000,000 to move, and City Engineer Macallum has located a proposed line which, in the matter of grades, excels the old route by such a margin as to be a handsome inducement to the railway to accept it.

It is claimed that the Hunter Street route has many disadvantages, from an engineering point of view. Among them the question of grades appears to be the most important, and being over one per cent., the grades have made a name for themselves as a disabling factor to continuous traffic by the stalling of many freights daily. The new route proposed by Mr. Macallum offers a grade of .64.

At any rate, the time has come for the elimination of level crossings, and if the railway authorities do not accept the city's proposal the depression of the tracks will likely ensue, although the company favors elevation, claiming an advantage in cost. It is likely that the Railway Board will shortly be presented with the case, and if it has not the authority to require the T., H. & B. to move, Parliament will likely be approached.

The city's request appears quite reasonable. It offers to indemnify the company for all reasonable loss, to provide a better grade and a route more suitable than the present one. In return the city desires to remove a railway line with its many inconveniences from its residential section, simultaneously eliminating a number of level crossings dangerous to life, detrimental to continuity of street traffic, and unsightly in the extreme.

AN ADVANCE IN ELECTRICAL ILLUMINATION.

Since the introduction of the incandescent lamp, over thirty years ago, the art of illumination has been as apt an example of meritorious study and its fruits as the world has had. From time to time during the interval from the great Edison discovery of the property of carbonized filament, up to the present, many additions of great utilitarian value have transformed the electric lamp from an experiment into a commodity upon which is dependent the health, comfort and general advance of civilization, and the commercial advantages of which alone have rendered possible an indeterminable production from accelerated industry.

Mr. J. S. Leese, a Manchester authority on illuminating engineering, was quoted in April 22nd issue of *The Canadian Engineer* concerning the use of metal filament and its economic value over carbon filament, together with the necessity of change in design and composition of globes and shades to offset the disadvantage of intense brilliancy and its effect upon the eye-sight, which had accompanied the newer filament, and which was considered serious in comparison with the softer light of carbon lamps.

The general displacement of the carbon lamp by that of metal filament has been further retarded to a considerable extent by items of first cost and short life. Its introduction, on the other hand, is due largely to the remarkably small amount of energy which it consumes. In this respect the argument in favor of the metal filament has been so potent as to overcome much pessimistic opinion created by the above-mentioned disadvantages.

The art of electrical illumination has now received an added stimulus in a report from the Schenectady laboratories of the General Electric Company to the effect that a type of tungsten lamp has been scientifically obtained that will consume less than one-half of the energy which the present lamp requires. This is obtained by enclosing the filament in an atmosphere of inert gas, such as nitrogen, the density of which is about the same as that of the surrounding air. It is claimed that the consumption of current in an ordinary tungsten lamp is thereby reduced to one-half watt per candle-power. The effect of this important attainment in the history of illumination is significant.

REVISED FIRE REGULATIONS FOR RAILWAYS.

An amendment to the Dominion Forest Reserves and Parks Act provides that "When a railway within a forest reserve is being constructed or operated by a company not under the jurisdiction of the Board of Railway Commissioners for Canada, the Minister of the Interior may require such company to establish and maintain an efficient and competent staff of fire rangers, equipped with such appliances for fighting fire or preventing fire from spreading as the said Minister deems proper, and to provide such rangers with proper and suitable equipment to enable them to move from place to place along the line of railway.

"The said Minister may require such company to maintain an efficient patrol of the line of railway and other lands in the vicinity thereof to which fire may spread, and, generally, may define the duties of such company, and of the said fire rangers, in respect thereof.

"For the purpose of fighting and extinguishing fire, the said fire rangers may follow fires which spread from the railway, to, over and upon any lands to which they may spread.

"The said Minister may require such company to make returns of the names of fire rangers in its employ in the performance of the said duties, and of the places or areas in which they are engaged."

The above amendment is similar to the provision in the Railway Act, applying to lines subject to the jurisdiction of the Railway Commission. In its last general order, dated July 4th, the Board enacted some important revisions respecting fire regulation. Among them the following differ most from corresponding sections of the old order dated May 22nd, 1912:—

"No employee of any railway company shall open the back dampers of the engine while running ahead, or the front dampers while running tender first, except when there is snow on the ground, and it is necessary to take such action in order to have engine steam properly."

"No such railway company shall permit fire, live coals, or ashes to be deposited upon its tracks or right-of-way, unless they are extinguished immediately thereafter, except in pits provided for the purpose."

"Every such railway company shall instruct and require its sectionmen and other employees, agents, and contractors to take measures to report and extinguish fires on or near the right-of-way as follows:—

"(1) Conductors, engineers, or trainmen who discover or receive notice of the existence and location of a fire burning upon or near the right-of-way, or of a fire which threatens land adjacent to the right-of-way, shall report the same by wire to the superintendent, and shall also report it to the agent or persons in charge at the next point at which there shall be communication by telegraph or telephone, and to the first section employees passed. Notice of such fire shall also be given immediately by a system of warning whistles.

"(2) It shall be the duty of the superintendent or agent or person so informed to notify immediately the nearest forest officer and the nearest section employees of the railway, of the existence and location of such fire.

"(3) The provisions of this section shall apply to all fires occurring within 300 feet of the railway track unless proof shall be furnished that such fires were not caused by the railway."

"Every such railway company shall give particular instructions to its employees in relation to the foregoing regulations and shall cause such instructions to be posted at all stations, terminals, and section houses along its lines of railway. In case said instructions are not also carried in employees' time tables during said prescribed period, or in 'operating' and 'maintenance of way' rule books, they shall, previous to April 1st of each year, be re-issued to all employees concerned, in the form of special instructions."

EDITORIAL COMMENT.

The council of the Canadian Society of Civil Engineers has appointed a committee to prepare a standard specification on reinforced concrete work. The following compose the committee: Mr. C. M. Morssen, Mr. Ernest Brown, Mr. P. B. Motley, Mr. Peter Gillespie, Mr. S. Baulne, Mr. E. S. Mattice, Mr. E. E. Brydone-Jack, Mr. H. M. MacKay, Dr. J. Galbraith, Mr. C. M. Monsarrat, Mr. H. Rolph, and Mr. Walter J. Frances, as chairman.

* * * *

The report of R. C. Harris, commissioner of works for the city of Toronto, relative to the extension of the waterworks system, and appearing in last week's issue of *The Canadian Engineer*, has been considered by the city council and adopted. A mechanical filtration plant to supplement the existing slow sand filtration plant will be established on Toronto Island. One million dollars have been set aside by the council for the installation, and it is understood that no time will be lost in getting the work under way.

FINENESS OF CEMENT AND RATE OF HYDRATION

IMPORTANT RELATION EXISTING BETWEEN THESE QUALITIES—RESEARCH SHOWS VALUE OF HYDRATION AS A TEST FOR FINE GRINDING—LIKELY TO SUPERSEDE THE SIEVE IN THE LABORATORY.

By HENRY S. SPACKMAN,

Consulting Engineer, Philadelphia.

HITHERTO uninvestigated field of research is brought to the attention of engineers in a paper read by Mr. Henry S. Spackman, at the recent convention of the American Society for Testing Materials, at Atlantic City. It brings out well the possibilities of developing a test more thoroughly indicative of the efficiency of grinding, than the present sieving test.

The tests forming the basis of this paper were undertaken in connection with membership in a special committee of the International Association for Testing Materials, to which was assigned the problem of developing a method for the determination of fine flour in cement. The members were advised that there was no pre-determined programme for the investigation, but that each member of the committee was left free to proceed independently to determine which of the two proposed methods, namely, the separation of the cement, either by air or by liquid, into portions, according to the size of the particles—would best serve the purpose, or to develop another method if he thought it desirable that both processes be abandoned and replaced by another more reliable or simple one.

It was decided, in view of the fact that the other members of the committee were studying the separation of fine particles by liquid or air, to investigate what relation if any, existed between fineness of grinding on the one hand, and the decrease in specific gravity and increase in combined or chemically fixed water in the set cement on the other. While it was realized that such a relation, if demonstrated, would give no definite information as to the various percentages of the different sized particles present, it was thought that if either the decrease in specific gravity or increase in water of combination was shown to have a sufficiently constant relation to the amount of cement present in a fine enough state of subdivision to take part in the chemical reactions of setting and hardening, the purpose for which the committee was appointed would be accomplished. It was also thought, in view of the known fact that the chemical composition and degree of burning, as well as fineness of grinding, are important factors in determining the activity of particles of cement of a given size, that the determination of the rate and extent of hydration would be a more correct index of the value of the cement than the mere determination of the percentages of particles of various sizes present, as the effect of chemical composition and burning, as well as of fine grinding, would be included in any conclusions drawn from the determination of the rate and extent of hydration, as evidenced either by the content of combined water or decrease in specific gravity.

While the following tests are in no way conclusive, and are confessedly open to criticism for lack of completeness and crudeness of the methods employed, they are sufficiently concordant to suggest, if not to prove, the existence of a more or less definite relation between the fineness of grinding on the one hand, and the decrease in specific gravity and increase in the content of water of combination of the hydrated cement on the other.

In order to ascertain in a general way the rate of hydration of a normal cement, a commercial sample which passed the Standard Specifications of this society was made into neat briquettes. These were stored 24 hours in moist air, then submerged in water. Briquettes were taken at the several periods indicated in Table I., ground, dried to a constant weight at a temperature of 100° to 110° C., and the specific gravity determined.

Table I.

	Specific Gravity
Cement before gaging	3.17
Gaged Cement:	
24 hr. in air	2.86
24 hr. in air, 24 hr. in water	2.78
24 hr. in air, 6 days in water	2.74
24 hr. in air, 13 days in water	2.63
24 hr. in air, 20 days in water	2.57
24 hr. in air, 27 days in water	2.57

These tests, as might be expected, showed upon first hardening a marked decrease in specific gravity and a gradual decrease as hydration proceeded, up to the 21-day period, after which no decrease in specific gravity was noted, indicating for this particular sample the practical completion of the initial hydration prior to the 21-day period.

In order to ascertain whether the maximum hydration took place when the cement was in the form of a mortar, a sample of the same cement was placed in a test tube with water and agitated for 28 days. This, when tested in the same manner, gave a specific gravity of 2.47 and a loss on ignition of 15.52 per cent., indicating probably the maximum hydration attainable at 28 days under ordinary temperature conditions.

In order to determine the effect of the size of grains on the rate of hydration, another cement having a specific gravity of 3.17 and loss on ignition of 1.70 per cent. was tested. Twenty-gram charges of the cement as received, of the portion of the cement passing the 100-mesh and retained on the 200-mesh sieve, and of the portion that passed the 200-mesh sieve, were placed in test tubes with 50 c.c. of water, and continuously agitated for a period of 24 hours, then dried to constant weight at 100° to 110° C., after which the specific gravity and loss on ignition were determined on the three samples. The results are given in Table II.

Table II.

Cement	Specific Gravity of Hydrated Cement	Loss on Ignition, per cent Before Hydration	Loss on Ignition, per cent After Hydration	Increased Loss by Hydration, per cent.
As received after hydration...	2.94	1.70	5.22	3.52
Passing the 100 and retained on the 200-mesh sieve	3.12	0.65	1.45	0.80
Passing the 200-mesh sieve...	2.84	1.95	6.17	4.22

In order to determine whether exposure to steam at atmospheric pressure would give at short periods hydra-

tion approximating that after a longer exposure in water, the same cement, in the condition it was received, the portion that passed the 200-mesh sieve, the portion passing the 100-mesh and retained on the 200-mesh sieve, and the cement after grinding in a laboratory ball mill for 1, 2 and 3 hours respectively, were made into neat mortar, allowed to stand in moist air for 24 hours, then subjected to steam at atmospheric pressure for 24 hours. The results obtained are given in Table III.

Table III.

Cement	Fineness, per cent passing sieves No. 100	No. 200	Specific Gravity of Hydrated Cement	Loss on Ignition, per cent. Before Hydration	After Hydration	Increased Loss by Hydration per cent.
As received.....	95.6	77.8	2.66	1.70	8.58	6.88
Ground 1 hr.....	99.8	91.0	2.60	1.70	9.41	7.71
Ground 2 hr.....	100.0	97.0	2.59	1.70	9.33	7.63
Ground 3 hr.....	100.0	99.0	2.58	1.70	10.93	9.23
Passing 100 and retained on the 200	100.0	00.0	3.03	0.65	1.60	0.95
Passing the 200 sieve	100.0	100.0	2.63	1.95	10.17	8.22

In order to determine whether subjecting the cement to the action of steam at high pressures and temperatures would show a further decrease in specific gravity and increase in water, of combination, another cement was made into briquettes. A part of these were subjected, after exposure, to moist air for 24 hours and to a steam pressure of 20 atmospheres in an autoclave for 2 hours. Table IV. shows the specific gravity, loss on ignition, and content of carbon dioxide and combined water, of briquettes exposed to moisture in the ordinary way and to high steam pressure in the autoclave.

Table IV.

Cement	Specific Gravity	Loss on Ignition, per cent.	Content of Carbon Dioxide, per cent.	Content of Combined Water, per cent.
Before hydration.....	3.16	0.50	0.40	0.10
Hydrated in moist air for 24 hr.	2.74	6.90	1.25	5.65
After hydration in air and exposed to steam pressure or 20 atmospheres for 2 hr.	2.63	9.60	1.35	8.25

In the absence of any known data showing the specific gravity of a completely hydrated cement, a sample of another brand of cement was taken as received, made into a slurry with 60 per cent. of water, placed in a laboratory ball mill, ground for 8 hours and allowed to stand over night. This cement, on examination next morning, was found to be partially set. Water to the amount of 60 per cent. of the original weight of the cement was added, grinding continued for 8 hours, and a sample taken for analysis. The cement was allowed to stand over night as before. The next morning, while not set, it was found to be too thick to allow of continuing the grinding; and a third addition of water to the amount of 60 per cent. of the original weight of the cement was added, making a total of 180 per cent. of water necessary to make the mixture sufficiently fluid to grind properly. Samples were taken at the expiration of the third day's grinding and at the expiration of the fifth day's grinding. After drying to constant weight at 100° to 110° C., the specific gravity of these samples was determined and analysis made for carbon dioxide and combined water. The results are given in Table V., and indicate a possible specific gravity of completely hydrated cement below 2.3 and a content of chemically combined water of above 15 per cent. It is doubtful whether so great a hydration ever occurs in practice, even after long exposure to water, altrhough the individual particles may have even lower specific gravity.

Table V.

Cement	Specific Gravity	Loss on Ignition, per cent.	Content of Carbon Dioxide, per cent.	Content of Combined Water, per cent.
Before hydration.....	3.12	1.50	1.20	0.30
After 2 days grinding....	2.27	15.50	2.60	12.90
After 3 days grinding....	2.27	16.90	2.50	14.40
After 5 days grinding....	2.27	18.05	2.50	15.85

While the above tests and others made in our laboratory show that a relation exists between fineness of grinding and the rate and extent of hydration of Portland cements, it remains to be determined whether this relation is sufficiently definite to admit of its forming a basis for the development of a test which will replace the use of sieves in the commercial laboratory.

We regret that we were unable to carry out our intention of repeating these tests a sufficient number of times to determine whether the phenomenon of hydration was sufficiently positive to prevent the results obtained being markedly affected by unavoidable variations in the conditions under which the test was made, and also to ascertain whether it was possible for different operators working on duplicate samples to check each other.

We had also hoped, by working on synthetic mixtures of cement containing known quantities of different sized particles, to develop whether any definite relation existed between the content of particles below a certain size and the extent of hydration; also to find an explanation for the anomaly shown by these tests, of the cement being able after hydration had proceeded to a certain point to fix additional water without a corresponding reduction in specific gravity being apparent; also to determine the changes in specific gravity and combined water of cement mortars during long periods of storage under water.

C.P.R. ELECTRIFICATION.

Following the announcement in *The Canadian Engineer* for July 3rd, of the intention of the Canadian Pacific Railway to electrify a section of its line in the Rocky Mountain division, comes a proposal to the city of St. Catharines, from one of the company's representatives, of an electric line from Hamilton to the Niagara River. The city is asked to contribute one-half of the cost of a railway bridge across the old Welland Canal. As an alternative proposition, the C.P.R. is willing to use a bridge jointly with the Canadian Northern Railway, which also intends to build through St. Catharines. In such a case the C.P.R. would pay one-third of the cost and expect the Canadian Northern and the city to bear similar proportions.

The city council looks favorably upon the proposition and will take up the new proposal with the Canadian Northern Railway, which has under consideration the building of a railway and vehicular bridge across the old canal, for which the city is asked to contribute $100,000 and grant a fixed assessment of property, the company to enter the city on a residential street, to which route there is considerable opposition.

The seventh annual convention of the National Society for the Promotion of Industrial Education will be held in the city of Grand Rapids, Mich., October 19-25th inclusive.

WOOD BLOCK PAVEMENTS.

Their Development in the United States, and Specifications Governing Their Use.

By Mr. Geo. W. Tillson,
Consulting Engineer, New York City.

THE earlier wood pavements, including the old cedar block pavements and the first surfacings in the use of chemically treated blocks, is discussed in a paper by Mr. Tillson presented at the Third International Road Congress, London, England. The paper is an excellent resumé of present practice, and contains a summary of the requirements of the specifications of the principal cities of the United States using wood block as a paving material. The following, relating to the construction of wood pavements with treated blocks, is extracted from his paper:—

The city of Indianapolis, Ind., was the first city to take up seriously the question of laying chemically treated wood block. This city in 1896 laid a few streets with blocks of red cedar from the State of Washington. The contract for this work provided that the blocks should be thoroughly dried in a vat at a temperature of 200° F. and then submerged in creosote oil heated to a temperature of over 200° F. and remain there for at least 6 hours. It was estimated that this treatment would amount to about 3 lbs. of oil per cubic foot. The blocks were laid at an angle of 45° with the curb, no provision being made for expansion, and the joints were filled with paving pitch. These streets gave a little trouble on account of bulging caused by swelling of the pavement in wet weather, but not to any great extent. These pavements are still in use and said to be in a splendid state of preservation. These streets were so satisfactory that a more elobarate treatment was undertaken subsequently, the blocks receiving a treatment of 10 lbs. of creosote oil per cubic foot, with certain specification requirements for the oil.

As a result of some investigation in the method of treating blocks there was devised a method which was known as the creo-resinate process. This consisted of impregnating the blocks with a mixture composed of one-half creosote and one-half resin, the early specifications having no requirement for the character of the oil; the idea being that as the creosote was a good preservative, if it could be kept in the blocks they would last until they were worn out, but if used by itself, being so volatile, it would evaporate and the blocks would decay long before they had become destroyed by traffic. The object of the creosote then was to preserve the blocks and of the resin to prevent the volatization of the oil. The first pavement of this character was laid on Tremont Street, Boston, opposite the Common, in 1900. This pavement in the latter part of 1912 was said to be in such good condition that it would probably remain intact for 10 years. In 1902 a sample pavement of one block was laid in Brooklyn, N.Y., with creo-resinate blocks, and later a general specification for same was adopted. This required that the wood should be long leaf yellow pine and that the blocks should be treated with a mixture composed of one-half creosote oil and the other half resin or some other suitable waterproofing material; no attempt was made to regulate the character of the oil. The blocks were to have such waterproof qualities that, after having been dried in an oven for 24 hours at a temperature of 100° F., they should not absorb more than 3 per cent. of water after having been immersed for 24 hours. It was also required that all blocks after treatment should sink in water. The object of requiring the immersion test was that the blocks should be so treated that they would be stable in size, not swelling in damp weather, and so, by bulging, causing deformation of the pavement, nor shrink to an undue extent in dry weather. The requirement that the blocks should sink in water was made because it was realized that it would be somewhat difficult to ascertain how much treatment was given to the blocks, the process being carried out some miles from the city, and it was thought that if they sank in water it would be proven that approximately 20 lbs. per cubic foot had been used or that the blocks were of such a character as not to require so much treatment. The blocks were laid on a ½-in. mortar bed formed of 1 part Portland cement and 4 parts sand, this mortar bed being spread on a substantial concrete foundation. The joints between the blocks were filled with fine dry sand, and the pavement was laid without expansion joints. Almost no trouble has occurred on city streets laid under these specifications on account of bulging.

It soon developed that if much of this class of pavement was used and the same amount of resin as of oil used that the cost of the treatment would be very large. Consequently in the borough of Manhattan, New York City, a specification was adopted by which only 25 per cent. of resin was required, but the specific gravity of the oil was fixed at 1.12. In the course of a few years the question arose as to the propriety of doing away entirely with the resin and using only creosote oil. A committee was appointed by the Board of Estimate and Apportionment of New York City, consisting of the pavement engineers of the different city boroughs, together with the chief engineer of the board and chief engineer of the Finance Department, to prepare a standard specification for wood block pavement. This committee investigated the matter carefully and adopted a specification omitting the resin entirely and having the following requirements for the treatment of the blocks:—

The blocks shall be so treated with an oil elsewhere described that the pine blocks shall contain not less than 20 and the gum blocks not less than 22 lbs. per cu. ft. After treatment the blocks are to show such waterproof qualities that after being dried in an oven at a temperature of 100° C. for a period of 24 hours, weighed and then immersed in clear water for a period of 24 hours and again weighed, the gain in weight is not to be more than 3½ per cent. for pine blocks and 4½ per cent. for gum blocks.

The oil with which the blocks are to be treated shall be a stable, antiseptic and waterproofing oil from which the water has been removed by distillation, and which shall have a specific gravity of not less than 1.12 at 38° C. When distilled in the manner hereinafter described, the oil shall lose not more than 35 per cent. up to a temperature of 315° C. The distillate between 255° C. to 315° C. shall have a specific gravity not less than 1.02, the said specific gravity being taken at a temperature of 60° C.

Some of the manufacturers who appeared before the committee argued in favor of the use of oil manufactured from water gas tar. The committee did not feel that there had been sufficient experience to warrant this, but was willing that a mixture of water gas tar oil and coal tar oil should be used; provided, however, that not more than 50 per cent. of water gas tar oil should be used. The requirement that the distillate between 255° C. and 315° C. should have a specific gravity not less than 1.02 at a temperature of 60° C. was made in order to maintain this limit.

The foregoing gives briefly the development of the specifications for creosoted paving blocks in the East. In other sections of the country the process was about the same, except possibly the provision in New York specifications allowing the mixing of oil from water gas tar with coal gas tar oil for the preservative; and it is extremely doubtful if this provision was ever taken advantage of in New York.

In considering requirements for specifications for wood pavements, there are several points that must be taken into account, some of which the municipal engineers are generally agreed upon and others upon which there is a wide difference. These points are: kind of wood to be used and the size of the blocks, the character of the preservative as well as the amount to be used, the cushion coat on which the blocks are to be laid, the filler for the joints, and the necessity for an expansion joint.

Kind of Wood.—The cost of lumber in the United States during the last few years has been so great that the first cost of the blocks is an important consideration, and while it is generally considered that long leaf yellow pine makes the most durable blocks, it is questionable if other varieties cannot be used either locally or on light traffic streets. The kinds of wood generally admitted by the different specifications are: Long leaf yellow pine, black gum, Norway pine and tamarack. It is probable, however, that if the work is to be done in the far West, some such wood as Oregon fir or Washington cedar could be substituted for these other materials with good results. As has been said, the long leaf yellow pine makes an extremely durable pavement, but it is produced only in one section of the country, so that transportation charges are high, and, when the traffic and local conditions will permit, it is desirable to use a cheaper material.

Some four or five years ago the United States Government laid as an experiment, on a street in Baltimore, a wood pavement made up of a great many different kinds of wood, all treated with 1.09 creosote oil, the idea being to ascertain the relative merits of these different kinds so that a selection of material could be made according to the traffic on any particular street or the availability of any material. The kinds of wood used were long leaf pine, Norway pine, tamarack, Douglas fir, Western larch, white birch and hemlock. The long leaf pine was used to serve as a standard of comparison. The conclusion reached after the examination of the pavement, four years after it had been laid, was that:—

The species used will be tentatively grouped in accordance with the results of this inspection in the order of their value for creosote oil-paving material as follows:

1. Long-leaf pine.
2. Norway pine, white birch, tamarack, eastern hemlock.
3. Western larch.
4. Douglas fir.

In the East, as a matter of fact, the long leaf yellow pine has been used almost entirely up to the present time, the principal exception being black gum. This, however, has not given entirely satisfactory results. The yellow pine, while particularly good as to wearing qualities, is, for that very reason, more slippery and from the formation of the wood liable to split, so that the blocks are often destroyed when taken up to permit of carrying on any underground work. It is probable, however, that on the whole it is the most satisfactory wood for general use.

In the West tamarack has been used slightly, with very satisfactory results.

Size of Blocks.—Not very much difference exists in the practice of the engineers on this point. The first blocks were generally 4 ins. in width, but the more recent practice has been to reduce this width to 3 ins. The permissible length is generally from 5 or 6 to 10 ins., this range in length being given so as not to increase the price by selecting lumber all of one particular width. A difference of $1 per M. ft. in the price of the lumber adds 4 cents per yard to the cost of the pavement. The depth should be governed by the traffic on the street, although, as the blocks are small, they must have sufficient depth to be stable, irrespective of traffic. The indications are from the present experience that the actual wear from traffic on hard pine blocks on an average street is very little, and that, so far as that is concerned, a block 3½ ins. deep would probably last for 20 or even 25 years. Its tendency to split, however, makes it advisable to use a greater depth if the funds will permit.

In this connection it might be said that a small bridge was paved in Brooklyn some years ago with wood blocks, laid upon an old wooden foundation that was extremely irregular and not solid enough to preserve the surface of the pavement under the traffic to which it was subjected. The blocks soon split into pieces averaging about 2 ins. square, but, on account of their not being disturbed, the pavement was very durable, lasting some three or four times longer than the surface which had been previously used.

Character and Amount of Preservative Used.—This is a point upon which there is a great divergence in the practice of different engineers. In determining it, however, it should be understood that the preservative has two functions, one to act as an antiseptic and so prevent the block from decay, and the other to act as a waterproofing material, so that the blocks may remain stable and not absorb water, causing expansion when wet, or allowing too much contraction in a dry spell and thus making the blocks loose. Although an oil of antiseptic properties is desirable, it is probable that if water could be kept entirely from the inside of the blocks there would be no decay. This, however, is an exceedingly difficult matter and probably impossible. It seems desirable that a preservative should be selected that in itself will be stable and remain in the blocks as long as possible, for on residence or light traffic streets the life of a wood pavement will be determined mainly by its ability to withstand decay and not the wear and tear of traffic.

The two main points at issue in the character of the preservative are its specific gravity and its origin. Some argue that the specific gravity of the oil should be approximately from 1.08 to 1.12, the so-called heavy oil, and others from 1.03 to 1.06, the so-called light oil; some also argue that the oil should be a distillate of coal tar, while others would admit oil manufactured from water gas tar. The experience of the past in treating wood demonstrates that an oil from coal tar does make a good preservative, and while the same results might be obtained from a water gas tar product, the experience with this material has not been such as would warrant engineers using it freely. The borough of Manhattan, New York City, is laying an experimental wood pavement, which, among other features, will have blocks laid with coal tar oil and water gas tar oil under similar conditions, both as to material and traffic, making an attempt to determine the relative merits of these two oils. The advocates of the heavy oil recognize that it is not absolutely a distillate oil, and so not similar to what is generally recog-

nized as creosote, but that its specific gravity is attained by combining distilled creosote oil of approximately 1.05 specific gravity with coal tar from which the water, light oils and excess of free carbon have been removed.

In the construction of wood pavements with creosote oil a certain amount of trouble has been caused by the exudation of the preservative upon the surface of the blocks soon after they have been laid, especially in hot weather, causing great inconvenience, particularly to foot passengers, as the surface is often covered with a thick, tarry substance which is exceedingly disagreeable. This exudation occurs when both the light and the heavy oils are used, although the advocates of light oil claim that it occurs much more frequently and to a greater extent with the heavy oils.

Quantity of Oil.—This is a point, too, upon which engineers differ, the quantities used for pine and similar blocks ranging from 14 or 15 lbs. up to as high as 20 lbs. per cubic foot. The quantity of oil used would undoubtedly make a material difference in the amount of exudation in hot weather, but this exudation does not continue for an extended length of time, and it can be taken care of by spreading sand over the pavement surface so as to absorb the exuded material. The action which causes it necessarily brings the material to the surface of the block, so that the pores at the surface must be thoroughly filled, and so cause the block to be as nearly waterproof as it possibly could be, giving after this excessive exudation has ceased a perfect surface so far as absorption of water is concerned. Experiments and experience are necessary in order to determine just what is the required amount of oil to be used. Its cost makes it an important factor in the cost of the pavement, so that it is important that no more should be used than is necessary. At the present time it is considered that on a heavy traffic street less oil can be used per cubic foot than on one of light traffic.

The early Brooklyn pavements referred to were all laid on a cushion coat of sand and Portland cement, mixed in proper proportions and with just enough water to allow the mortar to set. The blocks were rolled down to an even, smooth surface and not disturbed until the cushion coat was thoroughly hard. Recently a cushion of sand has been used in many instances, but the author believes that the mortar cushion gives the best results. It might be claimed that the pavement could be opened for traffic more quickly if a sand cushion were used than with one of mortar, but if traffic is kept completely from the pavement, the blocks can be laid before the foundation concrete has thoroughly set, so that the setting of the cushion coat and the concrete base can go on simultaneously.

Joint Filling.—The practice in this regard has been to use sand, cement and bituminous fillers. The advocates of the sand filler claim that if a fine dry sand is used the joints will be completely filled and that under traffic the surface of the street soon becomes practically homogeneous and that the sand in the joints will absorb a certain amount of the exudation of the preservative from the blocks and so make an absolutely waterproof joint. The advocates of the cement grout filler argue that it is necessary to use this material so that the joints will be absolutely full and remain full. The grout when used is generally made up of a mixture of 1 part of sand and 1 part of Portland cement, with enough water to flow freely into the joints. The opponents of this method argue that unless the pavement is kept free from traffic long enough to thoroughly set, which it is difficult to do, the bond of the mortar is broken, and even if not broken, it has not sufficient strength to resist traffic, so that in either event nothing better than a sand joint is obtained notwithstanding the increase in price. The advocates of the bituminous filler argue that if the joints are filled with coal tar or an asphaltic preparation, or some other similar substance, each joint is practically an expansion joint and that it will allow a certain expansion of the pavement as a whole without any bulging which with the same expansion would take place if a solid filler like sand or cement grout were used. The opponents argue that by the use of this filler, when the preservative exudes from the blocks, as it must to a certain extent, the bitumen in the joints simply adds to the nuisance which is caused by the exudation of the preservative on the surface of the street. In actual practice the sand and bituminous fillers are most generally used.

Expansion Joint.—Although the treatment of the blocks is supposed to prevent the absorption of water, causing expansion of the pavement, in practice it is impossible to have the blocks entirely waterproof, so a certain amount of expansion must take place. Provision for this is made by allowing a space along the curb, which is filled with some kind of bituminous material. For a roadway 30 ft. wide this expansion joint is generally from ¾ to 1 in. in width. No provision is made for taking care of longitudinal expansion, except in the city of St. Louis, although the pavement is continuous for a distance many times the width of the street. No more trouble seems to be caused by expansion in this direction than transversely. Some claim that the bulging is produced by the transverse expansion on account of the crown of the pavement, so that when the pressure is created the resistance to the lifting of the pavement is less than to the compression of the blocks and the result is that the pavement bulges along this line of least resistance. This theory might, to a certain extent, account for the lack of bulging by longitudinal expansion.

In the Brooklyn and Manhattan pavements no expansion joints are provided for, and as far as has been said, very little trouble has been caused by bulging when the material has been yellow pine and when the absorption test has been maintained. The result of this experience would seem to demonstrate that in the climate of New York City, at least, no expansion joint is necessary.

Specifications for Wood Block Pavement.—In the United States there are two organizations which have taken up in detail the matter of wood block specifications. Both are formed of city officials, and one is known as the American Society of Municipal Improvements, the other as the Organization for Standardizing Paving Specifications. This latter organization has had three meetings and has adopted specifications for wood pavements at each meeting; the American Society of Municipal Improvements has adopted specifications at one meeting only.

So that it may be known what the practice is of the engineers of the principal cities of the United States using wood pavements, the requirements of the specifications, as well as those of the two organizations, will be given on each of the general points previously discussed. In this statement the American Society of Municipal Improvements will be designated as "The Society" and the Organization for Standardizing Paving Specifications as "The Organization." It must be remembered that the specifications are constantly changing, but those here given represent the practice in 1912.

Kind of Wood.

The Organization.—Southern yellow pine, Norway pine, black gum, tamarack.

The Society.—Long leaf yellow pine, Norway pine or tamarack.

Borough of Manhattan, New York City.—Southern long leaf yellow pine.

Chicago.—Southern yellow pine and tamarack.

Cincinnati.—Southern yellow pine, Norway pine or tamarack.

Philadelphia.—The same as the organization.

Minneapolis.—Southern yellow pine, Norway pine, Washington fir or tamarack.

St. Louis.—Southern yellow pine.

Size of Blocks.

The Organization.—5 to 10 ins. long, to average 8 ins., 3 to 4 ins. in width, 4 ins. in depth, except on medium traffic and light traffic streets or alleys, where the depths can be reduced to 3½ and 3 ins., respectively.

The Society.—5 to 10 ins. long, to average 8 ins.; 3½ to 4 ins. in depth and width, according to traffic; light traffic streets, 3 ins. in depth.

Borough of Manhattan.—8 ins. long, 3 ins. in width, 4 ins. in depth.

Chicago.—5 to 10 ins. long, to average 6 ins.; 3¾ ins. in width, depth 4 ins., except in special cases.

Cincinnati.—6 to 10 ins. long, to average 8 ins.; 3 ins. in width, 3½ ins. in depth.

Philadelphia.—Same as the Organization.

Minneapolis.—5 to 10 ins. long, to average 8 ins.; 4 ins. in width, 3¼ or 4 ins. in depth.

St. Louis.—Not less than 6 ins. long, to average 8 ins.; 3 or 4 ins. in width, not less than 3½ ins. deep.

Character of Treatment.

The Organization.—Specification A: The preservative to be a product of coal gas, water gas, or coke oven tar, free from all adulterations contained in raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than stated; specific gravity not less than 1.10 nor more than 1.14 at a temperature of 38° C.

Specification B: Preservative to be a distillate of coal gas or coke oven tar, free from all adulterations, and contain no raw tar, filtered or unfiltered tars or pitches, petroleum compounds, or other tar products; specific gravity not less than 1.03 nor greater than 1.08 at 38° C.

The Society.—Oil to be a coal tar product, free from adulteration of any kind; specific gravity at least 1.10 at a temperature of 38° C.

Borough of Manhattan.—Oil to be a stable, antiseptic and waterproofing oil from which the water has been removed by distillation, and which shall have a specific gravity not less than 1.10 at 38° C. (Further description given in previous portion of this paper.)

Chicago.—Oil to be a distillate oil obtained only by distillation from coal tar; no other material of any kind to be mixed with it; specific gravity to be not less than 1.08 and not more than 1.12 at 25° C.

Cincinnati.—Oil A: The oil to be the best obtainable grade of coal tar creosote, a pure distillate of coal tar and free from admixtures of oils, tars or substitutes that are not pure coal tar; specific gravity to be at least 1.04 at a temperature of 38° C.

Oil B: The oil to be of a coal tar product, free from adulteration of any kind whatever; specific gravity to be at least 1.10 at a temperature of 38° C.

Philadelphia.—The same as The Organization.

Minneapolis.—Oil to be a pure heavy coal tar product only; specific gravity to be at least 1.10.

St. Louis.—The preservative to have a specific gravity of not more than 1.08 at a temperature of 38° C.

Amount of Treatment.

The Organization.—Pine and tamarack blocks to contain not less than 18 lbs., and gum blocks not less than 22 lbs. per cu. ft.

The Society.—20 lbs. per cu. ft.

Borough of Manhattan.—20 lbs. per cu. ft.

Chicago.—20 lbs., probably to be changed to 16 lbs. per cu. ft.

Cincinnati.—18 lbs. per cu. ft.

Philadelphia.—Same as The Organization.

Minneapolis.—No amount specified, but to be so treated as to be impervious to water and to prevent decay.

St. Louis.—16 lbs. per cu. ft.

Each specification contains requirements for the amount of the distillate at certain temperatures, but they do not vary much for the same kind of oil.

Cushion.

The Organization.—Cement mortar composed of 1 part of Portland cement and 4 parts of sand, not to exceed 1 in. in thickness; under special conditions mortar cushion to be omitted and a bituminous coating substituted therefor.

The Society.—Either a sand cushion 1 in. in thickness or mortar 1 in. in thickness made of 1 part of Portland cement and 3 parts of sand.

Borough of Manhattan.—1 in. of sand.

Chicago.—1 in. of sand, or ½ in. of mortar.

Cincinnati.—Either sand or mortar 1 in. in thickness made of 1 part of Portland cement and 3 parts of sand.

Philadelphia.—Mortar, 1 part Portland cement and 4 parts sand, not less than 1 in. thick.

Minneapolis.—1 in. of sand.

St. Louis.—1 in. of sand.

Joint Filler.

The Organization.—Suitable bitumen, or, when the blocks are laid upon a mortar or a bituminous cushion, sand.

The Society.—Sand.

Borough of Manhattan.—Sand.

Chicago.—Asphaltic pitch, cement grout, or sand.

Cincinnati.—Sand.

Philadelphia.—Sand.

Minneapolis.—Pitch.

St. Louis.—Sand.

Expansion Joints.

The Organization.—Not less than ¾ in. along the curb, filled with a suitable bituminous substance.

The Society.—¾ in. along the curb, filled with a suitable bituminous substance; on streets 50 ft. or more in width a second expansion joint similar to the other, separated from the first by a row of blocks; on heavy traffic streets, if deemed advisable by the engineer, expansion joints can be omitted.

Borough of Manhattan.—None.

Chicago.—1½ ins. along the curb, filled with a bituminous substance.

Cincinnati.—Similar to the Society's requirements.

Philadelphia.—¾ in. along the curb, filled with a bituminous substance.

Minneapolis.—1 in. along the curb, filled with pitch.

St. Louis.—1 in. along the curb and at intervals of about 100 ft. across the street at the direction of Street Commissioner, to be filled with a mixture of bituminous material and hard mineral dust.

Since the introduction of treated wood as a paving material it has increased in popularity very rapidly. It was seriously handicapped by the experience of the cities in the past, but, when the officials realized that by chemical treatment the wood would be preserved from decay, it soon came into general use. It has so many good qualities, the chief one being possibly its almost complete noiselessness, and its principal, and perhaps its only bad quality being its slipperiness, that property owners were quick to appreciate it despite its increase in cost over asphalt and other smooth pavements. The slipperiness of wood is experienced only when the surface of the pavement is frosty or damp, or when the grades are excessive. The former trouble exists only in a comparatively few days of the year, and can in a great measure be obviated by proper sanding; the latter can be prevented by judicious action in laying the pavement. The author's practice has been not to lay wood blocks on a continuous traffic street on grades of over 2 per cent.

In considering this question of slipperiness, however, it should be noted that Minneapolis, Minn., which has probably the largest amount of creosoted wood pavement in the country, reports that it has had no trouble whatever from slipperiness, and the city of Great Falls, Mont., also makes the same report. This is exceedingly interesting, when from other cities has come the most positive statements regarding the slippery properties of the pavement.

The popularity of wood as a paving material is illustrated by its present use. The city of New York alone awarded in 1912 contracts amounting to 320,000 sq. yds., while the amount laid in the United States previous to December 31, 1911, was 5,670,000 sq. yds., and it was estimated that from 2,000,000 to 2,500,000 sq. yds. would be laid in 1912. The cost of this pavement varies according to local conditions and specifications, but it averages from $3.25 to $3.50 per square yard, the blocks being 4 ins. deep, laid on a foundation of Portland cement concrete 6 ins. thick.

Repairs.—Very little information can be obtained of the cost of repairs to or maintenance of creosoted wood pavements, because these pavements have practically all been laid under a guarantee by which the contractor is obliged to keep them in repair for five years without extra cost, and also because, after the pavements are out of guarantee, although the repairs are made by the employees of the highways departments, still no exact record of costs has been kept in most cases. The pavement on Tremont Street, Boston, referred to earlier in this paper, has been in use 12 years and has cost absolutely nothing for repairs, and it is stated by the engineer in charge of the Boston pavements that the same is true of some other 14,000 sq. yds. which were laid at about the same time and in the same way. In the borough of Brooklyn, New York City, the first creosoted wood pavement was laid in 1902, without any guarantee, and has cost absolutely nothing for repairs. Pavements that were laid later and have been out of guarantee for 3 to 4 years, have been kept in repair by the borough and an accurate record kept of their cost. Some of the streets have cost absolutely nothing, and the average cost for the entire area out of guarantee has been 1 1/20 cents per yard per year. Many of these pavements, however, have been opened for subsurface work, and the engineer in charge of pavements states that in his opinion practically all of the repairs are due to settlements over trenches, and damage caused by fires, and not to actual wear and tear of traffic. The borough of Manhattan, New York City, has three streets which have been out of guarantee 3 years, one of heavy traffic, one of medium traffic and one of light traffic. The heavy traffic street has cost 7 cents per yard per year, while the average of all has been 6 cents per yard per year; but it should be explained here, as in the case of the Brooklyn streets, that the repairs have been due to wear and tear only on the heavy traffic street, which is a wholesale street in the business section. Repairs on the other streets are due to settlements over trenches, damage caused by fire, and practically nothing to wear and tear of traffic.

The city of Minneapolis, Minn., has 1,000,000 sq. yds. of wood block pavement, the first of which was laid in 1902. The greater part of the material is Norway pine and tamarack. The city engineer states that this pavement has required practically no repairs, the cost of same in 1911 being less than 1/10 cent per square yard. He also states that the street paved in 1902 is in good condition, and looks as if it might last for 10 years longer.

In St. Louis in 1909 repairs to 50,000 sq. yds. of wood pavement laid in 1903 cost $2.10, and in 1911 these same 50,000 sq. yds. cost less than 2/10 cent per yard, so that the total cost of repairing the 50,000 yds. of wood pavement the first nine years they were laid was 2/10 cent per yard. These pavements are all on light traffic streets.

Cleaning.—No definite information seems to be available as regards the relative cost of cleaning wood and asphalt pavements. In 1907, however, a commission was appointed by the mayor of the city of New York to investigate the entire matter of street cleaning. The following is quoted from the report of this commission:—

There is a very marked difference between the quantity of dust left upon the pavements of various kinds. Thus, if we call the average volume and weight collected from the sheet asphalt pavement 100, the relative quantities from other kinds of pavements were:

	Volume.	Weight.
From sheet asphalt	100	100
From block asphalt	130	182
From wood block (note)	332	145
From granite block	1,081	912

Note.—It should be said that the wood block pavement on which the examination was made is one of the oldest of its kind in the city, and its surface, being uneven, caught and held an unusual quantity of dust. Wood block pavement, when comparatively new, should compare favorably with asphalt block pavement in its freedom from dust retaining qualities.

After careful consideration of all the facts available, we estimate the average relative cost of cleaning, equally well, the various kinds of pavement in use in the city under similar conditions of repair, as follows:

Sheet asphalt pavement	100
Wood block pavement (new)	105
Asphalt block pavement	115
Brick pavement	120
Wood block pavement (old)	125
Medina block pavement	130
Granite block pavement	140
Belgium block pavement	150
Cobblestone pavement	3,000

On the assumption of 100 cleanings per year it may be shown that the annual cost of cleaning equally well a mile of each of the pavements named, over what it would be if sheet asphalt were substituted, would be as follows:

Wood block pavement (new)	$ 26.40
Asphalt block pavement (average condition)	79.20
Brick pavement	105.60
Wood block pavement (old)	132.60
Medina block pavement	158.40
Granite block pavement	211.20
Belgium block pavement	264.00
Cobblestone pavement	1,584.00

THE SITE OF THE MONTREAL FILTRATION PLANT.

THE board of engineers, consisting of Messrs. P. W. St. George, J. A. Jamieson and Frank A. Barbour, who were appointed by the City of Montreal at the joint request of the Board of Trade, the Canadian Manufacturers' Association and the Fire Underwriters' Association to enquire into and thoroughly examine the construction of the $5,000,000 filtration plant at Verdun, have submitted their report. In June 19th issue of *The Canadian Engineer*, the facts were given that led up to the appointment of this board. They consisted chiefly of a protest from the contractor, who alleged the site to be most unsuitable to support the heavy construction, and the design to be defective, predicting that further construction was unwise, considering the present condition. His statements were corroborated by a number of prominent engineers whose experiences with municipal installations bearing a close resemblance have been wide, and their opinions regarded authoritative.

The report, which has just been submitted to the city engineer, contains the following statements:—

Our investigation has included personal levelling by one of us to check benches and to determine the present elevation of structures, examination and measurements of the cracks and deformations now existing, studies of the design and of the very complete records prepared by the department engineers of the movements which have occurred, analyses of the soil and tests of the bearing capacity of the ground at various places under conditions, as nearly as possible, the same as those which will pertain when the plant is in operation.

The work has necessarily occupied a considerable period, largely because of the time required to move and set up apparatus, and to permit of observations of the settlement resulting from the loads imposed.

We find:—

(1) That the action of frost on the soil under foundations has been the cause, directly or indirectly, of all damage which has occurred.

(2) That settlement has not been a factor in causing damage up to the present time.

(3) That the design was good precedent, is adequate, and, if properly carried out, the resulting structure will be safe and well adapted to the intended purpose.

(4) That the soil has, and will have, under operating conditions, sufficient bearing capacity to support the loads to be imposed, and that such minor settlements as will occur, either on soil in natural position or on filled areas, will be, as shown by the tests made by us, well within the limit to which the structure may be subjected, without detrimental effect.

(5) That the design and method of construction of the arches is in accordance with good practice, and the superstructure of a type which does not require absolutely equalized foundation loads—this being indicated by the abuse which the superstructure has already withstood without serious final damage.

(6) That the walls, piers and superstructure which were raised, have now practically returned to original position, and except for some spalling of the masonry and the cracks in the division walls, will be, when the full load is on the roof, in practically as good condition as had no movement occurred.

(7) That in addition to the replacement of the damaged collectors, which has already been undertaken by the contractors, the important work necessary to return the structures to a condition practically equivalent to that which would have obtained if no movement by frost had occurred, includes the replacement or repairs of lifted floor slabs and collectors, the repairs of cracks in the division walls, gallery floor and conduit, and the replacement of the retaining wall back of the gallery walls.

(8) That the repairing, by forcing in cement grout under pressure, of structures which have been lifted from a good bearing on the soil, should, preferably, not be undertaken until after the full load to be imposed by the filling over the roof is on the supporting members, but that such grouting of space between masonry and the underlying soil should be completed before water is admitted to the filter units for any purpose.

(9) That since the raising of floors and collectors by frost has introduced abnormal conditions, it is essential that all vacant space be completely filled, or the lifted structures be replaced, and that the success of such filling of voids by grouting, as may be attempted, can only be proved by a test for leakage of the completed filter unit.

(10) That the fulfilment of such test of leakage may be accepted as proof that no damage affecting the working capacity of the filters has resulted from the movements occasioned by frost during the past winter.

We believe it necessary to recommend that, since the contract will not be completed this year, the contractor should be required to protect uncompleted work from the effects of low temperatures during the coming winter, in order to prevent a recurrence of the conditions of the past winter.

We have been greatly aided in our work by Mr. F. E. Field, resident engineer, and Mr. F. Y. Dorrance, principal assistant engineer, and by Mr. McLeod, contractor, who has co-operated in every way possible, and we desire to express our appreciation of the assistance rendered by these gentlemen, and to note the evident fairness of both these engineers and the contractor.

The structures which have already been placed by the contractor indicate good materials and workmanship, and an evident intention to fulfill the terms of the specifications, and we believe that by repair or replacement of those parts which have been damaged by frost, the work can be made entirely acceptable to the city.

The Board of Control will now decide whether the work should be continued by the contractor, or whether the city will undertake the work. Mr. McLeod has expressed his willingness to proceed with the construction, and during the six weeks in which the board of experts executed their careful investigation, he has been continuing the work on other sections of the plant.

MECHANICAL AND ELECTRICAL EQUIPMENT OF THE WINDSOR HOTEL, MONTREAL.

The power equipment for the new Windsor Hotel, designed and installed under the supervision of Mr. Kelsch, Consulting Engineer, is more complete than usual because of the problems to be met. The power plant, which is in charge of Mr. Winkworth, Chief Engineer of the Windsor Hotel Company, is one of the most up-to-date isolated power plants in Canada. The main object of the power plant is to furnish light and heat to the hotel and power for the various motors used in the laundry, for ventilating fans and in other parts of the hotel.

The steam equipment consists of three 200 H.P. Robb water tube boilers each with a heating surface of 2,143 square feet. Two of the boilers are set in a battery and one is installed singly. The boilers, which are built for 175 pounds working pressure, are equipped with Cotton blowers for burning anthracite screenings. This type of boiler consists of two horizontal cross drums with headers which are connected by a main bank of inclined tubes. The drums are connected by two rows of horizontal tubes which complete the path of circulation for the water. At the extreme top, superheating tubes connect the drums so that the steam which is separated in the front drum is thoroughly dried and slightly superheated when it enters the rear drum from which it is piped to the engines.

This boiler is distinguished from other water tube boilers by the large throat area where the front header joins the front drum giving a free and unrestricted passage for the large volume of water and steam passing from the main bank of inclined tubes into the drum. As the drums extend crosswise and the headers are as wide as the length of the drum, there is no contraction at the throat as is necessary in many types where longitudinal drums are used.

Great flexibility is another feature of this new boiler not only from the way it is placed in the setting on the supporting framework, but also because of the construction of the boiler itself. All the tube surfaces run in one direction and the plate surfaces in another, thus eliminating the strains caused in boilers where the longitudinal drums, headers, and tubes are connected rigidly together. A thoroughly modern design, this boiler has ample provision for cleaning, a handhole being placed in the header opposite each tube.

In the engine room of this power plant there are installed three Robb vertical compound engines which are run non-condensing. Each engine is direct-connected to a 150 k.w. electric generator made by the Canadian Westinghouse Company. These engines will operate the generators at 25 per cent. overload for two hours and 50 per cent. overload for one hour. With steam at 150 pounds pressure they will carry the normal load at a speed of 425 r.p.m. These engines are entirely enclosed so that working parts are protected from accident and there is no danger of oil being thrown about the engine room. Every revolving and sliding part is automatically lubricated by a system which consists of a pump and distributing pipes in which a pressure of from 10 to 20 pounds per square inch is maintained. Of the vertical type, these engines have many features which have been very successful in marine practice and modified for stationary practice enable the engines to maintain the speed desired for direct connection.

The electrical equipment had to take into account the fact that for some few years the hotel is under contract with the Montreal Light, Heat and Power Company for current, so that electrical machinery will be used only as a stand-by during this period. This situation called for especial skill in design because the Power Company operates with alternating current generators which means that the direct current switches of the hotel must remain open, except in the event of a shut down on the part of the Power Company. Should this happen the engines in the new power house will be started, the bus bars made alive therefrom and the circuit breakers and the switches on the feeders closed. Signal lamps indicate when the alternating current switches are closed and the direct current switches are open. These signals will enable the station operator to properly manipulate the switches so that the entire lighting system of the hotel will be transferred from the dead alternating current bus to the working direct current.

THE LOTSCHBERG TUNNEL.

The new Lotschberg Tunnel through the Alps was opened officially on June 20. The tunnel is the third longest in Europe, measuring over 9¼ miles, and the cost of the new line was over $17,000,000, the tunnel alone costing nearly $10,000,000. Electric traction will be used on the new route from Spiez to Domodossola, Italy. The weight of the locomotives is 112 tons, and they are fitted with two motors of 3,000 horsepower, weighing 27 tons each, the cost of construction being about $40,500, or twice that of an ordinary steam engine. The overhead or trolley system is employed, a current of 15,000 volts being carried. The locomotives are capable of pulling a train weighing 310 tons up the maximum grades of 27 per thousand at the rate of 31 miles an hour. According to the anticipations of the French press, the new railway will greatly increase the volume of trade between France and Italy, as it will bring the northern and more industrial part of France into direct communication with the peninsula. Italy lacks iron and articles made therefrom, and these have hitherto been imported through the St. Gothard Tunnel route from Germany, but the French iron works in the basin of Briey and Longwy may now be able to compete. At present the imports into Italy from Germany under this head amount to 237,000 tons annually, as compared with 17,000 tons from France.

A new Diesel oil-engine towboat of the Italian navy has a displacement of only 170 tons, but is equipped with a four-cylinder, two-cycle engine of 280 horse-power, running at 250 revolutions per minute. Compressed air at low pressure compared with that required for normal running is used for both starting and reversing. Only a few seconds are necessary for these operations, and a tank on board carries sufficient compressed air for starting or reversing sixty times.

A special bulletin has been issued by the University of Illinois Engineering Experiment Station, discussing the tests and methods employed in measuring deformations of steel and concrete in buildings. Extensive tests have been made on eight buildings in the last three years and they have shown the entire practicability of measuring deformations, or strains in critical parts of a reinforced concrete structure under load. As a direct result of the tests one company has modified its design of the floor slab adjacent to the column cap.

THE ROBB WATER TUBE BOILER.

A description of a water tube boiler that makes any pretensions to completeness would require much space, and would be uninteresting reading. Many of the details of boilers are common to practically all the makes of the water tube type. For this reason it will be only necessary to point out the difference between the Robb water tube boiler and others and explain the reasons for the improved constructions.

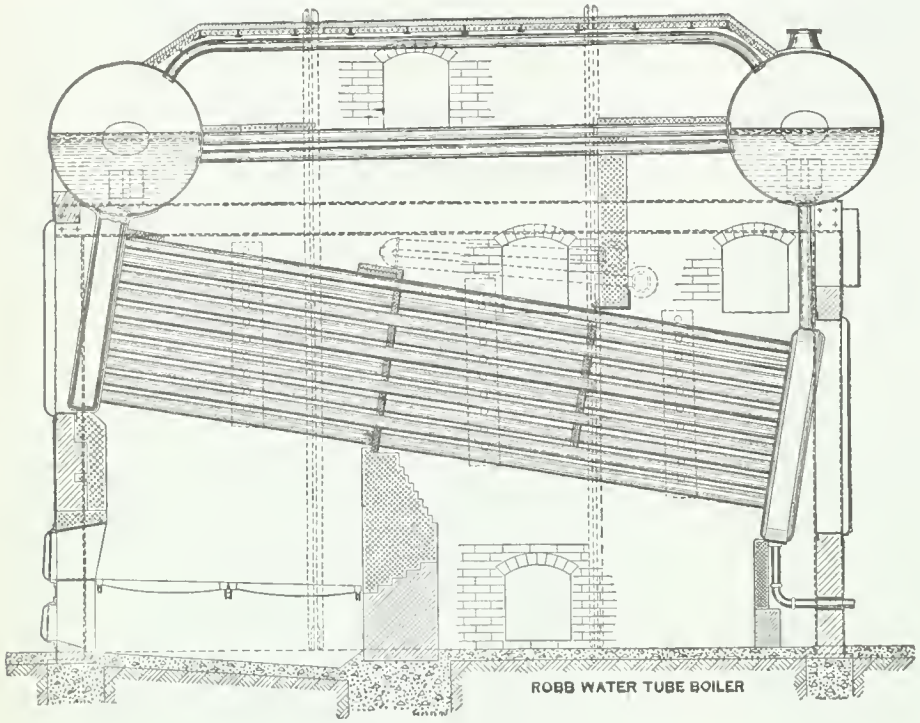


Fig. 1—Section of Robb Water Tube Boiler.

Probably the most distinctive feature of the Robb water tube boiler is the arrangement of parts to give really good circulation. This is accomplished by using two horizontal cross drums and headers, and arranging the connection between the front header and the front drum so that there is an abundantly large passage for the mixture of water and steam as it rises from the tubes just over the hottest part of the fire.

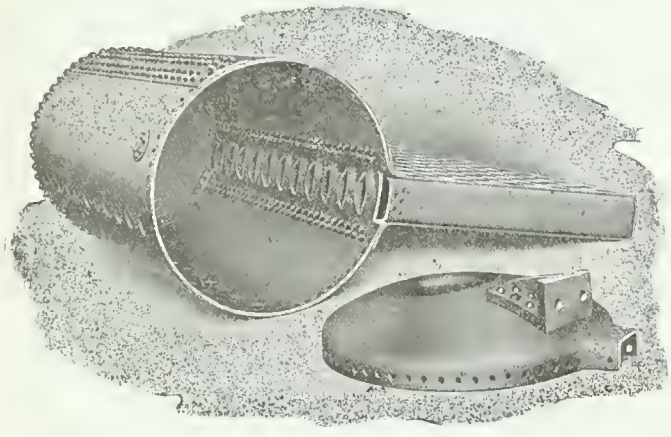


Fig. 2—Showing Construction of Front Drum.

With this construction it is not necessary that the mixture of steam and water pass through a small passage or a single tube for it has the large area provided by the header which extends the entire length of the front drum. By means of a patented throat connection this large passage is obtained without weakening the shell of the drum.

The circuit of the water is completed by connecting the two drums with a double row of horizontal tubes at the water line and by joining the rear header to the rear drum by a row of vertical tubes. This row of vertical tubes at the rear has abundant area for the passage of the water for at this point the water only must be provided for, whereas, at the front of the boiler a larger volume, a mixture of steam and water, must be taken care of.

Flexibility is another feature which has received much attention in the design of this boiler. Flexibility is closely allied to expansion and contraction. In order that such strains may be an absolute minimum in the above type of boiler, all the tube surfaces run in one direction and all the plate surfaces in another, thus avoiding the disastrous results often experienced from unequal expansion and contraction between thin tubes and thick drum plates when both run lengthwise and are connected rigidly.

The boiler is carried on a steel framework entirely independent of the brickwork. The front drum is the only part that is fixed in position. The rear drum is supported by brackets resting on rolls and the rear header is suspended by the long vertical tubes which connect the rear header and the rear drum. It is, therefore, free to swing back and forth and take care of the expansion and contraction of the main bank of tubes.

Dry steam is assured at all times, because the steam is not taken from the same drum in which it is separated from the water. The mixture of water and steam in this type of boiler enters the front drum, the steam separating out passing through the superheating tubes at the extreme top to the rear drum from which it is taken to the steam mains. The water which separates from the mixture flows to the rear drum through the horizontal tubes and mixes with the cooler entering feed water.

One other point is worthy of notice; that is, the arrangement for cleaning the inside of the tubes. The water

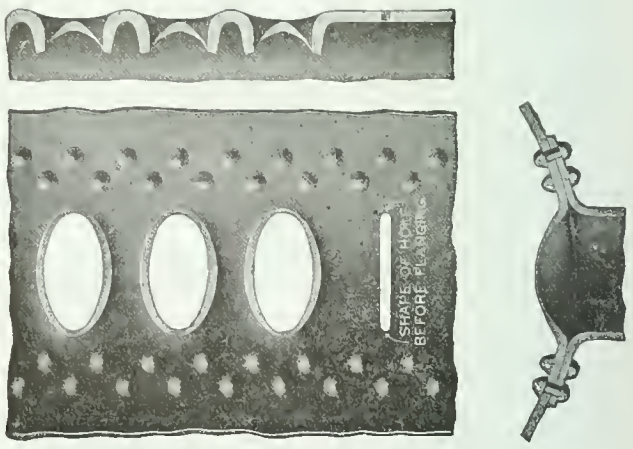


Fig. 3—Showing Throat Connection to Front Drum.

tubes are absolutely straight, as water tubes should always be, and to clean them it is only necessary to remove the front hand-hole plate opposite a tube, insert a scraper and push the sediment back into the rear header from which it drops into the mud chamber at the bottom. The hand-hole plates are oval and there is one opposite each tube. This greatly

increases the convenience in cleaning over those boilers having round hand-hole plates, which require that they be worked hand-over-hand amongst the stay bolts.

In all respects the new Robb water tube boiler, which is made by the International Engineering Works, Ltd., fulfils the requirements of the rules formulated by inspection and insurance companies and government officials. Although rated at 10 square feet of heating surface per boiler H.P., they have proved under severe tests to have a capacity 50 to 100 per cent. over rating without injury.

AMERICAN ROAD CONGRESS IN DETROIT.

How to systematize the purchase of road equipment and materials will be explained in a paper to be read by Henry G. Shirley, chief engineer of the Maryland State Roads Commission, at the American Road Congress which will be in session during the week of September 29 at Detroit, Michigan. This paper deals with one of the many important subjects to be treated by experienced engineers, public officials and road contractors at the big meeting. On account of the fact that the Maryland Commission has been working out the problems of good road administration in a most painstaking and thorough manner, Mr. Shirley's paper should be a most welcome contribution.

Col. E. A. Stevens, state highway commissioner of New Jersey, will have a paper at the Congress on treatment which he has found most effective for worn out or raveled macadam surfaces. New Jersey was the first State to adopt the State aid plan for road construction and consequently had a large mileage of water bound macadam roads prior to the advent of the motor vehicle. The problem of the State highway department has therefore been particularly along the lines of adopting the old roads to new traffic conditions.

The merit system in road administration will be aptly presented in an address by President John A. McIlhenny of the United States Civil Service Commission and will undoubtedly attract nation wide attention as it is a notorious fact that political favoritism and indifference characterize the administration of our public roads so generally as to cause a loss estimated by some experts as high as $40,000,000 a year. No more serious drawback to the progress of road improvement exists than the incompetent management of the roads and it is hoped that Mr. McIlhenny's address will help in securing much-needed reforms.

Other addresses and papers will be given by Capt. P. St. J. Wilson, State Highway Commissioner of Virginia; W. S. Keller, State Highway Engineer of Alabama; A. R. Hirst, State Highway Engineer of Wisconsin; Frank F. Rogers, State Highway Commissioner of Michigan; and many others prominent in the practical field of road construction and maintenance.

The Congress is held under the presidency of Logan Waller Page, director of the United States Office of Public Roads and comprises the conventions of the American Highway Association, the American Automobile Association, the Michigan State Good Roads Association, a large session under the auspices of a committee from the American Bar Association and other special sessions held under the auspices of the leading organizations identified with the road movement. The attendance at the first congress held in Richmond, Virginia, 1911 was 1,200; at the second congress held at Atlantic City in 1912, 2,000. This year the ratio of increase will be supplemented by an attendance of at least 2,000 at the State Good Roads Association, so that the management conservatively estimates the attendance this year will be over 5,000 delegates and members.

The National Association of Road Material and Machinery Manufacturers will be represented by a great commercial exhibit of road machinery and materials and arrangements have already been made for an exhibit of the remarkable collection of road models owned by the United States Office of Public Roads and for interesting exhibits by many of the States, cities and educational institutions.

MAINTENANCE OF PURE WATER IN SASKATCHEWAN BY PROVINCIAL BUREAU OF HEALTH.

As the present excessive death rate from typhoid fever in Canada is admittedly due to neglect in protecting surface waters from pollution, it may be interesting to record what measures are being adopted by the Saskatchewan government, through the Bureau of Public Health, towards the conservation of the purity of provincial waterways.

The Bureau of Health has continued to impress on all municipalities the grave lesson to be learned from the lack of foresight of older communities, and the towns and cities have been quick to realize that a system of sewerage is not a convenience but a sanitary necessity, and that the very object aimed at in its installation, namely, the protection of the public health, may be defeated if some efficient treatment is not provided to render the effluent incapable of supporting the germs of disease.

As a result of this policy, there are at present eight sewage disposal plants in operation in Saskatchewan. In seven of these installations, the sewage is treated by biological filtration, in addition to sedimentation, and a filter is being added to the remaining plant this year. Further, plans for ten additional sewage disposal installations for various towns have been submitted to the Bureau, and these works should be in commission before the end of the year.

This means that at the close of the present year the sewage from all the cities and thirteen towns in the province, representing about one-third of the total population, will be rendered practically harmless before being discharged into the water courses. When it is considered that in 1912 there were only five sewage disposal plants in operation, capable of treating sewage from a population of 16,500, it must be evident that municipalities are co-operating with the Bureau of Health in the improvement of the condition of provincial waterways.

Systematic supervision and inspection is made of the existing sewage disposal works by the engineering officials of the Bureau, and suggestions offered, which are calculated to give a higher standard of efficiency in each new installation. The Bureau of health has, up to the present, concentrated its efforts in the prevention of stream pollution by municipalities, but now that the towns and villages are alive to the consequences of neglect in matters of sewage treatment, it is the intention of the officials to direct their energies towards the large section of the population who, individually rather than collectively, contaminate surface water supplies. There are numerous settlements, camps and villages along the streams and creeks, which have no system of disposing of their sewage, but simply use the nearest watercourse as a common sewer. Such streams being subject to direct pollution from fecal matter entering the water from isolated houses or camps, are capable of carrying disease through the large areas of the province which they traverse, and is largely responsible for the outbreaks of typhoid which have occurred in the province. The possibility of some such direct pollution being present in a river, which is supplying unfiltered water to one

of the larger towns, is only one instance of the viligant guard which must be kept over the streams. With this in view, the Bureau of Health is about to commence a thorough and exhaustive inspection of the various watercourses throughout the province.

If immunity from typhoid is to be aimed at in Saskatchewan, all possible sources of domestic water supply must be under constant supervision, and this can only be accomplished by making a systematic survey of the entire province.

There are two periods in the history common to all rivers which serve as a source of water supply for the populated districts through which they flow. First, that of gradually increasing pollution from domestic sewage and trade wastes, which, unnoticed, continues to render the water dangerous, until a severe outbreak of typhoid fever is reported at some point down stream, involving the loss of perhaps scores of lives. Then follows a period of investigation into the source of contamination, and legislation to prohibit further pollution of the river in question. This history has repeated itself in practically every civilized country, and at the present time a bill is receiving its second reading at Ottawa, the object of which is to prohibit further pollution of Dominion waterways. A special committee has been elected to report on the subject. Further, the Commission on Conservation is making careful inquiry into the question of stream pollution, and inviting the provincial authorities to co-operate in safeguarding the public health. A third commission is seeking to solve the problem from an international standpoint.

It is to be regretted that several outbreaks of typhoid fever, accompanied by many deaths, should have been necessary to awaken general interest in the increasing pollution of our rivers and streams. Generally speaking, it is an accepted fact that the typhoid death rate of any country may be taken as the index for the condition of its streams and rivers.

The average death rates from typhoid fever in Norway, Sweden, Holland, Germany, Switzerland and Great Britain vary from 6.2 to 12.8 per 100,000 of the population. In Canada the typhoid death rate is 35.5. Unfortunately, the province of Saskatchewan has contributed in a large measure to this high death rate for the Dominion. Within recent years outbreaks of typhoid fever have occurred at Moose Jaw, Saskatoon and Prince Albert. The number of cases in Regina has never been so great as in the other cities. This fact is significant when it is considered that Regina receives its water supply from underground sources.

Conditions have greatly improved within the last few years, however, and the death rate from typhoid fever in the province should show a marked decrease this year. Saskatoon and Prince Albert have both installed efficient filtration plants, and Moose Jaw has abandoned a surface supply in favor of water from springs at Caron, the construction and plant of whose system was dealt with in *The Canadian Engineer* for March 6th, 1913.

A NEW ROAD MATERIAL.

With a view of obtaining a road surface which will give a better resistance to automobile traffic, experiments are being made again in France with a road-bed material consisting of a mixture of "iron straw," or iron in the shape of a wiry or fibrous mass, together with cement mortar and sand. Such material is called "ferro-cement," and it appears from tests that it is giving good results. The iron is specially prepared by suitable machines, and it is claimed that the resulting material is not over-expensive.

COAST TO COAST.

Regina, Sask.—The parks and playgrounds committee of the Town Planning Association are endeavoring to have more playgrounds established in the city, with the required equipment. The city of Regina has already spent thousands of dollars on this work.

Ottawa, Ont.—Preparations are being made to commence immediately the extension of the refinery at the Dominion Mint. A vote of $40,000 for that purpose was passed last session, as the refining of Canadian gold has gradually increased, and made necessary an extension of the present refinery. Last year the amount of Canadian gold was $1,168,823. Government architects will have charge of the work.

Toronto, Ont.—The proposal to use the Niagara River from Lake Ontario to a point near Queenston in connection with a new Welland Canal, which would be built from that point to a Lake Erie outlet, was presented before the Toronto Harbor Board recently by Ald. L. Pitt, of Niagara Falls, Ont., who is behind the project. Should this plan be adopted it is claimed that about $30,000,000 would be saved over the cost of the new Welland Canal proposed by the Government. Ald. Pitt, after showing the plans to the harbor board, stated that it was his intention to at once lay the question before Hon. Frank Cochrane, Minister of Railways and Canals.

Ottawa, Ont.—The Department of Public Works is investigating the utility of railway marine docks. Mr. Arthur St. Laurent, Assistant Deputy Minister of Public Works, has returned from Boston, where he inspected the Crandall engineering works, makers of this style of docks. For vessels or steamers up to 10,000 tons they are well suited, the ship entering a cradle and being quickly drawn up high and dry by an engine. The average cost is about $60,000, and as many as four vessels can be accommodated at once. Mr. St. Laurent was favorably impressed, and will recommend the railway docks for places where it is not desirable to go to the heavy expense of a graving or floating dock.

Ottawa, Ont.—Either the increase in population of the city, consequently causing an increased demand, or the percentage of waste has abnormally increased, is the reason for the high average of the water consumption reached this year. Acting Waterworks Engineer Wm. Storrie has reported to the waterworks committee that the average daily consumption last year was 17.7 million gallons daily, while so far the average this year has touched 18.6 million gallons per day. The figures this year for maximum million gallons daily are: January, 19.6; February, 19.7; March, 20.2; April, 19.1; May, 19.4; June, 20.0; July, to date, 21.5. The work on the pitometer survey for the detection of wastes is going ahead satisfactorily, and a number of small leaks have been detected and quickly repaired.

Vancouver, B.C.—Advertisements calling for tenders for the new dock to be built at Vancouver by the Dominion Government have been sent out and plans and specifications are being mailed to this city. Information to this effect was received recently by Mr. H. H. Stevens, M.P., in a telegram from Mr. J. B. Hunter, Deputy Minister of Public Works, Ottawa. The Government wharf will be located at the foot of Salsbury Drive, and will cost about $750,000. Construction work will probably start about the middle of next month, and the work is expected to take twelve months. The dock will be approximately 1,000 feet in length and 300 feet wide, with three railway tracks in the centre and concrete retaining walls on each side. The lowest depth of water at the land end of the dock will be thirty-five feet, thus enabling vessels of large draft to berth at all stages of the tide. A large

number of tenders are expected to be submitted, as the contracts are open to the world.

Windsor, Ont.—"Think of how few persons in the United States will be benefited by the Panama Canal, on which we are spending $420,000,000, and then consider the great benefits to be derived by the hundreds of thousands of people clean across the country from the Lincoln Highway, stretching from the Atlantic to the Pacific," said E. P. Brinegar, secretary of the Argonaut Trail Committee, of San Francisco, in Detroit recently. The Argonaut Trail Committee is the dynamic California force in the western movement that is aiding the ocean-to-ocean project as a memorial to Abraham Lincoln, and fostered by the Lincoln Highway Association. "The Panama Canal, for which every citizen must pay his share of the cost, will bring untold benefits to England and Europe, enabling commercial interests there to gain easy access to the Orient," Mr. Brinegar continued. "It will make it easy for Atlantic coast shippers to reach the Pacific coast, and vice versa. But will it help the people of Michigan, Ohio, Indiana, Iowa or any point in the middle or far west? Yet the Lincoln Highway, of which our own Argonaut Trail, we hope, will be a part, will pass the front door of uncounted multitudes of people, and will be perpetually at their service. An ocean-to-ocean road built for endurance is a national need. There are men in Nevada and in other States to-day who must haul water fifty miles over rough and burning trails. And in States far more opened to civilization the need is equally great."

Vancouver, B.C.—Many roads about Greater Vancouver are being opened, cleared and graded and put in shape for traffic by the Provincial Government, under the supervision of Provincial Road Superintendent, Mr. E. McBride. The Provincial Government has appropriated $25,000 to the municipality of West Vancouver for the improving of Marine Drive within its boundaries. To connect with the improved thoroughfare in the new municipality the Government is having Robson Road, from the west boundary of the city of North Vancouver to Capilano Creek, cleared and graded and put in good condition for all kinds of vehicular traffic. When all the roads on the north shore now in course of repair and improvement are finished, Road Superintendent McBride says that the districts on the north shore of the inlet will have excellent highways; in fact, nowhere in the province will there be better roads, and the scenery along the whole route from the North Arm to Howe Sound will be an attraction to tourists and others. Mr. McBride has charge of all road work in the Westminster district as far up the coast as Pender Harbor. In the district bordering this arm of the gulf much work is also being done by the Government in improving the roads. Mr. McBride in his periodical trips of inspection superintends all construction work. In numbers of cases after the roads have been cleared and graded the municipalities macadamize the surface and in other ways treat the portion of the roads which are most used for traffic.

Ottawa, Ont.—The Government is reported to be about to appoint a water power commission to be known as the St. Lawrence and Great Lakes Commission, for the purpose of studying the whole question of water power development from the head of the Great Lakes to Montreal. The probable members of the commission are given as: Professor McLeod, McGill University; Mr. Arthur Surveyer, Montreal; and Mr. C. R. Coutlee, of the Public Works engineering staff. It is expected the St. Lawrence and Great Lakes Commission will be engaged upon its task for several years to come. This work may result in the establishment of a permanent bureau dealing with water power questions to which the Government can go for reference. The Canadian section of the International Waterways Commission will have the use of the reports of the new commission.

Vancouver, B.C.—On a general inspection trip of Western lines of the Canadian Pacific Railway system, Mr. J. G. Sullivan, chief engineer for Western lines, arrived in the city recently. The question of utilizing oil as fuel instead of coal, as at present used on locomotives on the Cascade division of the Canadian Pacific Railway main line between Vancouver and North Bend, is one of the principal subjects to be taken up by the chief engineer with local traffic officials. Oil is used as fuel on other sections of the line in British Columbia, and an extension of the use has been planned in accordance with the general policy of increasing the efficiency of the service. Tanks for the fuel have been located at Port Moody, and the idea was mooted some time ago of having the oil piped to Coquitlam, where the Canadian Pacific Railway shops are now established. Mr. F. F. Busteed, engineer in charge of the double-track operations in British Columbia, accompanied Mr. Sullivan to the city from Kamloops, and will take up a number of questions with him before he leaves again for the East. Mr. F. W. Peters, general superintendent for the British Columbia division, and Mr. H. Rindal, district engineer, will accompany Mr. Sullivan on his inspection trip of the main line and branches in this Province next week. The various terminal improvement schemes, in the way of new docks, bridges and new depot, which are now being actively prosecuted by the Canadian Pacific Railway in Vancouver, will be inspected by the chief engineer, and he will also discuss the gigantic tunnel scheme in the vicinity of Rogers Pass with local officials.

Victoria, B.C.—Just what shall be done towards putting an end to harbor pollution, a subject on which there has been of late numerous suggestions made to the city council, is a question which has been under investigation by the health officials of the city. City Sanitary Inspector Lancaster has, as a result of his investigations, reported to the medical health officer to the effect that the chief source of trouble is from sewerage effluent from various vessels berthing at the wharves, and for this he can suggest no remedy. Another serious phase of the question is the dumping into the harbor, from vessels, of garbage, kitchen refuse, boxes ,etc., This can be remedied if those in charge of the vessels would insist that the rubbish now regularly deposited in the harbor be retained until the ships are well at sea. What can be done relative to the obnoxious odors which arise when the tide is out is another matter to be dealt with. The disagreeable odor arising from the mud flats below the Causeway during low water can apparently only be obviated by the dredging out of these banks so that at low water there will still be water over the mud. Whether the retaining walls now there would be affected if the present flats were dredged is a question which would have to be investigated. Either dredging would have to be resorted to or a smaller and lighter wall built some distance from the present walls and the space between filled in. Medical Health Officer Hall will shortly have a report before the city council going into the whole matter, and will make certain recommendations for the council's consideration.

Ottawa, Ont.—Experiments are to be made by Controller Nelson and Engineer Currie in the use of tarvia and oil on roads instead of water sprinkling. While the work this year will not be carried on in an extensive scale, it will form the basis of a report for next year's city council. It is estimated that the macadam and ordinary dirt streets can be treated with tarvia or oil for about ten thousand dollars more than the street sprinkling costs this year. The advantage of the extra expenditure will be more satisfactory work, and in addition it is claimed the oil and tarvia will pay the extra cost in added life of the roadway and lessened repairs. So far, tarvia, oil and similar substances have not been used to any extent by any city on asphalt pavements, and it is not proposed to experiment with them here. Water would

still be used, but instead of the present sprinkling carts, up-to-date flush tanks are proposed. Controller Nelson intends to shortly visit Detroit and Rochester to inspect the kind of streets they have there and the methods of treating them.

Montreal, Que.—Councillor W. G. M. Shepherd, of Westmount, has returned from an extensive road tour of New York and the New England States, in which he was the guest of Lorne Webster. Mr. Johnson, of the Department of Marine and Fisheries, accompanied the party. "American roads certainly show a vast improvement on Canadian ones," stated Mr. Shepherd. "Our trip, which was from Ogdensburg to Kennebunk Beach, Me., included an itinerary of nearly five hundred miles; and the worst part of all this stretch was much better than the majority of the roads around Montreal. In my opinion we are losing thousands of dollars every year in American tourists alone by our lack of automobile roads fit to run a car over. The fact that the highways bill lost out in the Senate should not prevent the Provincial Government from building a highway, say, from Montreal to Quebec. Nothing would advertise our province so well."

Toronto, Ont.—"United States Government aid will mean railroad construction to the extent of upward of one thousand miles," declares Falcon Josleyn, of Fairbanks, in a hearing on the Alaska Railroad bill before the house committee at Washington on territories. The Canadian Government is building the Grand Trunk Pacific across the continent to the Pacific Ocean through a country not nearly so productive or rich as Alaska for a distance of more than three thousand miles, and we are here to ask Congress to authorize the construction of only a little more than seven hundred miles of road. Our territory needs railroads for development of its natural resources, and we ask favorable action on our bill." Mr. Josleyn gave the committee detailed information about mineral and agricultural resources of Alaska, and also some information about the poor transportation facilities. The committee appeared impressed with his testimony, and questions asked indicated a disposition to help railroad construction in the territory.

PERSONAL.

Mr. E. J. WHITTAKER, of Seaforth, Ont., has received an appointment to the palœontological staff in the geological surveys branch of the Department of Mines, Ottawa.

Mr. T. BROCKMAN, landscape architect, of Berlin, presented an address on the subject of "Town Planning" to a recent meeting of the Regina Engineering Society.

Hon. FRANK COCHRANE, Minister of Railways and Canals, is on a tour of inspection of the Trent Canal. He is accompanied by W. A. BOWDEN, B.A.Sc., chief engineer for the department.

Professor S. A. MITCHELL has been appointed director of the Leander McCormick Observatory at the University of Virginia. Graduating from Queen's University in 1894, he secured a gold medal in chemistry for his spectacular attainments in research work. He has for some years held a professorship in Columbia University, New York.

Mr. C. W. GENNET, Jr., has assumed the duties of treasurer and manager of the Messrs. Robert W. Hunt & Company, Limited, at their principal office in the McGill Building, Montreal. Mr. Gennet has heretofore been in charge of the parent company's bureau of inspection of rails and fastenings at the home office in Chicago.

ARTHUR H. BLANCHARD, M. Can. Soc. C.E., Professor of Highway Engineering in Columbia University, has returned from Europe, where he attended the London Congress of the Permanent International Association of Road Congresses as a delegate from the State of New York and several societies. After the adjournment of the Congress Professor Blanchard made an investigation of various pavements and roads in England, France and Germany.

OBITUARY.

Mr. J. H. New, of Toronto, for many years president and managing director of the Hamilton and Toronto Sewer Pipe Company, died on July 17th after an illness of several weeks' duration. Mr. New had many business interests in the city and was long associated with manufacturing activities in Toronto and Hamilton.

Mr. N. G. H. Burnham, in charge of one of the sections of the Manitoba branch of the Hydrographic Survey of Canada, was drowned in the Valley River, near Dauphin, Manitoba, on July 15th, through the capsizing of a canoe. Mr. Burnham and his party were attempting to make a particularly difficult crossing at the juncture of two streams when the accident occurred. The unfortunate young engineer was a son of Dr. G. H. Burnham, of Toronto. He matriculated from Upper Canada College into the Royal Military College, Kingston, in 1906. On the completion of his course in the Royal Military College, in 1909, he entered the faculty of applied science at Toronto University, graduating with the degree of B.A.Sc. in 1912. For the past year and a half he has been engaged in hydrographic survey work in Manitoba and Saskatchewan.

COMING MEETINGS.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelfth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Honorary Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

A joint annual meeting of the Canadian and American Peat Societies will be held at Montreal, Canada, on August 18th, 19th and 20th, 1913.

The first International Exposition of Safety and Sanitation ever held in America will take place in New York City, December 11th to 20th, 1913, under the auspices of the American Museum of Safety. Safety and health in every branch of American industrial life, manufacturing, trade, transportation on land and sea, business, engineering, in all of their sub-divisions will be represented at this exposition. It will be the first step toward making a representative exhibition of the progress of safety and preventive methods in America.

READERS SHOULD NOTE THE REMOVAL OF THE LIST OF CANADIAN TECHNICAL AND MUNICIPAL SOCIETIES FROM THIS PAGE TO PAGE 94, IN THE REFERENCE SECTION OF **THE CANADIAN ENGINEER.** BY THIS CHANGE, ALMOST AN ENTIRE PAGE OF READING MATTER IS ADDED WEEKLY.

ORDERS OF THE RAILWAY COMMISSIONERS
OF CANADA

Each week on this page may be found sommaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

19709—May 30—Establishing collection and delivery limits of express companies in city of Portage la Prairie, Man., and rescinding Order No. 14882, dated Sept. 16th, 1911.

19710—June 27—Postponing, until Aug. 1st, 1913, the effective date of the modifications of Rule 7 G.T.R. special freight tariff, C.R.C. No. E 2374, I.C.C. No. 1660, contained in supplement Nos. 5 and 8, respectively, thereto, and of Rule No. 33, C.P.R. local freight tariff, C.R.C. No. E. 2141, I.C.C. No. E. 1288, contained in supplement Nos. 9 and 6, respectively, thereto.

19711—June 30—Amending Order No. 19546, dated June 10, 1913, by striking out words "distant signals" in second line of paragraph 2 of operative part of Order.

19712—June 30—Directing G.N.R. put into force on shipments of ore, in carloads, from Saimo to Nelson, B.C., following additional rates:—$1.10 per net ton when valuation does not exceed $15 per ton, $1.15 per net ton when valuation does not exceed $20 per ton; said rates to be made effective within 30 days from date of this Order.

19713—June 27—Directing C.N.R. move crossing lying to south of south switch in northerly direction, to a point 60 ft. from south switch, and grade road from said crossing to loading platform, to satisfaction of an engineer of Board; cost of grading road be borne and paid by Railway Company.

19714—June 30—Authorizing G.T.R. to reconstruct bridge No. 99 over public road between lots 16 and 17, in con. 3, Tp. Ray, at mile post 161.10, 9th Dist., 2.90 miles east of Midland.

19715—June 30—Approving revised location G.T.P. Branch Lines Co., station at Ruthilda, Sask., in Sec. 3-34-18, W. 3 M.

19716—June 30—Authorizing C.P.R. to use subway over Main St., at Kenora, Ont.

19717—June 28—Authorizing C.P.R. to construct following bridges: 1, 22.3 Toronto Sub-Div., Ont. Div., near Peterborough station; 2, 21.8 Toronto Sub-Div., Ont. Div., near Botulf station, and 3, 19.4 Newport Sub-Div., Eastern Div., near Sutton station.

19718—June 27—Authorizing G.T.P. Branch Lines Co. to operate trains over crossing at Arcola branch of C.P.R. at Griffin, Sask., without their first being brought to a stop.

19719—June 30—Directing that within 60 days from date of this Order, C.P.R. move stock pens at Shelburne to west side of its tracks, pens to be long enough to place not less than four cars at one time, each pen to have a gate opening to loading platform, upper deck loading chutes to be provided for sheep or hogs at each end of pens.

19720—June 30—Authorizing C.P.R. to construct spur for Cockshutt Plow Co., Ltd., Calgary, Alta., spur to be completed within three months from date of this Order.

19721—June 30—Relieving C.P.R. from providing further protection at highway at mileage 22.79 from St. Martin's Jct., Que.

19722—June 30—Authorizing T., H. & B. Ry. to construct spur into lands of John McInnes, Hamilton, Ontario.

19723—June 27—Refusing application Eustis Mining Co. for an Order amending Canadian Car Service Rules to provide for five days' free time at Sorel, Que., on copper-sulphur ore shipments for transfer to vessels.

19724—June 30—Authorizing C.P.R. to construct spur for Wells & Emerson, Port Arthur, Ont., spur to be completed within three months from date of this Order.

19725—June 30—Approving proposed change in location of C.P.R. siding for William Davies Co., Ltd., near intersection of Front St. and Esplanade Ave., Toronto, Ont.

19726—June 30—Approving revised locations of portions of C.P.R., constructed line, Shuswap Sub-Div., mileages 0 to 25, Revelstoke to Taft, B.C.; 2, authorizing company to construct revision in grade of line and in grade of highway crossings, as constructed, on said line; 3, authorizing company to construct, by means of grade crossings, additional track (double track) across nine (9) highways between mileages 0 and 25.

19727—July 2—Extending until August 31st, 1913, time within which C.P.R. complete spur adjoining Neebing Avenue, Fort William, Ont.

19728—June 30—Approving change in location of C.P.R. station at Farm Point, from mileages 16.05 to 16.36, lot 240, R. 16, Tp. Hull.

19729—July 2—Amending Order No. 18161, dated Nov. 29, 1912, according to application of C.P.R., that words, "as lessee exercising the franchises of the Alberta Railway & Irrigation Company" in the recital of said Order, be struck out; and that plan "A.," filed under file No. 19574.1, showing location to be constructed by C.P.R., be substituted for plan approved under Order No. 18161.

19730—July 3—Granting leave to C.L.O. & W. Ry. to operate trains over crossing of Whitby, Port Perry & Lindsay Branch of G.T.R., in town of Whitby, for construction purposes only, for a period of six months from date of this Order, subject to and upon condition that crossing be protected by a watchman appointed by G.T.R., at expense of C.L.O. & W. Ry. (C.P.R.)

19731—July 3—Granting leave to Winnipeg, Selkirk & Lake Winnipeg Ry. to cross, for construction purposes only, until Oct. 31st, 1913, the Selkirk Branch of C.P.R., subject to and upon certain conditions.

19732—June 21—Approving revision in location of portion of C.P.R.'s constructed line, Shuswap sub-division, from station 1517-08.2 in S.E. ¼ Sec. 32-20-13, W. 6 M., at mileage 102.70; in southwesterly direction to station 1480, in N.E. ¼ Sec. 29-20-13, W. 6 M., at mileage 103.39, zero of said mileage being at Revelstoke, B.C.; 2, Revision in grade of line and highway crossings, as constructed, as shown on plan, be approved, and, 3, authorizing company to construct additional track (double track) across seven (7) highways, between mileages 96 to 131.55; 4, After diversion at mileage 102.92 is made and grade crossing constructed thereon in accordance with standard regulations of Board, company may close portion of present road allowance within limits of its right of way.

19733—July 2—Approving proposed change in location of C.P.R. station on N.E. ¼ Sec. 14-20-10, W. 6 M., at Salmon Arm, B.C.

19734—July 2—Authorizing C.P.R. to construct bridge No. 52.3 on Havelock sub-division, Ontario Division, over Salmon River, near Ardendale station, Ontario.

19735—July 2—Authorizing C.P.R. to construct ballast pit spur across road allowance between Section 12-34-25 and Section 7-34-24, W. 2 M., at mileage 54 from Wynyard, on Lanigan subdivision, Saskatchewan Division, by means of a grade crossing.

19736—July 2—Authorizing C.P.R. to operate bridges over Kaministiquia River and McKellar River, Fort William terminals, Ont.

19737—July 2—Authorizing C.P.R. to construct road diversion in N.W. ¼ Sec. 4-3-22, W. P. M., Man. After such diversion is made and grade crossing constructed in accordance with Regulations, company may close portion of present road allowance to be diverted between Secs. 9 and 4, Tp. 3, R. 22, W. P. M., portion to be closed being whole of road allowance extending along north boundary of N.W. ¼ of Sec. 4. And rescinding Order No. 15833, dated January 24th, 1912, made herein.

19738—June 30—Directing that G.T.P. Ry. adjust freight charges on sand received at Edmonton over company's railway, since June 21st, 1912, to basis of 2,600 lbs. per cubic yard; and that freight charges be collected on this basis until company's track scale is drained and corrected, or is removed and reinstalled, not later, in either case, than Nov. 1st, 1913.

19739—July 3—Authorizing C.P.R. to construct industrial spur to coal mines at Bienfait, Sask., by means of a grade crossing, across road allowance between Secs. 1 and 16-2-6, W. 2 M.

19740—July 3—Authorizing C.P.R. to operate trains over interlocking plant without their first being brought to a stop, where said company crosses Hull Electric Railway, in city of Ottawa.

19741—July 3—Authorizing C.L.O. & W. Ry. (C.P.R.) to construct its ballast pit spur, by means of a bridge, over and across G.T.R. at mileage 89.9 on its railway, in west ½ of Lot 9, Con. 1, Tp. Murray, Co. Northumberland, Ontario.

19742—July 3—Approving revised plan showing pedestrian subway proposed to be constructed by G.T.R. at Jacob's Ladder Stairway, town of Port Hope, Ont., filed as plan "A" under file No. 3675.5.

19743—July 2—Approving, subject to terms of agreement, proposed connection and junction of C.N.R. with N.T.R., Eastern Div., at St. Boniface, Manitoba.

19744—July 3—Directing that C.N.R. appoint caretaker at Hymers, Ont., whose duty it will be to keep waiting-room clean and heated, see that freight is properly housed and freight shed kept locked, and take charge of key of said freight shed, same to be kept at point convenient for persons coming for their goods between hours of 8 a.m. and 6 p.m.; station waiting room and outside of building to be painted, freight shed doors put in condition so that same can be locked, station platform repaired, and portable stock-loading chute be installed; caretaker be appointed and said work be completed by Aug. 15th, 1913.

19745—July 2—Approving (1) revised location portion of C.L.O. & W. Ry. (C.P.R.) from mileage 119 to mileage 119.66 (West Riding), Ont., and (2) location of said company's station on block of land lying to north of Park street, in Sub. Div. No. 8, Lot 17, town of Cobourg, Co. Northumberland (West Riding), Ont., at mileage 119.72 from Glen Tay.

19746—July 4—Authorizing C.P.R. to construct diversions of road allowances running north and south, and east and west, and bounding Secs. 19, 20, 29 and 30, Tp. 7, R. 27, W. 2 M., and to construct its Weyburn-Lethbridge Branch across diversion at mileage 94.28 from Weyburn, by means of grade crossing.

19747—July 4—Approving location C.N.Q.R. through Tps. Chilton and Lussier, Co. Montcalm, Que., mileages 36.52 to 57.49 from St. Jacques Jct.

19748—July 4—Approving location C.N.Q.R. through Tps. Chertsey and Rawdon, Co. Montcalm, Que., mileages 16.87 to 36.52 from St. Jacques Jct.

19749—June 28—Approving (1) Dominion Express Co.'s Schedules "B," C.R.C. No. 4345, to supersede C.R.C. No. 2583; "C," C.R.C. No. 4346, to supersede C.R.C. No. 2584; and "D," C.R.C. No. 4347, to supersede C.R.C. No. 2585, approved by Order No. 14418, dated July 19th, 1911. (2) C. N. Express Co.'s Schedule "B," C.R.C. No. 791, to supersede C.R.C. No. 725, approved by Order No. 14418, July 19, 1911. (3) Canadian Express Company's Schedules "B," C.R.C. No. 1514, to supersede C.R.C. No. 1364, and "C," C.R.C. No. 1515, to supersede C.R.C. No. 1365, approved by Order No. 14413, July 19, 1911; and (4) Great Northern Express Co.'s Schedules "A" and "B," C.R.C. No. 298, to supersede C.R.C. No. 270, approved by Order No. 14417, July 19th, 1911. Said tariffs to be published twice, consecutively, in the Canada Gazette.

19750—July 5—Approving proposed change in location C.P.R. station in N.E. ¼ Sec. 4-8-19, W. 2 M., at Khedive, Sask.

19751—July 4—Approving revised location Burrard Inlet Tunnel & Bridge Co.'s Railway from station high water mark, north shore Burrard Inlet, to station 174-88.7; and rescinding Order No. 505, dated June 13, 1905.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Bassano, Alta., sewage disposal works	Aug. 15.	July 17.	86
Battleford, Sask., public building	July 31.	July 17.	78
Carlyle, Sask., waterworks and electric lighting	Aug. 1.	July 10.	86
Galt, Ont., drill hall	Aug. 5.	July 17.	80
Lloydminster, Sask., interior fittings for post office, customs and inland revenue office	July 25.	July 10.	78
London, Ont., substructure for highway bridge	July 31.	July 17.	88
Millbrook, Ont., drill hall	July 29.	July 17.	80
Napanee, Ont., drill hall	July 30.	July 17.	80
Revelstoke, B.C., drill hall	July 29.	July 17.	80
Saskatoon, Sask., motor truck	July 31.	July 17.	80
Toronto, Ont., cutting pulpwood	Aug. 15.	July 19.	78
Toronto, Ont., Toronto harbor works	Aug. 25.	July 17.	84
Toronto, Ont., sewage pumping engines	July 29.	July 17.	84
Toronto, Ont., concrete culvert with abutments and slab	July 28.	July 17.	84
Vancouver, B.C., wharf	Aug. 21.	July 17.	80
Victoria, B.C., residences	Aug. 5.	July 17.	80
Victoria, B.C., concrete pipe and appurtenances	July 31.	July 10.	86
Victoria, B.C., steel pipe and appurtenances	July 31.	July 10.	84
Welland, Ont., gate lifter	July 29.	July 3.	84
Windsor, Ont., Incinerator	July 29.	July 10.	84
Windsor, Ont., street-flushing machine	July 29.	July 17.	76
Winnipeg, Man., motor generator	Aug 9.	July 10.	76

RAILWAYS—STEAM AND ELECTRIC.

Moose Jaw, Sask.—On the completion of extensions being made by the Canadian Pacific Railway, this city will possess the third largest yards owned by the Canadian Pacific. Nearly 200 men are now engaged on the work of increasing the site of the terminal facilities, on which more than $100,000 is to be spent. In connection with the improvements, the trackage is being increased approximately 15 miles. The double track line from Swift Current into Moose Jaw is also nearing completion.

+—Ottawa, Ont.—The Morrisburg and Ottawa Electric Railway Company, it is reported, has awarded Mr. FRANK LEAMY the contract for the construction of the new road. Discussing construction matters, President Kilt stated he thought the road might be built for $15,000 per mile, exclusive of the cost of bridges and approaches, but he did not agree with the estimate made by some of the "insurgent" stockholders that $12,000 per mile was sufficient.

St. Catharines, Ont.—The Canadian Pacific Railway proposes to build an electric line from Hamilton, through St. Catharines, to the Niagara River. The city is asked to contribute one-half of the cost of a railway bridge across the old canal. As an alternative proposition, the C.P.R. is willing to use a bridge jointly with the Canadian Northern, which also intends to build through St. Catharines. In such a case the C.P.R. would pay one-third of the cost and expect the Canadian Northern and the city to bear similar proportions. The through line would be built through the northern section of St. Catharines, with a spur line to a new station to be erected at the market square. The city council looks favorably upon the proposition and will take up the new proposal with the Canadian Northern.

Toronto, Ont.—The Grand Trunk Railway management has placed an order for 75 of the most up-to-date locomotives. Fifty of them will be used on the Canadian lines while the other 25 will be used in the United States. These locomotives will be of the most modern type and the largest in the country. They will cost $25,000 each, so that the company will pay out $1,875,000 within the next year for motive power. Most of them will be built in the Montreal shops and some in Philadelphia.

+—Toronto, Ont.—The Canadian Northern Railway has awarded the following contracts in connection with the additions to the rolling stock: The contract for 7 consolidation locomotives to the CANADIAN LOCOMOTIVE COMPANY; 15 heavy ten-wheel locomotives to the MONTREAL LOCOMOTIVE WORKS; 6 first-class cars, 5 baggage cars and 50 box cars to the CANADIAN CAR AND FOUNDRY COMPANY; 2 combination cars to the PRESTON CAR AND COACH COMPANY; 5 second-class cars and 100 flat cars, 60,000 pounds' capacity, to the CROSSEN CAR COMPANY, and the contract for 170 Hart cars to the HART-OTIS CAR COMPANY.

Vancouver, B.C.—Foley, Welch & Stewart, of Vancouver, the contractors for double-tracking the Canadian Pacific Railway tunnel through the Selkirks, will require a great quantity of material and equipment in connection with the work. Manager A. C. Dennis announces that the cost of this alone will amount to about $500,000, and includes separate steam plants for both sides of the job.

Vancouver, B.C.—The Canadian Pacific Railway are to try the experiment of electrifying their branch line in Western Canada from Castlegar to Rossland, B.C., and operating trains between these two points by electricity instead of steam power, using 2,400 volts direct trolley system.

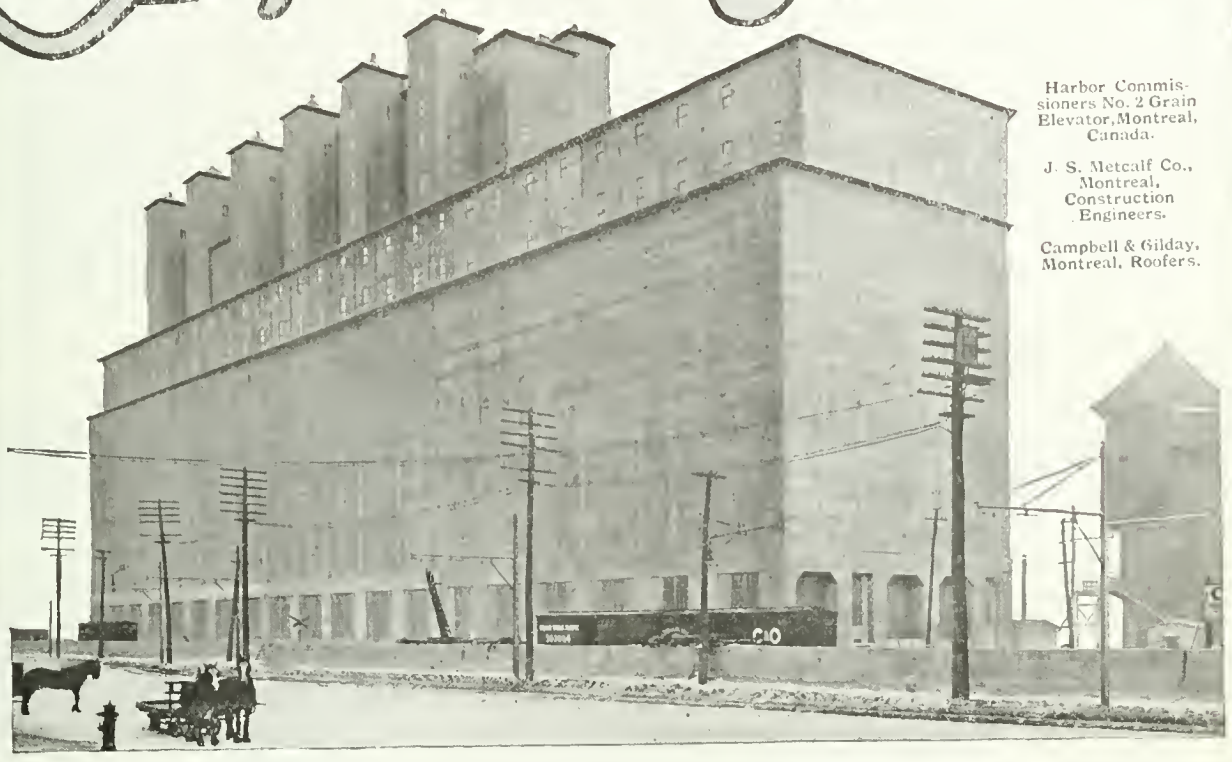
Vancouver, B.C.—The Canadian Pacific Railway is now starting to convert locomotives in the Vancouver-North Bend service into oil-burners, and it is expected that all the engines will be transformed by the end of the year.

Vancouver, B.C.—Tenders will shortly be called for the unfinished sixty-mile Kettle Valley line across the Hope Mountains, according to Mr. J. J. Warren, president of the company. The Kettle Valley Company will build, own and operate the section, but the Great Northern will contribute toward the cost and both will enjoy running rights. An early start on the work is assured.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—A number of by-laws to provide for paving are soon to be submitted to the ratepayers. They will be for extensions of pavements in places where the commissioners consider paving is an urgent necessity. The larger and most important will be a by-law providing for the paving of Nose Hill. It will be a general by-law and is planned as part of the policy of the health department to deliver garbage to the east end incinerator at the least possible expense.

Barrett Specification Roofs



Harbor Commissioners No. 2 Grain Elevator, Montreal, Canada.

J. S. Metcalf Co., Montreal, Construction Engineers.

Campbell & Gilday, Montreal, Roofers.

On the World's Largest Concrete Grain Elevator

As we have frequently pointed out, most of the large commercial buildings of the day are covered with a Barrett Specification type of roof.

For example, here is the great new grain elevator at Montreal. It is said to be the largest in the world, with a capacity of 2,600,000 bushels. It carries a Barrett Specification Roof 55,000 square feet in area.

The engineers chose this type of roof because it is the lowest-priced and most reliable roofing known.

Barrett Specification Roofs require no repairs or attention of any kind, they invariably last twenty years or more, and are fire-retardant.

Architects, engineers and owners of permanent buildings of all kinds should have a copy of the Barrett Specification on file.

A request will bring it by return mail.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification revised August 15th, 1911, using the materials specified and subject to the inspection requirement.

THE PATERSON MANUFACTURING COMPANY, LIMITED

Montreal Toronto Winnipeg Vancouver St. John, N.B. Halifax, N.S. Sydney, N.S.

+—Edmonton, Alta.—The city council has awarded Messrs. SMITH & KEITH the contract for the construction of two bridges, each 250 x 55 feet, of wood superstructure. The estimated cost is $27,194.

Halifax, N.S.—Tenders will be received up till the 28th of July, 1913, for the construction of bridges and culverts in the county of Annapolis. Plans and specifications may be obtained from the Department of Works and Mines, Halifax. E. H. Armstrong Commissioner.

+—Maplewood, Mo.—The DOLARWAY PAVING COMPANY have been awarded the contract for the construction of 1,750 square yards of their pavement there.

Ottawa, Ont.—City Engineer Currie is preparing an estimate as to the cost of placing every street in the city in good condition. And he is going at the matter in a very thorough manner. He has placed an engineer of the department at this work, and in addition has the ward foremen assisting. Each ward foreman has a map of his ward, and he is required to report on each street, giving the width of roadway construction and condition. The engineer in charge of the work is also taking various parts of the city and making reports. These reports will all be compared and amalgamated, and then City Engineer Currie will have accurate information on which to base the figures as to the cost of putting the various streets in shape. The report when ready will be a comprehensive one, but will not be out for a month yet.

Ottawa, Ont.—The counties of Lanark and Carleton have awarded MR. JAMES TODD, Burritt's Rapids, the contract for the construction of a bridge over the river between the two counties.

▲—Toronto, Ont.—Tenders will be received up till the 6th of August, 1913, for the construction of a reinforced culvert. Plans and specifications may be obtained from Frank Barber, County Engineer.

▲—Toronto, Ont.—Tenders will be received up till the 6th of August, 1913, for the construction of a bridge. Plans and specifications may be obtained from Frank Barber, County Engineer.

Welland, Ont.—Tenders will be received up till the 28th of July, 1913, for the construction of three concrete bridges. Plans and specifications may be obtained from George Ross, county engineer, and Robt. Cooper, county clerk.

▲—Welland, Ont.—Tenders will be received up till the 4th of August for the construction of sewers. Plans and specifications may be obtained from *The Canadian Engineer*, 62 Church Street, Toronto, and James Hughes, Chairman Sewerage Committee.

LIGHT, HEAT AND POWER.

Brantford, Ont.—Tenders will be received up till the 30th of July, 1913, for the construction of a substation building. Specifications may be obtained from Brantford Hydro-Electric System, Brantford, Ont.

Edmonton, Alta.—The EDMONTON CONSTRUCTION COMPANY and Messrs. HULBERT & WILSON have been awarded the contracts for the extension to the telephone system. The prices were $33,500 and $18,666, respectively.

London, Ont.—The report of Mr. A. Eastman, manager of the Essex and Lake Shore Railway on the estimated amount of earnings and operating expenses of the London and Port Stanley Railway if electrified, has been made public. The report is disappointing, inasmuch as it shows clearly the unfeasibility of the scheme, and that the road could not be run by electricity except at a loss to the city.

Ottawa, Ont.—Tenders will be received up till the 14th of August, 1913, for the supplying of 47,000 feet of underground lead cavend cables and 14 induction regulators. Specifications may be obtained from J. E. Brown, electrical superintendent.

+—Regina, Sask.—The City Commissioners have awarded Messrs. BRUCE, PEEBLES & COMPANY, LIMITED, Edinburgh, through their Eastern Canadian agents the contract for supplying a 1,200 K.W. motor generator.

Winnipeg, Man.—Tenders will be received up till the 31st of July for supplying 25,000 lbs. of weatherproof insulated copper wire. Plans and specifications may be obtained from the Board of Control. M. Peterson, secretary.

GARBAGE, SEWAGE AND WATER.

▲—Bassano, Alta.—Tenders will be received up till the 15th of August, 1913, for the construction of a sewage disposal works. Plans and specifications may be obtained from the John Galt Engineering Co., Ltd., consulting engineers and Geo. B. R. Bond, secretary-treasurer.

Calgary, Alta.—City Engineer Craig has completed the estimates of cost and the by-law is now ready to be submitted to the council. The by-law provides for a trunk sewer to cost $45,500 and laterals and accessories to cost a total of $32,400 more. It is the intention of the commissioners to get the work under way as soon as circumstances will permit.

+—Edmonton, Alta.—The city engineer, A. J. Latornel, reports to the commissioners showing an analysis of the tenders on water and sewer contracts for Riverside and Glenora. These tenders are recommended to be accepted:—For sewers, contracts 6 and 7: C. L. DEVALL, for contract 6, $42,046; for contract 7, $22,215.25. For water—Contract 6, C. STANGER, $11,489.20; contract 7, C. L. DEVALL, $4,611.50. The tenders submitted both for the water and the sewer contracts were: Water main, Glenora contract 6—W. Graham, $12,130.95; C. L. DeVall, $11,732.25; G. Stanger, $11,489.20 and Philip Agrois, $14,100.40. Water main, Glenora contract 7—W. Graham, $4,998.50; C. L. DeVall, $4,611.50; G. Stanger, $4,812, and Philip Agrois, $6,158.75. Sewer, Glenora contract 6—Hulbert & Wilson, $58,221.60, and C. L. DeVall, $42,046. Sewer, Riverview, contract 7—A. J. McGarry, $34,158.10— Hulbert & Wilson, $25,287.85; C. L. DeVall, $22,215.25, and Benson and Mills, $24,624.75.

+—Montreal, Que.—The Board of Control has awarded the ALLIS-CHALMERS COMPANY the contract for supplying an electric-driven pump, of six million gallons capacity of the high level reservoir. The Canada Boving Company and the Escher, Wyss Co. also tendered.

+—Montreal, Que.—The Board of Control has awarded the WICKS COMPANY the contract for supplying two steam boilers for the low level station. The tender price is $16,000, which was the lowest.

Montreal, Que.—The long-expected report on the filtration plant prepared by F. N. Barbour, of Boston; J. A. Jameson and P. W. St. George, of Montreal, was handed to the Board of Control recently. The report deals with the nature of the ground, etc., upon which the filtration plant at the wheel-house is being constructed. The report bears out the contention of Mr. G. Janin, chief engineer of the city; T. Lesage, superintendent of the waterworks, and of Messrs. Hering and Fuller, filtration experts, of New York, that the site of the plant is satisfactory, and that it is capable of bearing much heavier loads than those called for by the city's specifications. Upon the strength of this new report the Board of Control will decide whether to allow the contractor to complete the work or whether the city will carry out the contract itself.

Oshawa, Ont.—Tenders will likely be called for later in the season for laying of new intake pipe. A pressure mechanical filtration plant will likely be installed in 1914, if the water becomes as turbid next winter as it did last winter.

▲—Victoria, B.C.—Tenders will be received up till the 31st of July, 1913, for the fabrication and laying of about 10¼ miles of 36-in. riveted steel pipe and appurtenances on the line of the Sooke Water Supply. Plans and specifications may be obtained from C. H. Rust, Water Commissioner.

▲—Victoria, B.C.—Tenders will be received up till the 31st of July, 1913, for the laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit. Plans and specifications may be obtained from the Sooke Water Supply office, and C. H. Rust, Water Commissioner.

Welland, Ont.—The town will call for tenders for the construction of sewers shortly. D. T. Black, town engineer.

INDUSTRIAL WORKS.

+—Bruce Mines, Ont.—The Dominion Government has awarded the SOO DREDGING AND CONSTRUCTION COMPANY the contract for dredging. The contract price is $8,832.

+—Calgary, Alta.—The JAMES G. CORCORAN COMPANY, Calgary, have been awarded the contract for the con-

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For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

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WELDLESS TUBES up to 12 inches diameter, in lengths up to 40 feet.

Laying Mannesmann Pipes under water in Netherlands

LAP-WELDED TUBES from 12 inches up to the largest diameters.

MANNESMANN TUBE COMPANY, LIMITED

51 VICTORIA SQUARE, MONTREAL

struction of a twelve-inch pipe line from Carlish, Kansas to Carlton, Mo., a distance of 100 miles.

Fort William, Ont.—Extensions and improvements to the Kaministiquia Power Company's plant, which will mean an outlay of approximately $1,000,000 will be commenced in the very near future, according to Mr. R. S. Kelsch, consulting engineer for Hosmer, Holt and Thompson, of Montreal, principal owners of the plant. It is the intention to instal a third big aqueduct from the intake pipe to the power house, a distance of little over a mile.

Halifax, N.S.—Tenders will be received up till the 1st of August, 1913, for dredging required at Cheticamp, Little Lorraine, Petit de Grat, Whycocomagh and Port Mulgrave, Nova Scotia. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Kerrisdale, B.C.—Tenders will be received up till the 28th of July, 1913, for supplying fire apparatus. Specifications may be obtained from G. G. Heighway.

Kerrisdale, B.C.—Tenders will be received up till the 28th of July, 1913, for the construction of an incinerator. Plans and specifications may be obtained from G. G. Heighway, C.M.C.

+—Killarney, Ont.—The Dominion Government has awarded the C. S. BOONE DREDGING COMPANY the contract for dredging. The contract price is $8,000.

London, Ont.—City Engineer Ashplant has submitted his report to the Board of Works on the breakwater question. In reviewing the question the engineer stated that in the past fifteen years $21,178 had been spent on the breakwater for piling, planking and general filling. None of this work had been of a permanent character and he recommended a permanenet construction paid for out of debentures, as the saner and better policy. He reviewed the previous reports on various types of construction and recommended a reinforced embankment, faced with concrete, as the most effective form of construction. The estimated cost of this would be $12.40 per foot, and would provide for the required gravel and earth filling (40,000 yards), the reinforced concrete facing and a pipe rail fence for the protection of the top of the bank. With an additional 10 per cent. for contingencies the cost would amount to $22,139.

Ottawa, Ont.—Tenders will be received up till the 28th of August, 1913, for the construction of a single-screw steel steamer. Plans and specifications may be obtained from the Department of Marine and Fisheries, Ottawa. Alex. Johnson, Deputy Minister.

+—Ottawa, Ont.—The contract for a modern power lifeboat, it is expected, will be awarded to V. M. DAFOE, of Vancouver, the price mentioned being in the neighborhood of $10,000. The arrangement is in pursuance of the policy of the Administration of having all vessels for the Government service built in Canada. The new vessel will be stationed at Claquot, on Vancouver Island, and will be the third of the sort in Canada. They are 36 feet, ocean-going vessels, unsinkable and self-righting. The new boat is to be built in accordance with the specifications of the United States authorities.

+—Ottawa, Ont.—The Dominion Government has awarded the DOMINION DREDGING COMPANY, Ottawa, the contract for the construction of the first section of the enlarged Welland Canal. The firm offered to do the work for $3,500,000. This was the lowest tender. It provides for the construction of the first few miles of the canal from the Lake Ontario end. Tenders for other sections of the canal, which is to have a depth of 34 feet, will be called shortly. It will, when completed, allow the largest lake boats to reach the St. Lawrence with full grain cargo from the west.

Ottawa, Ont.—The Board of Control have passed local improvements amounting to $250,000.

Regina, Sask.—The city is calling for tenders for the construction of 500,000 square feet of concrete sidewalks, and City Engineer McArthur is calling for tenders for equipment required for street cleaning and road grading.

+—St. Andrew's, N.S.—The Dominion Government has awarded the MARITIME CONSTRUCTION COMPANY the contract for dredging. The contract price is $7,03[illegible].

The Pas, Man.—Tenders will be received up till the 1st of August, 1913, for the constructing and equipping wireless telegraph operating house. Plans and specifications may be obtained from Chief Engineer Hudson Bay Railway, Winnipeg, and the Department of Railways and Canals. L. K Jones, secretary.

▲—Toronto, Ont.—Tenders will be received up till the 5th of August, 1913, for painting several bridges. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

▲—Toronto, Ont.—Tenders will be received up till the 25th of August, 1913, for the construction of a sea wall, breakwater, ship channel and retaining walls. Plans and specifications may be obtained from the District Engineer and the Harbor Commissioners, Toronto; H. J. Lamb, Windsor; J. L. Michaud, Montreal; and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Toronto, Ont.—The Spanish River Pulp and Paper Company, the Lake Superior Company and the Ontario Pulp and Paper Company have merged. The Spanish River Pulp and Paper Mills, Limited, is one of the largest manufacturing concerns in the Dominion. Its pulp limits, coursed by the Spanish, Vermilion and Onaping Rivers, cover an estimated area of 6,000 square miles, and possesses a twenty-one-year agreement with the Ontario Government. The company's mill and plant are at Espanola and Sturgeon Falls. The concern owns its water and electric power plant. The shareholders will be asked for permission for the directors to approach the Lieutenant with a view to obtaining supplementary letters patent increasing the capital stock of the company to $20,000,000.

▲—Toronto, Ont.—Tenders will be received up till the 5th of August, 1913, for the equipment of the civic abattoir. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Mayor.

+—Vancouver, B.C.—The Dominion Government has awarded the VANCOUVER SHIP YARD LIMITED, the contract for the construction of three gasoline launches.

Vancouver, B.C.—As evidence of the work carried on by the Canadian Pacific Railway in the way of assisting firms to locate in the west, the industrial branch of the natural resources department of the company reports that, up to the end of June, the department had been instrumental in establishing 56 retail businesses, 31 wholesale houses, and 89 manufacturing plants in Western Canada.

+—Victoria, B.C.—The city council has awarded the following contracts for supplies:—F. H. FOLSAM, the contract for supplying 100 cedar poles; to Messrs. NEPAGE, McKENNY & COMPANY the contract for installation cables, junction boxes, etc., and installing arc lighting on Dallas Road; to Messrs. HUTCHINSON BROS. the contract for supplying cluster light globes.

+—Winnipeg, Man.—The School Board has awarded JAMES BALLANTYNE & COMPANY the contract for installing a heating and ventilating system in the Mackray school. The contract price is $19,557.

MISCELLANEOUS.

+—Calgary, Alta.—The Government has awarded Mr. F. L. DAVIS the contract for the rebuilding of a boarding school on the Blackfoot Indian reserve. The contract price is $50,990.

Calgary, Alta.—The Crystal Ice Company, manufacturers of artificial ice, will erect a plant in this city. The estimated cost is $200,000.

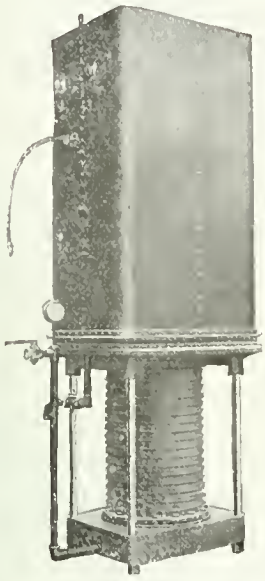
Calgary, Alta.—The Canada Malting Company will locate a machine shop in this city. The cost will be $10,000.

▲—Cobalt, Ont.—Tenders will be received up till the 15th of August, 1913, for the erection of a three-story concrete and municipal building. Plans and specifications may be obtained from R. L. O'Gorman, town clerk.

+—Duncan, B.C.—The Dominion Government has awarded MESSRS. ROURKE, McDONALD & MONCRIEF, the contract for the erection of a public building. The contract price is $38,463.

+—Edmonton, Alta.—The directors of the Exhibition have awarded the DUNLOP-JOHNSON CONSTRUCTION COMPANY the contract for the construction of the stock pavilion.

The Pistonless Hydraulic Press



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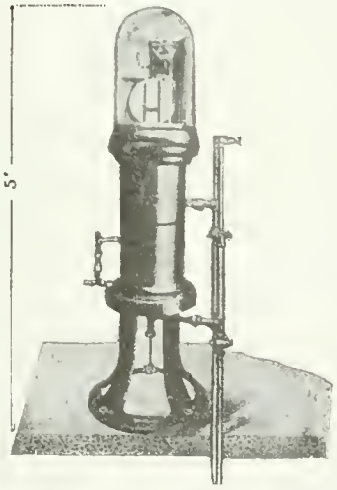

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One eight-day marine clock.
Rectangular chart—daily or weekly. Total flow five dial register—glass dome or metal dome with glass doors, if desired.
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The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction ot the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

Sterilization Co.

Union Building, Clinton Street

NEWARK, N. J.

Also engineers for the electrolytic treatment of water.

+—**Edmonton, Alta.**—The Board of Commissioners have awarded MESSRS. NESBITT & MILLER the contract for the construction of a fire hall. The contract price is $11,942.

+—**Elmira, Ont.**—The Dominion Government has awarded Mr. E. A. BLEAKNEY the contract for the erection of a public building. The contract price is $35,000.

+—**Hartford, Conn.**—The MACARTHUR CONCRETE PILE AND FOUNDATION COMPANY, New York, has been awarded the contract for the complete foundation for the new Hartford City Gas Light Company retort buildings.

Indian Head, Sask.—Tenders will be received up till the 28th of July, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

+—**Madoc, Ont.**—The Dominion Government has awarded Mr. L. E. ALLEN, Belleville, the contract for the erection of a drill hall, the contract price of $16,800 being the lowest.

+—**Maple Creek, Sask.**—The Dominion Government has awarded NAVIN BROTHERS, of Moose Jaw, the contract for the erection of a drill hall. The contract price is $27,313.

+—**Medicine Hat, Alta.**—The Medicine Hat Golf and Country Club have awarded Messrs. SCANLON & HALL the contract for the erection of a club house. The contract price is $12,000.

Ottawa, Ont.—Rapid progress is being made in equipping the militia with drill halls. Nineteen are now under contract, tenders are in and under consideration for eight more, and tenders have been called for twenty-five additional. This makes a total of fifty-two centres which are being supplied at the present moment with accommodation.

+—**Preston, Ont.**—The Dominion Government has awarded Mr. GEO. E. PROCTOR the contract for the erection of a public building. The contract price is $44,861.

+—**Prince Albert, Sask.**—The Bank of Ottawa has awarded MR. A. P. ANDERSON the contract for the erection of an addition to the present building. The contract price is $40,000.

Regina, Sask.—The Canadian Pacific Railway will build a large hotel at Long Lake, a popular pleasure resort.

Regina, Sask.—Tenders will be received up till the 31st of July, 1913, for the erection of an isolation hospital. Plans and specifications may be obtained from L. A. Thornton, City Commissioner.

Renfrew, Ont.—Tenders will be received up till the 8th of August, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy-Minister.

+—**Saskatoon, Sask.**—Dr. G. E. Holmes has awarded the FRID-LEWIS CONSTRUCTION COMPANY the contract for the erection of a six-story block. The contract price is $250,000.

+—**Shelburne, Ont.**—The Dominion Government has awarded Messrs. ALEX GREEN and H. N. CAMPBELL the contract for the erection of a public building. The contract price is $29,707.

Sudbury, Ont.—Tenders will be received up till the 6th of August, 1913, for the erection of a public building. Plans and specifications may be obtained from Thos. Hastings, Toronto, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

St. John, N.B.—The municipal council will erect a hospital for consumptives. The estimated cost is $46,900.

+—**The Pas, Man.**—The Dominion Government has awarded Messrs. SNYDER BROS. the contract for the erection of an Indian boarding school and hospital. The contract price is $76,578.

Toronto, Ont.—The United Typewriter Company will erect a new ten-story building. The estimated cost is $150,000.

+—**Toronto, Ont.**—The Government has awarded Messrs. MITCHELL & SON the contract for the erection of postal station "G." The contract price is $124,000.

+—**Toronto, Ont.**—The Canadian Pacific Railway has awarded the JOHN HAYMAN AND SON COMPANY the contract for the erection of a building to be an addition to the coach repair department. The contract price is $26,000.

+—**Vancouver, B.C.**—The Credit Foncier has awarded H. L. STEVENS & COMPANY the contract for their ten-story building. The building is to be of reinforced concrete construction.

+—**Vancouver B.C.**—The city council have awarded Mr. FRANK J. PALO the contract for the erection of the proposed police station.

+—**Vancouver, B.C.**—The Salvation Army has awarded MR. J. W. SPENCER the contract for two new buildings. The contract prices are $20,000 and $30,000 respectively.

+—**Victoria, B.C.**—The city has awarded Messrs. HANSON & JOHNSTON the contract for the erection of Ridgedale School, in the Matsqui district.

+—**Winnipeg, Man.**—Messrs. G. F. and J. Galt have awarded the J. A. GIRVIN COMPANY the contract for the interior alterations of their warehouse. The estimated cost is $25,000.

+—**Winnipeg, Man.**—The Government has awarded MESSRS. CARTER, HALL AND ALDINGER the contract for additions to the Selkirk Asylum. The contract price is $64,000.

MONTREAL MARKET REPORT

If the iron and steel trade is not more cheerful in other parts of the Dominion than it is in Montreal, there will not be many good things said of it at the present time. No doubt the local dullness is largely due to the conditions on the other side of the international boundary. In addition to this, however, there is some easing down in Canadian industrial activity and this is naturally reflected in the iron and steel trade.

Advices from the United States are doing their best, as it were, to look cheerful. From Chicago comes the news that the pig iron market is showing increased strength, owing to a falling off in production of merchant furnaces. This is not the best reason for strength, but in the absence of a still better one, it will have to contribute its cheer. As an American critic says, with the limitations imposed by money conditions, iron and steel works are dealing more and more with the country's up-keep requirements. It is the unknown factor, the time and the extent of the release of funds for new enterprises which account for the diverse views entertained in the steel trade as to its course in the late months in the year.

In the United States, it is claimed that supplies of steel are nearing exhaustion at a number of points. This will, of course, contribute to firmness, but it will not make volume of business, inasmuch as if the mills were all operating they would not be able to market their output and the price would have to decline. Conditions in the steel market, however, have been making a better showing right along than in the pig iron market and, notwithstanding all the unfavorable occurrences, the United States Steel Corporation has been making a fair profit and, according to all accounts, will be able to show its dividends and a balance. Nevertheless, it is acknowledged that the incoming business is exceedingly small. Some statistics published recently gave this incoming business in daily rate, as follows:—

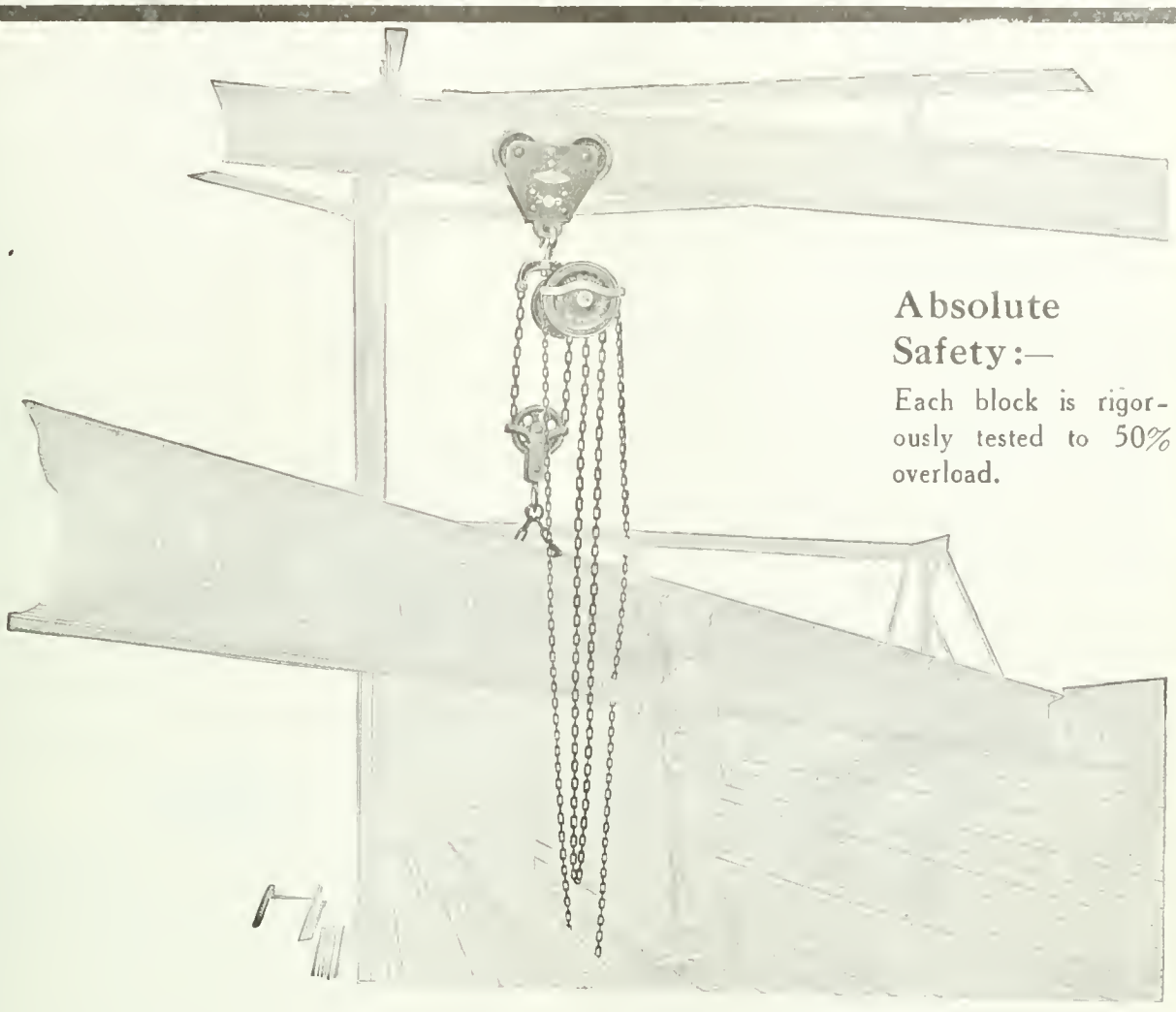
1912, October	...75,000 tons	1913, January	...40,500 tons
" November	53,000 "	" February	..38,000 "
" December	46,000 "	" March	.....37,000 "
		" April	.....26,000 "
		" May	.....20,800 "
		" June	.....23,000 "

The above related to the Steel Corporation and doubtless is as favorable a showing as the other companies are making. Since the middle of June, it is thought that operations have fallen off at least 5 per cent.

It is hard to say to what extent the recent strike of iron moulders in the city of Montreal may have interfered with the iron trade. It is understood that most of the men have gone back to work again. The men insisted on a nine-hour day and the employers refused to treat with them, claiming that they had only made a contract with them a year ago. It is doubtful if the iron and steel trade here is more optimistic than previously, as is reported to be the case in the United States, and it may even be that the contrary is the case.

A demand will shortly spring up for shipment before the close of navigation, but it is doubtful if this demand will bear a very cheering comparison with the customary fall demand. Meantime dealers generally quote prices the same as a week ago.

THE TRIPLEX BLOCK



Absolute Safety:—

Each block is rigorously tested to 50% overload.

STOP REHANDLING LOADS.

LIFT your load, move your load and lower your load by the same device, merge the three operations into one. You will then reduce rehandling; you will then save labor and time. That is the principle of the derrick.

Apply that principle in your shop and yard. Apply it by means of a Triplex Block on an overhead track. The trolley is light running, the track is level and no obstructions are in the way.

Triplex blocks are steel; steel from load-hook to I-beam. One worker alone handles ten tons, 20,000 pounds, with absolute safety; he can lift, transport and adjust steel plate, for instance, as he would handle a sheet cork. Weight or fear no longer limits his output.

Procure your copy of the new Book of Hoists now. There are concise tables, data, suggestions and photographs with action. Post yourself on the new handling practice.

TRIPLEX BLOCKS: 16 Sizes: One-quarter of a ton to forty tons. 300 Active Stocks all over the United States and Canada.

Also Duplex Blocks, Differential Blocks and Electric Hoists.

The Canadian Fairbanks-Morse Company, Limited

YALE PRODUCTS
Locks, Padlocks, Builders' Hardware, Door Checks and Chain Hoists.

6

MONTREAL TORONTO CALGARY ST. JOHN WINNIPEG VANCOUVER OTTAWA SASKATOON VICTORIA

TENDERS CALLED FOR

TENDERS FOR EQUIPMENT OF MUNICIPAL ABATTOIR AND RENDERING BUILDING NOW BEING ERECTED AT THE FOOT OF TECUMSEH STREET, TORONTO.

Separate Tenders for the several trades mentioned below in connection with the above buildings will be received by registered post only, addressed to the undersigned, up till noon on

TUESDAY, 5th AUGUST, 1913.

1. Machinery for Killing Departments, Pens, Iron Fencing, etc., Tanks, and Rendering Machinery.
2. Ice Machine and Motor, with all Piping, Condenser, and Foundations.
3. Insulation of Chill Room—floors and walls.
4. Electric Wiring, Fixtures, etc.
5. Steam Heating for Offices and Men's Rooms.
6. Cattle Chute, Connecting Bridge, Conduct, Catch Basin, Chimney, Elevators, Chill Room, Drip Pans.
7. Boiler Room Equipment, including Boilers, Heater, all Piping, Fittings, and Pumps.
8. General Painting of Buildings, Iron Work, Machinery, Pens, Fences, etc.

Plans and specifications may be seen and forms of tender and all information obtained at the office of Messrs. William R. Perrin and Company, 530 King Street East, Toronto, and No. 200 Old Colony Building, corner Dearborn and Van Buren Streets, Chicago, Ill.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City By-law must be strictly complied with or tenders will not be entertained, and all tenders are to be subject to the condition that the work will be finished by April 1st, 1914.

Parties tendering shall submit with their tender the names of two personal sureties or the bond of a Guarantee Company.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman Board of Control.

TENDERS FOR THE CONSTRUCTION OF SEWERS.

Sealed tenders will be received by Mr. C. M. Webber, Town Clerk, Welland, Ontario, up to 5 p.m. on Monday, 4th August, 1913, for the construction of Separate Sewers on the following streets:—

Maple Avenue; William Street; Oakland Avenue; Asher Street; River Road; Duncan Street; Cady Street; John Street.

Specifications and tender forms may be had at Engineer's Office, Welland. Plans and specifications may also be seen at the office of *The Canadian Engineer*, 62 Church Street, Toronto, on or after 25th instant.

A marked cheque for 10 per cent. of the amount of the tender must accompany each tender, or an acceptable bidder's bond of same value will be accepted.

The lowest or any tender not necessarily accepted. The tenders may be awarded separate or in bulk.

JAMES HUGHES,
Chairman Sewerage Committee.

Welland, July 22nd, 1913.

TENDERS FOR BRIDGE CONSTRUCTION.

Sealed Tenders plainly marked as to contents will be received by the undersigned up to NOON of WEDNESDAY, AUGUST 6th, 1913, for the construction of a reinforced concrete beam bridge on Yonge Street, just north of Aurora, in the County of York.

Plans and specifications and all necessary information may be seen at the office of the undersigned, 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
County Engineer.

Toronto, July 22nd, 1913.

NOTICE TO CONTRACTORS

Sealed proposals will be received at the offices of the Water Commissioners, City Hall, until 12 noon, July 31st, 1913, for the fabrication and laying of about 10¼ miles of 36-in. riveted steel pipe and appurtenances on the line of the Sooke Water Supply pressure conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer for such construction, pursuant to the provisions of By-law No. 814.

Plans and Specifications can be seen, and Forms of Tender obtained at the Sooke Water Supply Office, 1414 Douglas Street, Victoria, B.C.

The lowest or any tender not necessarily accepted.

C. H. RUST,
Water Commissioner.

Victoria, B.C., June 27th, 1913.

Sealed tenders addressed to the undersigned and endorsed "Tender for Toronto Harbour Works," will be received at this office until 4 p.m., on Monday, August 25th, 1913, for the construction of a Sea Wall, Breakwater, Ship Channel and Retaining Walls at the City of Toronto, in the County of York, Province of Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of J. S. Sing, District Engineer, Confederation Life Building, Toronto, Ont.; Harbor Commissioner's Office, 76 Adelaide Street West, Toronto; H. J. Lamb, Esq., District Engineer, Windsor, Ont.; and J. L. Michaud, Esq., District Engineer, Post Office, Montreal, Que.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to five per cent. (5 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, July 12, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—44297.

For further Tenders see page 86.

An Invitation

We cordially invite all engineers and architects to correspond with us regarding fireproofing when designing new structures. Our knowledge of fire protection and the matters that govern insurance rating is very thorough and highly specialized. Without charge this knowledge is at the service of engineers and architects so that when their structure is complete we will be able to obtain for them the very lowest possible insurance rate.

E. M. SELLON & CO.
LIMITED
INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E. J. J. Creelman

136 St. James Street · Montreal

Cost of pipe = 20% cost of work
Saving by using poor pipe = 20%
Saving on total cost = 4%

IS IT WORTH WHILE?

If the sewer is to cost $10,000, for instance, MIMICO pipe would likely not cost more than $2,000, probably considerably less. Not more than $400 could be saved on this pipe cost by purchasing a poor grade of pipe. You would then have a poor sewer costing $9,600, when for $10,000 you might have had the very best sewer possible to build. Is it worth while to buy poor pipe? No! Then buy Mimico Brand and put an end to sewer troubles.

Write for 1913 Catalogue

Round Pipe and Square Dealings

The Ontario Sewer Pipe Co.
LIMITED
MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24".

RENOUF PUBLISHING CO.

25 McGill College Ave.
MONTREAL

NOW READY
FOURTH EDITION, Revised and Enlarged

GEBHARDT—**Steam Power Plant Engineering**

By G. F. Gebhardt, Professor of Mechanical Engineering, Armour Institute of Technology. 8vo, xvi + 966 pages, 605 figures. Cloth, $4.00 net.

The development of Steam Power Plants has been so rapid during the past three years that it has become necessary to re-write this book. Over three hundred new illustrations have been added, and the entire text has been reset.

Note the reduction in price from $6.00 net to $4.00 net.

PEABODY—**Computations for Marine Engines**

By Professor Cecil H. Peabody, Massachusetts Institute of Technology. 8vo, iv + 209 pages, 52 figures. Cloth, $2.50 net.

This book gives the methods of computing the proper size and strength of the parts of a marine engine, similar to those in good practice, with special attention to instruction, and perhaps carried to a somewhat greater degree of refinement.

PEABODY—**Propellers**

By Professor Cecil H. Peabody, Massachusetts Institute of Technology. 8vo, iii + 132 pages, 29 figures. Cloth, $1.25 net.

Gives a reliable and convenient method of designing propellors, based on model experiments, and free from all theoretical intricacies and uncertainties.

KING—**Steam Engineering.** A Text-book

By William R. King, U.S.N., Retired. Principal of the Baltimore Polytechnic Institute. 8vo, vii + 450 pages, 177 figures. Cloth, $4.00 net.

Presents concisely the principles and constructive details of the make-up of a steam-power plant, together with such calculations as are necessary for a practical knowledge of steam engineering.

TENDERS CALLED FOR

TENDERS FOR PAINTING BRIDGES.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on **Tuesday, August 5th, 1913,** for painting North Glen Road Bridge over Rosedale Ravine, St. Clair Avenue (Moore Park), over Vale of Avoca, and Wallace Avenue Bridge (footbridge over C.P.R. and G.T.R tracks).

Specification and tender form may be obtained upon application at the office of the Railway and Bridge Section, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relative to tendering as prescribed by City By-law must be strictly complied with or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor).
Chairman, Board of Control.

City Hall, Toronto,
July 15th, 1913.

TOWN OF BASSANO, ALBERTA.

SEWAGE DISPOSAL WORKS.

Sealed tenders, addressed to the undersigned, will be received up till 18 o'clock on Friday, 15th August, 1913, for all labor and materials (except filter distributors) necessary for the construction of sewage disposal works, consisting of tank and filter and relative works near the town of Bassano.

Tenders must be accompanied by an accepted cheque for five per cent. of the amount of the tender, or alternatively by the bond of an approved guarantee company.

Plans and specifications and other information may be obtained at the offices of the Consulting Engineers at Winnipeg and Calgary, on deposit of $25, which will be returned to bona fide tenderers on return of the plans.

The corporation do not bind themselves to accept the lowest or any tender.

GEO. B. R. BOND,
Secretary-treasurer, Bassano, Alta.

July 1913.
The John Galt Engineering Co., Ltd.,
Consulting Engineers.

TENDERS.

Will be received by the undersigned up to Friday, August 15th, 1913, for the erection of a three-story concrete and brick municipal building for the town of Cobalt, approximately 43 feet x 100 feet, according to plans and specifications prepared by Messrs. Angus and Angus, architects, North Bay.

Contractors are required to enclose a marked cheque along with each tender for 5 per cent. of the amount of same, the lowest or any tender not being necessarily accepted.

Work to commence immediately on award of contract.

Plans and specifications may be seen at the office of the architect or at the office of the undersigned.

R. L. O'GORMAN,
Town Clerk.

Cobalt, Ont.

TOWN OF CARLYLE, SASKATCHEWAN.

WATERWORKS AND ELECTRIC LIGHTING.

Sealed tenders, addressed to the undersigned, will be received up till 18 o'clock on Friday, 1st August, 1913, for the following contracts:—

1.—Construction of brick power house and concrete reservoir, and laying approximately 800 lineal feet of pipe in trenches, and relative works.
2.—Supply of Air-lift Pumping System.
3.—Supply of Duplex Steam Pump.
4.—Supply and erection of two H.R.T. Boilers and Stack.
5.—Supply and erection of compound vertical steam engine.
6.—Supply and erection of Generator, Exciter, and Switchboard.
7.—Supply of poles, arms, hardware, copper wire, transformers and meters.
8.—Supply of Series Tungsten street lighting apparatus.
9.—Erection of Pole Line.

Tenders must be accompanied by an accepted cheque for five per cent. of the amount of the tender, or alternatively by the bond of an approved guarantee company.

Plans and Specifications and other information may be obtained at the offices of the Consulting Engineers at Winnipeg and Calgary. A deposit of $25 will be required on Contract No. 1, which will be returned to bona fide tenderers on return of the plans.

The Corporation do not bind themselves to accept the lowest or any tender.

F. J. STENT,
Secretary-Treasurer,
Carlyle, Sask.

The John Galt Engineering Co., Limited,
Consulting Engineers.

TENDERS FOR BRIDGE CONSTRUCTION.

Sealed Tenders plainly marked as to contents will be received by the undersigned up to NOON of WEDNESDAY, AUGUST 6th, 1913, for the construction of a reinforced concrete culvert on Yonge Street, at Langstaff, opposite Lot 36, Markham, in the County of York.

Plans and specifications and all necessary information may be seen at the office of the undersigned, 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
County Engineer.

Toronto, July 22nd, 1913.

EXTENSION OF TIME.

CITY OF VICTORIA, B.C.

Sealed proposals will be received at the offices of the Water Commissioner, City Hall, until 12 noon, July 31st, 1913, for the fabrication and laying of about 27½ miles of reinforced concrete pipe and appurtenances on the line of the Sooke Water Supply gravity conduit, and in accordance with the requirements of the general specifications prepared by Wynn Meredith, Consulting Engineer, for such construction, pursuant to the provisions of By-law No. 814, and adopted by the Council.

Plans and Specifications can be seen, and Forms of Tender obtained, at the Sooke Water Supply Office, 1414 Douglas Street, Victoria, B.C.

The lowest or any Tender not necessarily accepted.

C. H. RUST,
Water Commissioner.

Victoria, B.C., June 14th, 1913.

For further Tenders see page 84.

We offer

for WATER SUPPLY, Mines, PENSTOCKS or Manufacturing Purposes,

2,000 ft., 30 in. diameter, 3/8 in. thick

(NOMINAL)

STEEL PIPE

(LAPWELDED)

For sale at a sacrifice

Immediate Delivery

Lengths in stock from 11 to 12 feet and multiples of this can be supplied to suit customers' requirements with butt or flanged connections as desired.

INTERNATIONAL MARINE SIGNAL CO., Limited

OTTAWA, ONT.

MANUFACTURERS OF—

"Willson" Automatic Acetylene Gas Buoys
"Willson" Flares
Travelling Cranes
Boilers and Tanks
Structural Steel
Plate Work of all descriptions

Cut this coupon and MAIL TO-DAY!

INTERNATIONAL MARINE SIGNAL CO., Limited
OTTAWA, ONT.

Please let us have full particulars regarding STEEL PIPE advertised in The Canadian Engineer.

NAME.....

ADDRESS.....

SECOND-HAND MACHINERY

Second Hand Rock Crushers

100% of service in these machines, at **50% of their cost** when new. Send for complete Price List.

1—30" x 14" "Buchanan" Crushing Roll
1—24" x 14" "Buchanan" Crushing Roll (Manganese steel shells)
1—25" x 16" "Mosser" Crushing Roll
1—No. 5 "Gates" Gyratory
1—No. 4 "McCully" Gyratory
2—No. 3 "McCully" Gyratory
1—9" x 15" "Farrell" Jaw
1—No. 3 "Champion" Jaw
1—8" x 8" "Jeffrey" pulverizer

L. F. SEYFERTS' SONS, Inc.
437 North Third St., PHILADELPHIA, Pa., U S.A.

FOR SALE—almost new, differential tackle and track; carry two tons. Canada representatives, 193 Spadina Avenue, Toronto.

FOR SALE—almost new, two 700-gallon cypress wood tanks with fittings, and 4 one hundred-gallon tanks on castors. Canada representatives, 193 Spadina Avenue, Toronto.

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

FOR SALE at a snap: 60-H.P. Cowan and Co. engine and 80-H.P. Cowan and Co. boiler. Write for particulars, J. F. Barnard and Son, Spencerville, Ont.

WANTED.—A second-hand handing-up machine; state make, price and time used. Box 74, *The Canadian Engineer*, Toronto.

QUOTATION WANTED.—For steam boiler; delivered Norwood; twenty horse-power; steel, tubular, also firebox type; give dimensions. E. J. Laing, Secretary, Board of Education, Norwood, Ont.

WANTED.—Left-hand water wheel (flume wheel), to give 25- horse-power under twelve feet head; must be in good condition. Box 76, *The Canadian Engineer*, Toronto.

CORLISS ENGINE—16 x 36—new two years ago; very reasonable. Box 82, *The Canadian Engineer*, Toronto.

FOR SALE.—Lidgerwood cableway, capacity 10 tons on single line; 14-in. x 28-in., double reversing engine, three grooved drums 50-in. diameter, steel gears 72-in. diameter. Box 78, *The Canadian Engineer*, Toronto.

FOR SALE.—Quantity of steel pipe, four feet diameter, ¼-in. thick, cut to any length to suit purchaser. In A1 condition. Address Box 80, *The Canadian Engineer*, Toronto.

FOR SALE.—Steam Barge, sand dredge, 2 deck scows, 1 barge. For full particulars apply to Box 88, *The Canadian Engineer*, Toronto.

FOR SALE.—3 second-hand contractor's Dinky Vulcan Locomotives in first-rate condition. One 9 in. x 14 in. and two 10 in. x 16 in. Also a 50-ton Steam Shovel, and some contractor's Dump Cars. Apply to The Canadian Fairbanks-Morse Co., Limited, 444 St. James St., Montreal.

WANTED.—A second-hand centrifugal pump, 6,000 to 10,000 gallons capacity, electric motor or gasoline driven, direct connected. Address Box 90, *The Canadian Engineer*, Toronto.

CURRENT NEWS.

Edmonton, Alta.—One and a half million dollars is the amount by which the civic authorities have decided to cut the construction programme for the present season in view of the present state of the money market. Since Kleinworts, of London, the purchasers of the city's debentures, warned the city that they might be obliged to fall back on the "war" clause in their agreement, the administration has decided to retrench where possible. All heads of departments have reported where work might be curtailed without serious injury and work will be cut accordingly. Eight hundred thousand dollars will be saved in connection with the street railway department, the electric light, telephones and fire department, while plans for sewer extension will be modified and some of the paving work postponed.

Kerrisdale, Point Grey.—There seems to be a misunderstanding by contractors as to the meaning of the advertisement calling for tenders for the building of a municipal incinerator. One tenderer appeared before the board of works recently and asked to be enlightened as to the requirements of the district. He was told that the municipality desired an incinerator capable of disposing of twenty-five tons of garbage daily and must be so constructed that equipment for disposal of another twenty-five tons per day can be added. Each tenderer will be required to submit his own specifications and plans, for there is such a large number of incinerator equipments that no particular type was specified by the council.

London, Eng.—A contract of over £1,000,000 has been signed for the construction of a railway and new harbor on the west coast of Ireland in connection with the All Red route scheme, which the Canadian Government has now approved. The railway will run from Collooney to Black's Bay, County of Mayo, which is to be the port for the steamers which will make the run to Halifax in three and a half days.

ENGLISH ENGINEERS FOR UNDERWRITERS' LABORATORIES

Messrs. Heap and Digby, of London, England, have recently been appointed engineers in Great Britain to the Underwriters' Laboratories, Incorporated, Chicago, and are therefore in an excellent position to approve and inspect apparatus made in Great Britain for the Canadian market, to ascertain if it complies with the requirements as laid down by the National Board of Fire Underwriters.

Mr. Pollard Digby has been engaged in consulting practice for ten years, during which time he has inspected a great deal of electrical machinery for the Indian government, for South American railway companies, as well as a number of the South African mining companies.

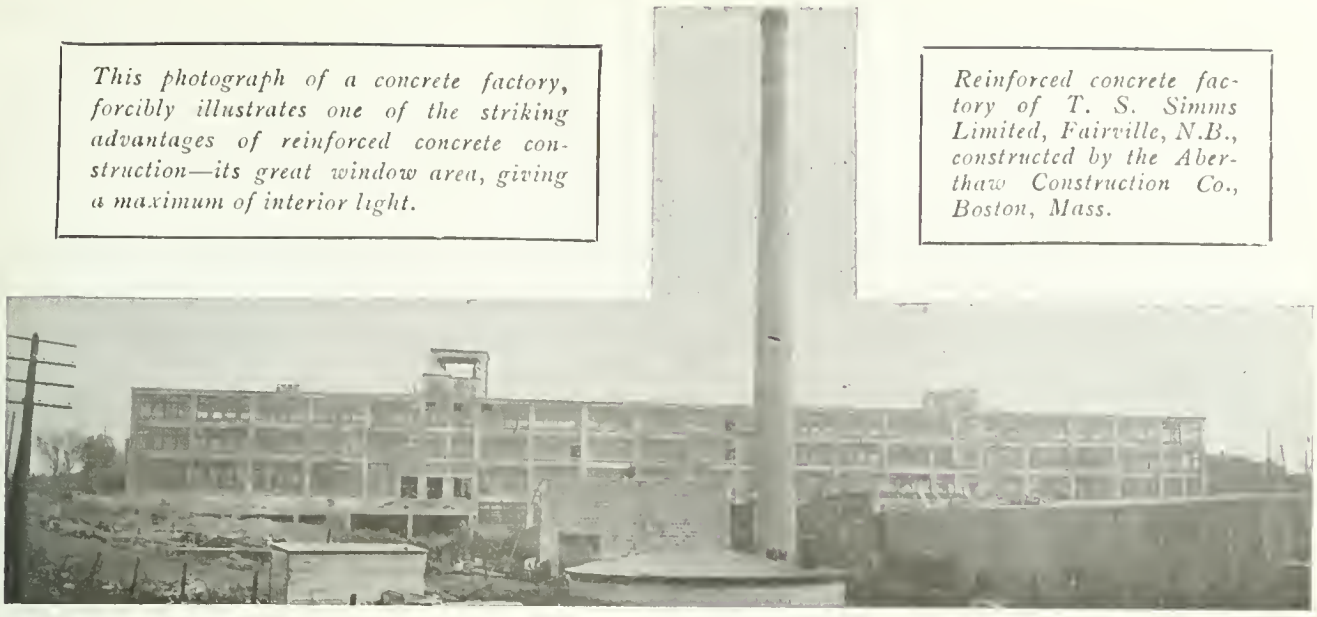
Mr. Digby is an associate member of the Institution of Mechanical Engineers, and also an associate member of the Institution of Electrical Engineers.

Mr. Arthur C. Heap was, previous to joining Mr. Digby last year, engaged for something like twenty-five years as a manufacturer of all types of electrical machinery, and therefore familiar with the details of construction, design and testing. He is a member of the Institute of Electrical Engineers.

The firm has a fully equipped laboratory where all the testing is done. They also have a branch office in Manchester, and Mr. Heap, the senior member of the firm, has for some years now made periodical visits to the United States and Canada, and is therefore in a position to fully understand Canadian requirements.

This photograph of a concrete factory, forcibly illustrates one of the striking advantages of reinforced concrete construction—its great window area, giving a maximum of interior light.

Reinforced concrete factory of T. S. Simms Limited, Fairville, N.B., constructed by the Aberthaw Construction Co., Boston, Mass.



Concrete Factories are Most Efficient

The efficiency of a machine is the ratio of the amount of work a machine does, to the amount of work required to operate it. The output is equal to the input minus the work lost or wasted. The less wasted the greater the efficiency.
In the same way the efficiency of a factory may be defined as the ratio of output to input. Output, financially, is increased by reducing unnecessary expenses.

Concrete Stops Wastes

Concrete buildings are proof against fire, water and vermin. They give the maximum light and are sanitary. They resist vibration, and are permanent and durable.

Fire-proofness reduces insurance rates. Water or liquids used in certain processes will not leak through floors to destroy valuable goods below. Rats and other vermin find no place to live in a concrete building, thus eliminating losses from this cause. Maximum light and sanitary conditions increase efficiency of employees. Lack of vibration reduces wear and tear on machines. Permanency and durability reduce depreciation.

The way in which concrete stops these leaks is fully described in our handsomely illustrated 224 page book, "Factories and Warehouses of Concrete." It contains photographs and data of factories and warehouses for all classes of industries.

You can have a copy free if you will mention this advertisement.

CANADA CEMENT COMPANY
LIMITED
MONTREAL

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.

By the city of Port Arthur, Ontario, **competent Ontario Land Surveyor** to act as Corporation Surveyor. Permanent position for the right man.

Apply giving experience, references and salary expected.

L. M. JONES,
City Engineer.

WANTED.—Superintendent for canal work. Must be experienced in steam shovel work, also four foremen. Address Box 84, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

ENGINEER,—Mechanical and electrical; A.M.I.E.E.; 29 years; married. Commercial, practical and technical experience and training. Good organizer, correspondent, salesman and advertiser. Author engineers' reference book with world-wide circulation. Requires position with opportunity for advancement. Box 501, G. P. O., Toronto.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

WHO WANTS to employ a man who has finished his third year in civil department at University of Toronto? Box 86, *The Canadian Engineer*, Toronto.

ELECTRICAL ENGINEER with ten years' experience in design, construction and operation of electric light, power, street and interurban railways; desires position as engineer, superintendent or foreman. Good references. Change personal reason. Single. Box, 44, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Anyone desiring to obtain the invention covered by Canadian patent No. 134782, granted on August 8th, 1911, to Spinnerei and Weberei Steinen, A. G., of Steinen, Germany, for spool changing mechanism for looms, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Smart. Castle Building, 53 Queen Street, Ottawa. Russel S. Smart, resident.

Agent Wanted

We are open to negotiate with a reliable firm to act as agent for Canadian business.

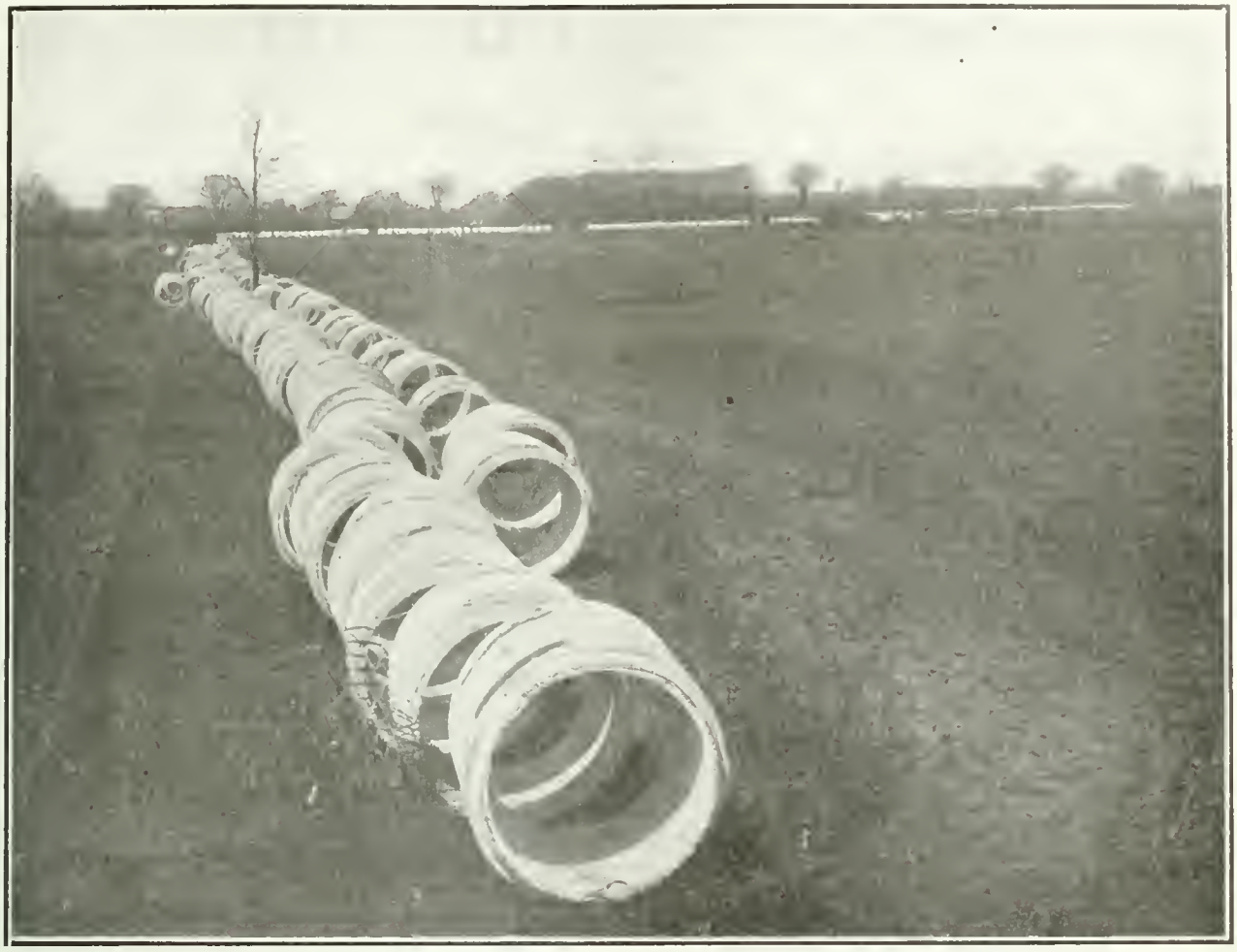
W. H. ALLEN, SON & CO.
LIMITED
Queen's Engineering Works
BEDFORD - - ENGLAND

Engineers and Builders of
STEAM, HYDRAULIC, AND
D.C. ELECTRIC MACHINERY

See advertisement on page 39.

Address firm's representative, c/o Box 92, *Canadian Engineer*, 62 CHURCH STREET, TORONTO.

The value of sandstone production in 1911, according to the statistics contained in the annual report on mineral production by Mr. John McLeish, B.A., was reported as $451,183, being a slight falling off as compared with the production in 1910, which was valued at $502,148. The greater part of the sandstone quarried is used for building purposes, though small quantities are also used as rubble and for paving purposes. Of the production in 1911, building and ornamental sandstone was sold to the value of $391,784, or 86.8 per cent. of the total sandstone sales. This amount comprised $86,502 in rough stone and $305,282 in dressed stone sold by the quarry operators. The production in 1910 of building and ornamental stone was valued at $454,220, comprising $118,364 in rough stone and $335,856 in dressed stone.



54-inch pipe distributed for sewers at Montreal, Canada.

MERIWETHER SYSTEM
CONTINUOUS RE-INFORCED
CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

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MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, July 19th, 1913.

Prices hold very steady, being again unchanged, as follows:—

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Copper.—Prices are 16¾c. Excellent demand.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are: Queen's Head, $4.35; Colborne Crown, $4.25; Apollo, 10¾ oz., $4.25. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lead.—Prices are firm at $5.35.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft. x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is active and strong:—$36 for 6 and 8-inch pipe and larger; $37 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 73½ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black and 63½ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, July 23rd, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 65c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.80, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1¼c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 7.5c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $6, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, July 22nd, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bare.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil; 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅞, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.60; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50: galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8¾ to 15c. per pound

Volume 25 Toronto, July 31, 1913

Contents of this issue on page 245

The Canadian Engineer

An Engineering Weekly

THE DESIGN OF CENTRAL HEATING SYSTEMS

PART III.

THE UNDERGROUND TRANSMISSION SYSTEM CONTINUED—FORMS OF CONDUIT IN USE AND THEIR COMPARATIVE COSTS—THERMOSTATIC CONTROL

By A. G. CHRISTIE, M.E.,

Assistant Professor of Steam Engineering, University of Wisconsin.

The method of installation of the piping system and its protection must be of such a character that settlement of the trench or the pressure of the earth will not cause the pipe to become out of level or alignment. The pipe must be free to expand and there must be no restriction to this movement or some parts shall surely fail. The

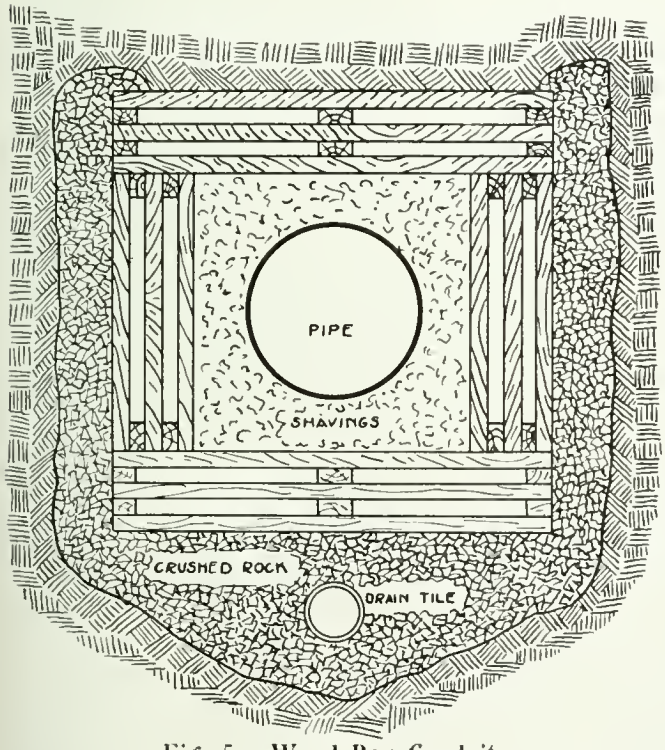

Fig. 5.—Wood Box Conduit.

insulating material and the conduit itself which protects the pipe must be of such a nature that it will not be affected by temperature changes in the pipe or in the earth. Otherwise cracks in the conduit will occur. These cracks allow water to seep in and not only to destroy the insulating material, but also to increase the line losses. All steam pipes should be carefully graded to the low points of the system where automatic steam traps should be placed in the manholes to remove the condensed steam and discharge it into sewers.

The earlier heating systems were usually provided with conduits built up of boards and paper with air spaces between and filled, as a general rule, with oiled shavings, as shown in Fig. 5. These conduits were very cheap in first cost, and gave good service when new. However, in a few years the oil commenced to distill out of the shavings and the wood started to decay, especially when laid in certain soils. A very uncertain factor was

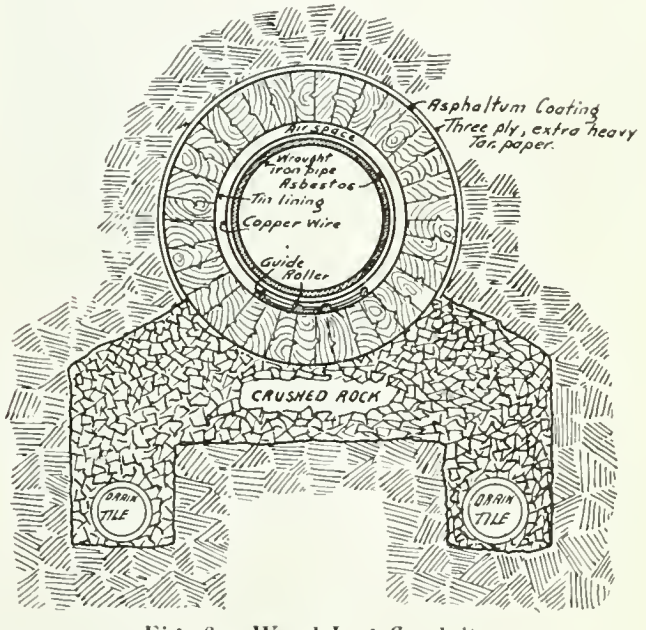

Fig. 6.—Wood Log Conduit.

the variation in decay in the length of an ordinary system due to variation in soils. Thus such systems became more inefficient with age, while the heating load, as a general rule, increased. It was also found hard to keep these conduits watertight. Their life has been stated to be anywhere from 15 to 25 years, depending on the soil surrounding them. After such experiences with this form, engineers have turned to other classes of conduit not so subject to decay or decrease in efficiency with age.

An improved form of construction is shown in Fig. 6, known as the "wood-log" conduit. It consists of white pine staves which have been thoroughly air and

kiln dried, cut to segmental section, and bound together into a circular form by heavy steel banding wires. These staves are provided with tongue and grooves, as shown. The outside is waterproofed by tar and usually an additional waterproof tar-paper covering is provided. The inside is lined with tin to cut down radiation losses and prevents any charring of the wood which might occur. The sections of casing can be obtained in lengths up to eight feet and are fitted together with mortise and tenon joints four inches long. The shell is usually four inches thick. The pipe is generally of wrought iron or steel, and all joints not adjacent to special fittings are made with heavy, long pattern couplings. The pipe itself is frequently wrapped with a special winding of asbestos paper secured in position by copper wire. Metal sealing rings are used at the joints of the casing when a watertight construction is desired. Girders and rollers for supporting the pipe are placed about eight feet apart. Special fittings are enclosed in watertight brick boxes

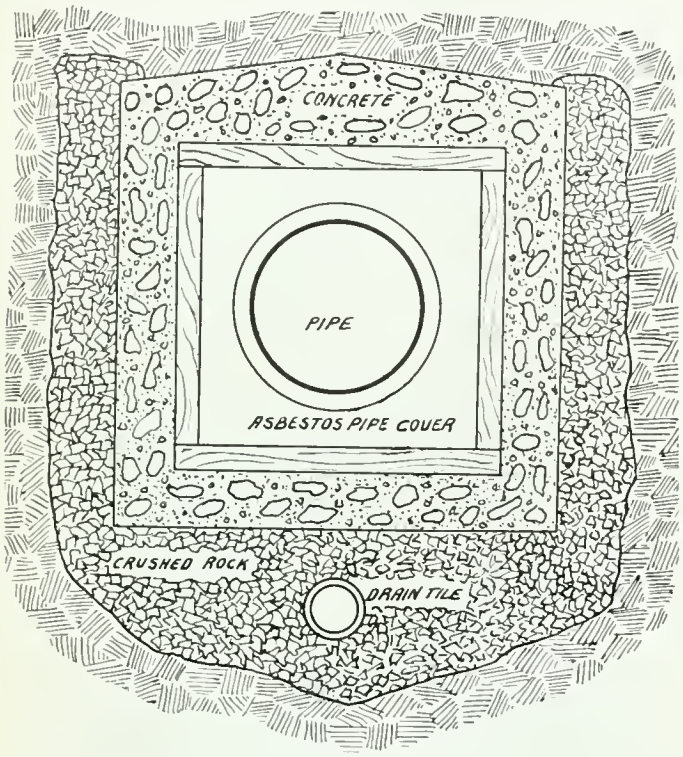

Fig. 7.—Concrete Conduit.

filled with oil-soaked shavings to prevent radiation losses. This conduit must be well underdrained to be efficient, which is usually done by means of single or double lines of 4-inch farm drain tile. It is fairly cheap and quite efficient, and can be readily taken up and repaired. The main objection to this construction is its deterioration, which is more or less rapid. In summer, when the heat is off the system, the wood is said to absorb moisture either from infiltration, from the ground, from leaky sewer pipe, or from broken water mains. The consequent swelling of the wood stretches the wires so that when hot and dried out again they are loose and allow the joints to open. The conduit is not then waterproof and the heat losses consequently increase. It has been noted in several cities that this wooden conduit deteriorates much more rapidly when laid under pavement or in cinders than when under sod.

Another form of conduit that has been used in a few cases consists of one of the wooden constructions already described, surrounded by a concrete shell.

Several heating systems have been recently built with the pipe line covered with an asbestos or similar moulded covering, which is waterproofed. A wooden box is then built around this, as shown in Fig. 7., and the whole then enclosed in a concrete box, thoroughly waterproofed and well underdrained. In some constructions oiled shavings have been used instead of the moulded covering, though less efficient. Concrete alone is not a good insulator so that dependence must be placed on the material surrounding the pipe. This conduit is expensive to lay, but is very enduring and maintains its high efficiency if it has been thoroughly waterproofed when laid. The principal objection to it is the difficulty of getting at the line for repairs or alterations.

The Milwaukee Central Heating Company use a type of conduit similar to Fig. 7, except that they install cast iron pipe with universal joints to carry the steam. This company has about 42,000 feet of main in service and have tried three different types of conduit. Their experience has led them to consider this type superior to either the wood-log construction or the concrete conduit filled with oiled shavings.

Another form of conduit, used at Beaver Dam, Wis., consists of hollow building tile in place of the concrete on the sides and top, as in Fig. 7. If this is once opened for inspection or repairs the tile is rendered useless. It has also been noted that tiles are liable to break in service, and, on the whole, this conduit has not proven very satisfactory.

Recent practice in heating systems has tended towards the adoption of the split glazed tile conduit shown in Fig. 8. The pipe is covered with a moulded or asbestos covering waterproofed by tarred paper or other means. A dead air space is provided between the covering and the tile. The joints of the tile are cemented together when the conduit is closed up. This conduit is very efficient as a heat insulator, cheaper than concrete, and more easily accessible for repairs. If the tiles are not first-class they break and thus destroy the efficiency of the system.

Cost of Conduit Construction.—The cost of conduit construction is a subject on which there is little information available. E. Darrow, in the Electrical World, April 6, 1911, in a paper on "Exhaust Steam Heating as Developed by a Large Central Lighting Station," gives the following costs for glazed tile conduits similar to that shown in Fig. 8.

Size, in inches	20	15	12	10	8	6	4
*Cost per ft.	$19.50	14.75	12.35	9.50	8.40	6.85	5.25

*Including trenching and paving.

For rough calculations this conduit may be said to cost $1 per foot length per inch diameter of steam main.

Conduits as shown in Fig. 7 are said to cost practically the same as the glazed tile. Wooden box conduits as shown in Fig. 5 are said to cost from 35 to 50% of the values given above. When hot water is used and two pipes are necessary, these costs have to be considerably increased.

There will be found in an article on "Wilkes-Barre's District Heating System," in the Engineering Record of September 14, 1912, the data reproduced in Table 4 on the costs of installing in Wilkes-Barre steam heating conduits of the type shown in Fig. 6. All re-paving was done by the city but the heating company was obliged to pay the city for permits to cut through the pavement at the rate of $3 per square yard for asphalt and $2.50 per square yard for brick, the measurements for which in-

cluded an excess of 8 inches beyond the actual cut and all tunnels and cuts under the pavement.

In the table, trenching includes cutting through the pavement, excavating the trench to grade, preparing subtrenches for underdrains, all backfilling and hauling away of surplus material. Laying pipe includes the furnishing and placing of all pipe, fittings, expansion devices, wood log, etc., the furnishing and laying of underdrains and all brickwork such as boxes around special devices and manholes for valves, traps and expansion joints.

The prices given were a fair average at the time the pipe was laid, but for use at the present time should be increased about 10 per cent. This work largely replaced a former system and was installed complete between May 31 and October 23 in 1911.

Temperature Control.—One of the most essential requirements of every well operated modern heating system is the installation of some form of thermostatic control valve on all service connections. In the case of residences, this valve may be located where the service enters the house and the thermostat may be placed in a central position in the living rooms. In office buildings each radiator is usually fitted with its own control valve and thermostat.

Thermostatic control with careful handling is said to reduce the charges for service by 6 to 8 cents per sq. ft. when on a flat rate basis. When meters are used, the savings that may be effected by this control system over hand-controlled service are as much as 15 to 30%, according to several central station managers.

However, when thermostats are installed on a system, the customer's attention should always be called to the fact that unless some simple rules are strictly followed the thermostat will waste heat. For instance, a window may be opened to air the rooms in the morning, and as the thermostat maintains a constant room temperature, this window may be left open for a considerable period. This would result in an enormous waste of heat. With a flat rate the heating company loses by such practice, while the customer has to pay bills that are unduly high when meters are installed.

When air-controlled thermostatic valves are used on the system, an air line has to be laid from the central station along the side of the heating main with branches carried to each service. The compressed air in this pipe is usually at about 15 pounds pressure. Johnson, Powers or National thermostats may be used with this system. In some cases independent thermostats like the Sylphon Regithern are placed on each individual service.

Miscellaneous Central Plant Service.—Vacuum systems are now quite commonly used in large office buildings, stores, libraries, private residences, etc., for cleaning and dusting. It has long been known that one of the cheapest means of transmitting energy is by the use of compressed air. In the case of vacuum the air is much less dense than when the air is under pressure and the losses are correspondingly reduced. It has, therefore, been proposed that the central heating company might in-

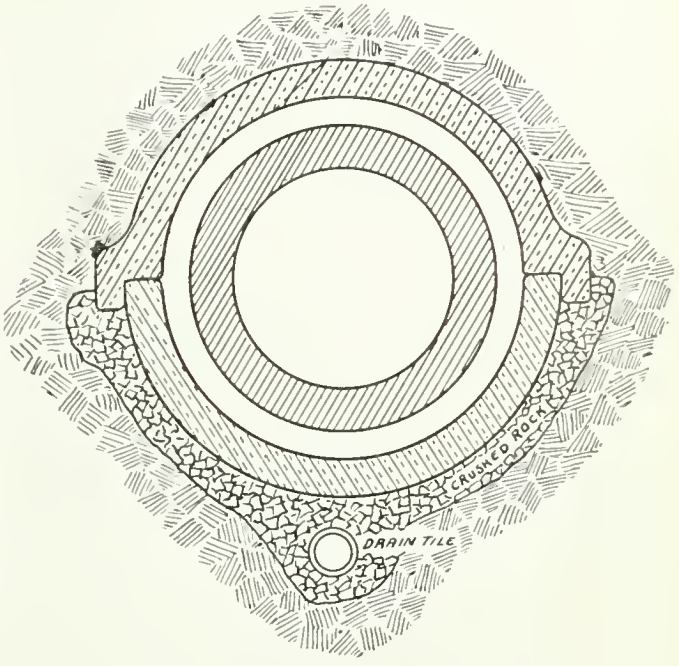

Fig. 8.—Split Glazed Tile Conduit.

stall a system of vacuum piping together with their heating system, and thus be prepared to furnish service to customers over certain periods of the day at a flat rate. No information has come to hand concerning such a

Table 4.—Conduit Costs at Wilkes-Barre.

Size, in inches.	Pavement.	Length, in feet.	Cost: Re-paving.	Trenching.	Laying pipe.	Incidentals.	Total.	Per lin. foot.
6	Brick	294	$ 405.35	$ 157.67	$ 1,210.46	.....	$ 1,773.48	$ 6.03
6	Asphalt	1,585	2,210.89	907.52	6,890.52	$ 52.04	10,060.97	6.35
8	Asphalt	489	744.68	283.95	2,878.63	3.66	3,910.92	8.01
9	Asphalt	361	533.97	229.76	2,582.40	.....	3,346.13	9.28
10	Brick	1,053	1,419.05	764.26	7,477.58	17.46	9,678.35	9.19
10	Asphalt	851	1,238.83	625.77	6,090.82	11.67	7,967.09	9.36
12	Asphalt	585	966.10	489.27	5,406.86	11.08	6,873.31	11.75
14	Asphalt	2,109	3,337.30	1,571.11	20,951.42	142.81	26,002.64	12.33
16	Asphalt	2,607	4,378.34	2,240.64	35,832.42	157.92	42,609.32	16.35
20	Brick	552	1,033.17	652.61	10,954.77	.....	12,640.55	22.89
24	Brick	275	521.83	484.18	6,807.59	6.23	7,819.83	28.39
18 and 24	Brick (in station)	....	.....	.....	.....	.....	978.45	.....
Total	.....	10,761	$16,789.51	$8,406.74	$108,061.92	$402.87	$133,661.04	
					Reconnecting house services ...		3,067.27	
					Engineering, 1.17%		1,600.64	
					Total cost of work		$138,328.95	

service at present in operation, though large hotels use these systems. However, the possibilities of such a system warrant a careful investigation of the project.

It has also been suggested that a hot water system might be supplied with cold water to cool the buildings during the intensely hot summer weather. Such results could be obtained by simply pumping cold water through the system if it were available or a system of refrigeration could be installed to artificially maintain the desired temperature. Such cooling service has been provided in some first-class hotels and in some theatres that run during the summer. Usually, however, the cooling of buildings is secured by passing the ventilating air through cold water sprays. While such cold water service as has been suggested would be welcomed by most people during the intensely hot summer weather, it is questionable whether this could be made profitable. It would be decidedly a luxury and not a necessity, as heat is in winter.

Ice-making plants have already been installed by several heating companies and many more are considering the advisability of such plants. These ice plants are run only during the summer season, and as they are usually of the absorption system, the exhaust steam is used which in winter goes to the heating system. As the electric load is frequently light during the summer months, in some cases compression machines have been installed. However, many decided improvements have been made of late years in the absorption system, and as exhaust steam can be readily used in it there is every probability that it will be used to a greater extent in the future than in the past.

Among the factors that should be considered when it is proposed to add an ice-making plant as an auxiliary to a central heating plant, the following should receive careful attention:—

1. The first cost and up-keep of the ice-making plant.
2. The probable demands for ice.
3. The competitive prices for ice.
4. The cost of making and delivering ice.
5. The power or exhaust steam available during the summer months for ice-making purposes.

A conservative estimate of the net profits to be derived from such an auxiliary plant is the real index that will show whether or not such installation is warranted.

Measuring and Charging for Central Station Service.—When central heating systems were first installed, charges for service were made by one of the following methods. At first, a fixed amount was charged the customer for the heating season equal to his average coal bill. This was unfair to the heating company, for it did not take into consideration the rising price of anthracite coal, the expense of removing ashes or the cleaning, repair and up-keep costs on the furnace used by the customer. This form of contract also encouraged the customer to minimize his former costs of coal. Besides this, customers usually practised strict economy in the use of heat from their own plants, but when this was supplied by a central station they were apt to be very wasteful. This last condition invariably occurs whenever charges are made on flat rates, and forms one of the strongest arguments against such systems of charging. A second system, which is still in use to a limited extent, provided for a fixed charge per unit of space heated. This method was often unjust, owing to the variation in the construction of the buildings heated, the height of ceilings, and use made of the building. A third method, which is still in use, consisted of a fixed charge per sq. ft. of radiation served. This system is not fundamentally correct, as it does not take into consideration the variation of heat demand with differences of glass and wall exposures, size of room, etc. However, if the radiators have been carefully designed for each room, the rates are, on the whole, very equitable. Such service should in every case be provided with thermostatic control, or otherwise the heat waste will be very great. While this method is still used to some extent with exhaust steam, it is used almost universally on hot water systems, for up to the present time no device has been placed on the market which will measure the heat supplied in hot water service. Such a meter is now being developed by Gebruder Sulzer at Winterthur, Switzerland, but has not yet been put on the American market. Some form of measured service is the best solution of the question of charges, both for the customer and for the company supplying heat.

The amount of heat supplied to a customer when exhaust steam is used can be determined by catching the condensation in a trap and discharging it through a hot water meter. The two meters of this type generally used are the "Simplex," made by the American District Steam Company, of Lockport, N.Y., and the "Detroit," made by the Central Station Steam Company, of Detroit, Mich. Other condensation meters of various types have been used and are being tried on heating systems with various degrees of success. All such instruments must be inspected periodically to see that bearings are not gummed up and stuck, that the dials are recording properly, that the spouts and nozzle are not choked up, and that the meter has not become out of level.

In some cases it is found desirable to measure the amount of steam supplied to a heating system, or, in the case of a large consumer, to measure the steam supply rather than the condensation. This can be done quite accurately by a steam flow meter. At the present time the type most widely used is that of the General Electric Company, Schenectady, N.Y. This meter is essentially a Pitot tube with either a mercury manometer or dial indicator or a special tilting device with a recording mechanism. Several tests have shown that these meters possess a high degree of accuracy for ordinary commercial work. Other steam flow meters that have been used include the Gebhardt, the St. John and the Sargent.

Water, either for boiler feed or for heating service, is most conveniently measured by the well-known Venturi meter, manufactured by the Builders Iron Foundry Company, of Providence, R.I. It is always provided with both an indicating dial and a recording dial of the circular chart type, and has an accuracy of within 2%. The Lea Water Flow Recorder, recently introduced into this country by the Yarnall-Waring Company, Philadelphia, Pa., is also used to measure and record the flow of fluids. In it the water passes over a V-notch and the quantity passing is recorded by means of a float and rack and pinion mechanism operating a pen on a paper chart driven by a clock. This apparatus cannot be used under pressure.

It will be noted that all condensation meters discharge to the sewer. This results in a certain loss of heat. When the supply of boiler feed water is bad, this loss of condensed steam is a serious matter and must be taken into consideration.

Probably the most important factor in the executive administration is the determination of equitable rates for service rendered. Rates, as already pointed out, should be based on the manufacturing cost of heat alone, independent of the financial benefits the company may derive

from the use of the steam generated to develop electric power. With such rates, reasonable profits will be assured irrespective of whether live or exhaust steam is used.

The rates to be charged for service will be dependent on: (1) the cost of coal; (2) the first cost and operating cost of the distribution system, and (3) the extent of the service and the number of customers. The rates in effect in cities throughout this country are very variable, as shown by the data presented in the "Report of the Committee on Rates" at the National District Heating Association's meeting in Detroit in June, 1912. From this report it can be seen that the average season on which heat is maintained on the distribution systems is 8.5 months. About 60% of the steam used in low pressure heating systems is exhaust steam, the remainder coming direct from the boilers through reducing valves. In almost every system reported the meters, where used, were installed by the operating company, though the taps were usually supplied by the consumer. The condensation is returned to the central station in about 20% of the plants. On steam systems customers are, almost without exception, required to install economizer coils at their own expense. About 50% of the companies charge the customer for service connections. The cost of coal ranged from $1 per ton to $8 per ton. The flat rates for low pressure steam ranged from 18 cents to $1 per sq. ft. per season. The flat rates, based on cubical contents, ranged from $2.50 to $8 per 1,000 cu. ft. per season. In meter rates there was an almost infinite variety from which no general conclusions of value can be drawn. In many hot water heating systems the rate per sq. ft. is limited by ordinance. The charges for hot water services on flat rates ranged from 10 to 30 cents per sq. ft., the average charge being about 20 cents per sq. ft.

DUNMORE IS RAILWAY TERMINUS.

Dunmore, Alta, is the eastern terminus of the Crow's Nest Railway. Starting at Dunmore, the Crow's Nest line opens up Southern Alberta country, and is the main thoroughfare to the rich Kootenay district, whose development in metals, timber and fruit is in its infancy.

Traffic increased to such an extent along this railway that the Canadian Pacific Railway decided to establish a station, round-house, and extensive yards at Dunmore, and the Canadian Pacific Railway estimates for 1913 show additional trackage and shipping facilities.

Dunmore is situated in easy access to raw material required for the manufacture of brick, pottery, tile, and terra cotta work; glass factories, iron plants, cement works, etc.

Mr. C. R. Ross of the Dunmore Development Company, Medicine Hat, will supply manufacturers interested with any information.

In his oxy-acetylene welding of copper, which is proving successful in German works, Carl Canzler has developed a process somewhat different from iron welding. Larger torches are necessary, and a liquid welding paste is employed, with a special copper welding wire. Formation of oxide is prevented by the paste. Copper plates an inch in thickness have been welded without difficulty, and the strength of the weld —which is not affected by acid—is found to be quite equal to that of solid copper in a continuous sheet.

ACTION OF SALTS IN ALKALI AND SEA WATER ON CEMENTS.

IN a recently issued bulletin of the United States Bureau of Standards, a paper is published containing results obtained from an investigation into the effect of alkali and sea water on concrete. The paper contains a good deal of experimental data which has been obtained during the past three years, and which is conclusive with respect to a number of points that have long been under discussion. The investigations were started in the structural materials testing laboratories of the Technologic branch of the United States Geological Survey, Mr. Richard L. Humphrey being in charge. They were transferred three years ago to the Bureau of Standards and the work continued by P. H. Bates, chemist, A. J. Phillips, assistant chemist, and R. J. Wig, associate engineer physicist, Bureau of Standards, under whose names the article appears. It is 157 pages in length and contains numerous illustrations, tables and diagrams. A few explanatory paragraphs, and the results which have been obtained to date, are given as follows:—

The disintegration of cement structures, when placed in contact with sea water, is a phenomenon which has attracted the attention of cement manufacturers and cement users almost from the first time that such material was used for marine construction. There are cement structures which have withstood the action of sea water for years and probably will continue to do so, yet there are structures which have failed; and it is also possible in the laboratory by artificial solutions to destroy almost completely a briquette, or cube, or cylinder made of cement mortars or concrete. The cause of this disintegration is not certain, though it is almost universally believed that it is the reaction of sulphate of magnesia of the sea water with the lime of the cement (formed during the setting) and the alumina of the aluminates of the cement, resulting in the formation of hydrated magnesia and calcium sulpho-aluminate, which crystallizes with a large number of molecules of water.

The other constituents both of the sea water and the cement are usually considered of little effect, though lately attention is being drawn to the fact that both sodium chloride and magnesium chloride rapidly attack the silicates.

Concrete structures have been made (especially in this country) which are resisting the attack of sea water to a marked degree. It is therefore not surprising that many engineers attribute the disintegration when it does occur to poor workmanship or materials, or to the abrasion of the sand or floating bodies in the water, and to the mechanical action of waves and frost action (as the disintegration usually takes place at or near the water line) rather than to any chemical reaction or crystallization due to such reaction.

It is not surprising that when cement structures were first placed in our arid regions this disintegration was not considered, though it was well known that these regions contain large quantities of magnesium sulphate, which, together with the sodium sulphate, forms the principal salts of the so-called "white alkali" in distinction from the black alkali, which is largely sodium carbonate. However, a short time after these structures were placed it was noticed that there was a softening of the mass along the water line and in due time this attracted considerable attention. It was investigated first by the Colorado State Agricultural College in the case of some dis-

integrated cement tile; and the Montana State Agricultural College in the case of the sewers and culverts of the city of Great Falls. These investigators, however, do not discuss the cause of the destruction other than to mention the sulpho-aluminate of lime formation, and in the case of the cement tile to mention that the silica and alumina were removed.

As the U.S. Government has been locating a large number of its irrigation projects in such regions, it was considered to be within the scope of the investigation of the Structural Materials Laboratories to make a study of this condition, which work was later consigned to the Bureau of Standards.

Scope of Investigations.—These investigations were planned for the purpose of determining the suitability and permanency of various cements in structures exposed to the chemical and mechanical action of sea water and alkali salts and, if possible, the cause of failure or disintegration of cements and concretes.

The study of the subject was begun in such a manner as to determine, if possible, just what reaction would take place when the salts, commonly present in sea water and alkaline soils, were allowed to act on cement mortars. In order that this study should be complete, information should be obtained not only as to what salts present in any solution might cause destruction, but also in what manner this destruction is being accomplished. Both chemical and physical investigations were made in the laboratory, and field tests in sea water were made. In both series of laboratory tests there have been used at various times, in addition to sea water from Atlantic City, solutions of sodium chloride, sodium sulphate, sodium carbonate, magnesium chloride, magnesium sulphate, ferrous sulphate, and also solutions in which there were present in equal parts by weight two salts as sodium chloride-sodium sulphate, sodium chloride-magnesium chloride, sodium chloride-magnesium chloride, sodium chloride-magnesium sulphate, sodium sulphate-magnesium sulphate, sodium sulphate-magnesium chloride, sodium chloride-sodium carbonate, sodium chloride-calcium chloride, sodium sulphate-sodium carbonate, magnesium chloride-magnesium sulphate. It will be noted that a solution of calcium sulphate was not used. This salt is comparatively insoluble, and a series of tests using it, even in a saturated solution, would hardly be comparable with the series in which the above were used and in which the solutions contained but 2 per cent. by weight of the anhydride salts. Moreover, when this solution contained the sulphuric anhydride radical, calcium sulphate would be formed in the cement.

With regard to field investigation, while much valuable information can be obtained from an inspection of existing concrete structures in sea water, it is practically impossible to obtain reliable and complete information after a structure is several years old as to the qualities of the materials used and the character of the workmanship in construction. The field laboratory was located at Atlantic City, N.J., as it was readily accessible and the sea water at this point was rather pure and undiluted from fresh-water streams. Atlantic City is situated about 150 miles south of New York on an island 7 miles long and from ⅛ to 1 mile in width, lying about 6 miles from the New Jersey mainland, with bays and salt marshes between. The building used as a laboratory, under which the exposure tests were made, was located on a pier 700 feet from shore, about 20 feet above mean tide with 20 feet depth of water beneath.

Concrete of varied composition was made with Portland, natural, slag, and other special sea-water cements under conditions approaching as closely as possible the various methods used in sea-water construction. Several thousand briquettes and other small test pieces were made and exposed to sea water in connection with the concrete tests for the purpose of comparing various types and brands of cements.

Conclusions.—The conclusions must be limited by the scope of this investigation and since the physical tests cover a period of exposure not exceeding 3½ years the conclusions should be considered as somewhat tentative.

1. Portland cement mortar or concrete, if porous, can be disintegrated by the mechanical forces exerted by the crystallization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate and a rapid formation of crystals is brought about by drying; and as larger crystals are formed by slow crystallization, there would be obtained the same results on a larger scale, but in greater time if slow drying were had. Porous stone, brick, and other structural materials are disintegrated in the same manner. Therefore, in alkali regions, where a concentration of salts is possible, a dense non-porous surface is essential.

2. While in the laboratory a hydraulic cement is readily decomposed if intimately exposed to the chemical action of various sulphate and chloride solutions, field inspection indicates that in service these reactions are much retarded if not entirely suspended in most cases, due probably to the carbonization of the lime of the cement near the surface or the formation of an impervious skin or protective coating by saline deposits.

3. Properly made Portland cement concrete, when totally immersed, is apparently not subject to decomposition by the chemical action of sea water.

4. While these tests indicated that Portland cement concrete exposed between tides resisted chemical decomposition as satisfactorily as the totally immersed concrete, it is felt that actual service conditions were not reproduced, and therefore further investigation is desirable.

5. It is not yet possible to state whether the resistance of cements to chemical disintegration by sea water is due to the superficial formation of an impervious skin or coating, which is subsequently assisted by the deposition of shells and moss forming a protective coating, or by the chemical reaction of the sea salts with the cement forming a more stable compound without disintegration of the concrete, or by a combination of both of these phenomena.

6. Marine construction, in so far as the concrete placed below the surface of the water is concerned, would appear to be a problem of method rather than materials, as the concrete sets and permanently hardens as satisfactorily in sea water as in fresh water or in the atmosphere, if it can be placed in the forms without undue exposure to the sea water while being deposited.

7. Natural, slag, and other special cements tested in concrete mixtures showed normal increase in strength with age both in sea water and in fresh water.

8. In the form of neat briquettes most of the Portland cements of high iron content, several of the cements of high or normal alumina content and one special slag cement did not show any marked difference in tensile strength whether exposed to fresh or sea water for all periods up to two years. Other cements of various com-

positions showed signs of disintegration after a few weeks.

9. All cements resisted disintegration in sea water better in mortar mixtures than in the form of neat briquettes. In most cases the mortar briquettes had normal strength up to 2 years' exposure.

10. The physical qualities of the cement, which depend essentially upon the method of manufacture, would seem to determine its resistance to decomposition when brought into intimate contact with the sulphate and chloride solutions.

11. Contrary to the opinion of many, there is no apparent relation between the chemical composition of a cement and the rapidity with which it reacts with sea water when brought into intimate contact.

12. Tricalcium-sulpho-aluminate could not be formed, and therefore disintegration could not result from this cause.

13. In the presence of sea water or similar sulphate —chloride solutions:

(*a*) The most soluble element of the cement is the lime. If the lime of the cement is carbonated it is practically insoluble.

(*b*) The quantity of alumina, iron, or silica present in the cement does not affect its solubility.

(*c*) The magnesia present in the cement is practically inert.

(*d*) The quantity of SO_3 present in the cement up to 1.75 per cent. does not affect its solubility, but a variation in the quantity present may affect its stability by affecting its rate of hardening.

14. The change which takes place in sea water when brought into intimate contact with the cement is as follows:

(*a*) The magnesia is precipitated from the sea water in direct proportion to the solubility of the lime of the cement.

(*b*) The sulphates are the most active constituents of the sea water and are taken up by the cement. Their action is accelerated in the presence of chlorides. No definite sulphate compound was established.

(*c*) The quantity of chlorine and sodium taken up by the cement is so small that no statement can be made as to the existence of any definite chloride of sodium compound formed with the cement.

15. The SO_3 added to a cement in the plaster to regulate the time of set is chemically fixed so that it will not go into solution when the cement is brought into intimate contact with distilled water.

16. Metal reinforcement is not subject to corrosion if embedded to a depth of 2 inches or more from the surface of well-made concrete.

An economical mine telephone system, already at work in a Prussian mine, has been brought to notice by O. Dobbelstein, a German electrical engineer. Any of the continuous lines of metal extending into the mine—such as rails, air or water pipes, or cables—may be used as a conductor, and the other side is earthed in the usual way, although the metal is already connected to earth. The usual telephone receiver is used. Current is supplied by a battery of 12 volts, and in the secondary circuit an induction coil is used. As the current is not sufficient to ring a bell, a form of relay is necessary. The telephone current energizes a weak magnet, and this vibrates a metal disc, which acts upon the special circuit to ring a bell. Temporary telephones may be quickly put in place, or the installation may be of permanent kind.

PAVEMENT SUB-GRADE.

By S. J. Van Ornum,
Consulting Engineer, San Francisco, Cal.

Engineers who have charge of road building have, as a rule, given slight attention or thought to the proper preparation of the earth sub-grade upon which pavements are constructed. It is obvious that the earth under a pavement sustains the weight of the traffic, and if the earth sub-grade is not prepared properly and compacted sufficiently to sustain such loads, irregularities and depressions will gradually appear in the pavement. The official organ of the League of California Municipalities contains an article in its July 13th issue by Mr. Van Ornum which brings up strongly the necessity of carefully constructed sub-grade and carefully prepared specifications covering the same.

The pavement base provides a stable material upon which to construct the wearing surface, and also equalizes and distributes on the earth sub-grade, the loads subjected to the pavement by the traffic.

The weight of loads hauled by wagons and trucks has increased rapidly in the past few years, and especially is this true since the automobile truck has become so successful. Loads as great as ten and twelve tons are now hauled by automobile trucks over pavements which were not constructed to properly withstand such weights. Great care should, therefore, be taken to provide a sub-grade so prepared and compacted that it will sustain the heaviest loads imposed upon the pavement without injury to the base or wearing surface. Recent reports from New York and London state that the excessive loads transported over some of the streets of these cities have caused serious injury to the concrete base. One street pavement in London, which for many years has carried a very heavy street traffic without apparent damage, shows signs of failure since automobile 'bus lines have been running over it, and an examination discloses the fact that the concrete base has badly subsided.

Although engineers realize the necessity of a properly compacted paving sub-grade, yet, in preparing specifications they give slight consideration to this phase of paving construction, with the result that the section relating to the rolling of the sub-grade is generally inadequate and often not sufficiently explicit to obtain a hard and firm sub-grade. When the engineer has implied authority, the phrase "rolled to the satisfaction of the engineer" is quite general. One paving specification recently examined simply states that the sub-grade "is to be compacted by rolling or tamping," but failed to place any conditions or restrictions upon such rolling or the weight of the roller to be used. Another specification for the construction of a standard pavement required the sub-grade "to be compacted by rolling and tamping," and the rolling "to be done by a steam roller of a weight not less than five tons." A five tandem roller has an effective compressive weight of approximately 175 pounds per lineal width of tire, while the wagons hauling the materials over the sub-grade for the paving of the street exert a pressure of over twice this amount and loads as great as one thousand pounds per lineal inch width of wheel tire are at the present time hauled over pavements.

A light roller will not sufficiently compact the earth, nor will it disclose any local weakness in the sub-grade, such as carelessly refilled pipe trenches or an improper character or condition of material immediately underneath

the surface of the sub-grade, but will simply form a slight surface crust which has insufficient strength to sustain heavy loads. The writer has observed standard pavements badly subsided and shattered and their life greatly decreased due entirely to the faulty preparation of the sub-grade.

Heavy rollers are so constructed that the effective rolling is accomplished by the rear two wheels and the weight is generally distributed so that approximately one-third the weight of the roller is carried by each wheel. Specifications for compacting sub-grades in general require the use of a certain weight of roller expressed in tons, or provide a minimum weight per lineal inch width of roller tires. Road rollers are manufactured with several widths of rear wheels, and by merely specifying the weight of the roller the compression per lineal inch width of tire can vary to a considerable extent, and thus a heavy roller with wide tires will not give as much actual compression as one weighing two tons less which has narrow tires. On the other hand, a heavy roller may be specified, which with narrow tires gives an excessive weight and might endanger water and other pipes if the ground be in a loose and unstable condition. The minimum and, in unfavorable soil conditions, the maximum compressive weight per lineal inch width of tire seems the more logical manner of specifying the weights, and obviates any uncertainty of the compression which will actually be used in rolling the sub-grade.

The slight increase of cost which thorough rolling entails is incomparable with the added durability and utility of the completed pavement resulting from a well compacted and solid sub-grade.

ELECTRIFICATION OF RAILWAYS.

In connection with the consideration which the Canadian Pacific Railway Company is giving to the electrification of a portion of its lines, it is interesting to note what American railways are doing in this respect. The day of electrification of steam roads is dawning. It has been stated that it costs about the same, mile for mile, to electrify as to build a new road, and the question is, therefore, almost entirely one of the advisability of heavy investment.

The Pennsylvania Railway is contemplating electrifying its line between Pittsburg and New York, a distance of over 400 miles, which will be at least double-track, and which will cost approximately $40,000 per single track mile.

In the Western States the Great Northern Railway, and the Chicago, Milwaukee and Puget Sound Railway have planned the electrification of 530 and 440 miles respectively, contracts having already been let for roadbed, power, etc. This revolutionary step is occasioned by the poor coal and water conditions with which steam locomotives have to contend in North Dakota, Montana and Idaho, and with hydro-electric power in abundance.

The Denver, Rio Grande and Western is electrifying one of its mountain divisions, 114 miles in length. Some 73 miles of mountain electrification for heavy coal haulage is a very interesting application of electricity in railroading which the Norfolk and Western Railway is planning in West Virginia. The new suburban electrified section of the Pennsylvania, extending from Philadelphia to Paoli, will comprise 70 miles of single track.

Electrifications which have already been made in the United States by steam railroads are as follows:—

	Miles of single track.
Baltimore and Ohio ..... The original electrification of the steam railroad. The pioneer user of heavy electric locomotives.	7.4
New York, New Haven and Hartford ..... Including 22 miles on the Hoosac tunnel route of the Boston and Maine, the lines from New York to Stamford, and Providence to Warren (38.5 miles and 109.3 miles); the Harlem River Branch, 141.4 miles; the line from Stamford to New Haven, now nearing completion, 210 miles, besides more than 50 miles of short lines, including a very complete system about Hartford.	594.8
New York Central ..... Two hundred and thirty-four miles out of New York City, 19 miles on the Michigan Central (Detroit River tunnel), and 118 miles on the West Shore Railroad between Utica and Syracuse.	371.6
Pennsylvania ..... Comprising 186.8 miles on the Long Island Railroad, 98.4 miles on the Pennsylvania's approach into New York, and 150.3 miles between Camden and Philadelphia.	435.5
Butte, Anaconda and Pacific ..... An ore-carrying mountain line	90.0
Southern Pacific ..... Suburban lines at Berkeley, Oakland and Alameda, Cal., close to San Francisco Bay.	96.0
Grand Trunk ..... Four miles of tunnel track (St. Clair tunnel) at Port Huron, Mich.	4.0
Erie ..... In Central New York to the south of Rochester.	40.0
Great Northern ..... The electrification of the Great Northern Railway's cascade tunnel, between Leavenworth and Skykomish, about 100 miles east of Seattle.	6.0

Word comes from London that Dr. Goldschmidt, the inventor of a new system of wireless telegraph which, it is said, will revolutionize such communication, has telegraphed his London agent that he has satisfactorily established communication between Neustadt, Ruebenberg, near Hanover, Germany, and Tuckerton, N.J., for two days during the day time, when the power employed at Neustadt—namely, 150 kilowatts, was more than sufficient for the distance of 3,900 miles. In the tests the new "singing wheel" used in this invention showed itself to be capable of such delicate adjustment that secret messages can be sent inasmuch as it can be varied and adjusted instantaneously to any length of wave. The reception of messages is so delicate that an attempt to tap it would involve the necessity of another company tuning to within .0 per cent. of a Goldschmidt message in order to be able to receive anything that could be understood. An English company with a privately-subscribed capital of $5,000,000 will probably be registered shortly. Sir Oliver Lodge, the scientist, expresses the opinion that the Goldschmidt machine will rule the aerography of the future.

PUBLIC CONSTRUCTION CONTRACTS.

The special committee of the American Society of Engineering Contractors presented a report which contains a fund of suggestions concerning public construction contracts. The report, which was made by Mr. Wm. B. King, is not an exhaustive one, but serves well as a basis for further discussion among engineers and contractors. As appearing in the Journal of the society for March, it contains the following:—

1. Your committee thinks it impossible to submit a complete form to cover all phases of all engineering contracts, but a work of much value can be done by adopting some general principles and formulating them so that they may be made a part of substantially every contract.

2. Every condition of whatsoever character by which the parties are to be bound should be submitted to bidders as a part of the specifications on which they bid. The contract to be signed should be annexed to the specifications. In this way the bidder is not liable to be surprised by new conditions appearing in the contract submitted for his signature after his bid is made and accepted.

3. The greatest vice of contracts is uncertainty. In adopting any form of contract or specifications, every effort should be made to secure exactness of definition of the rights and duties of both parties.

4. Recognizing the impossibility of foreseeing every emergency, some authority must be devised for the determination of either unexpected physical conditions or unforeseen ambiguities in the contract.

5. The first requisite to this is promptness, so that work may proceed. This doubtless requires that all disputed questions shall be primarily settled by the engineer present on the work.

6. But, while the engineer is the best fitted person to reach a prompt decision, his relation to the owner unfits him for an impartial decision. There must, therefore, be some provision for an appeal to an impartial tribunal, and final settlement of all disputes by it.

7. Disputes should, as far as possible, be settled as the contract progresses, so that the parties can know how they stand. To this end, all matters of dispute should be reduced promptly to writing and all appeals from the engineer's decisions should be promptly taken.

8. Each party should assume full responsibility for his own share of the contract.

9. This involves the assumption by the owner of responsibility for the local conditions and for the borings or other explorations of the site. The contractor should bid on guaranteed local conditions, with an increase or reduction of price for variations from these. The locality belongs to the owner and the contractor should not be obliged to gamble on it.

10. The principle also requires that a contract should not both provide the exact details of construction and guarantee the result. If the contractor is to do the work according to exact plans furnished him by the owner, the owner should take the responsibility for the result. If the contractor guarantees the result, he should be free to adopt his own methods of construction.

11. The contractor, especially when bound by a time limit, should be given the utmost freedom as to the order and manner of doing the prescribed work.

12. Definite provision should be made for the assertion in writing of demands made by either party varying from the normal contract price. The contractor should give prompt notice of a claim for extras and the owner of a claim for a decrease or for the assessment of damages.

13. Some rule should be prescribed for the owner's protection in case of delay on the contractor's part, either by a right to annul the contract, or to take over the work in whole or in part, or to deduct actual or liquidated damages. The subject is one of great difficulty and needs most careful consideration.

14. The contractor should be protected from loss by delay of the owner or the owner's other contractors and provision made for settling such losses, without suit, where possible.

15. What is the proper amount of retained percentages? What should be the maximum part of the contract price to be retained until final payment? Differences of opinion should be adjusted and a uniform rule adopted.

16. Material men insist that the contract bond should provide for payment for materials and labor. This leads to greater security to the material men and consequently lower prices. But it is an unnecessary cost to contractors to establish credit. This subject needs the views of both sides.

17. Some contractors and engineers maintain that the contract conditions should be as brief as possible. Your committee believes that all subjects which experience has shown may produce conflict should be definitely disposed of by the provisions fixed in the contract, even if this extends its length.

18. After every effort has been made to avoid all uncertainty in the contract and to settle disputes as they arise, some honest differences of opinion as to the rights of the parties may persist to the end of the contract. The final settlement of uncontested matters should be made without prejudice to the right of the contractor to recover disputed claims in the courts. It has, unfortunately, become too common to declare that on final payment the contractor shall sign a release of all claims arising out of the contract. This is a one-sided and dishonest provision. When payment is earned by a fulfilment of the contract, it ought not to be denied because the contractor believes that he is entitled to more, nor should he be forced by necessity to waive access to the courts to correct wrongs done him in the course of the contract.

Your committee might extend this discussion much farther, but believes that enough has been said to show the difficulties of the subject and the need of full consideration. Many forms of contracts have been drawn by various authorities. The standard forms of the Royal Institute of British Architects and of the American Institute of Architects have much to commend them. One general remark may be made in regard to nearly all such forms—that they have been generally prepared by persons representing owners, such as architects and engineers, and that, however fair their intention, the inevitable tendency has been to protect the owner's rights at the cost of the contractor's.

Boiling an iron or steel article in a gallon of water to which has been added four ounces of phosphoric acid and an ounce of iron filings will give it a black, non-corroding coating.

Canada's waterpower is estimated at 16,600,000 horsepower, equal to an annual production of 367,000,000 tons of coal; only 1,016,521 horse-power has been developed.

THE DESIGN OF A REINFORCED CONCRETE ABUTMENT.

Application of Theoretical Formulæ to Practical Design.

By H. R. Mackenzie, B.A.Sc.

THE general dimensions for the abutment shown in detail in Fig. 1, as designed for general use, are from the set of standard abutments of the Board of Highway Commissioners for the Province of Saskatchewan. The distance from bottom of footing to grade level is taken as 24 feet. The spans allowed for are truss spans up to and including 175 feet. The bottom chords of the standard Petit truss bridges are 17 feet 6 inches centre to centre. The width and depth of bridge seat are constant and the wing wall of the abutments slope back at an angle of 30 degrees with the face wall and decrease in height at a 1½ to 1 slope.

The dead load for a 175-foot Petit truss span consists of steel, 1,250 lbs. per lineal foot, while the live load is assumed as 100 lbs. per square foot of floor, (16 feet wide), and a 25-ton traction engine, with two-thirds of its weight assumed to act on rear wheels, which are 30 inches wide and 8 feet centres; axles being 10 feet centres.

This abutment was designed by the aid of general usages and empirical formulæ, and it is the purpose of this article to investigate the design from the standpoint of theoretical formulæ.

Foundations.—When rock foundations are unattainable on account of the great depth of soil, piles are driven to increase the bearing capacity of the foundations. If the nature of the soil is accurately known, the number of piles required can usually be determined before the excavations are made. As a guide in determining the necessary increase in bearing capacity of a certain soil, or the allowable stress on foundations of other materials, Baker's and Rankine's tables of crushing strengths for various materials likely to be used as foundation beds for abutments are of great service.

It is the custom of the Board of Highway Commissioners for the Province of Saskatchewan to carry the excavation to such a depth that the top of the piles shall be below low-water level. This condition is not required in the case of concrete piles, but the equipment required in driving is more elaborate, and is usually not included in the plant of contractors doing this class of work, hence wooden piles of 25 feet in length with a minimum diameter at the tip of 6 inches, are always used under normal conditions. These piles are placed principally under the main buttresses, centre of wing walls, and toe of footings, and vary from three feet to five feet centres, according to the requirements of the specific case considered. Spacing is left largely to the judgment of the resident engineer.

Design.—The base is approximately one-half the height. Two buttresses support the bridge seat, and are placed directly beneath the centres of bearing of the bottom chords of the truss. A face wall connects these buttresses, which resists the lateral earth pressures transmitted through the earth. The face wall is continued forming the wing walls. The buttresses and the face wall rest on a continuous base which resists the earth pressures. At the back of the bridge seat is a parapet wall supported by the bridge seat, which runs into the wing walls and simply serves as a retaining wall to protect the bridge seat.

Parapet Wall.—This wall is designed as a cantilever beam connected by continuous reinforcement to the bridge seat. Its height is 2 feet 6 inches. We shall consider a strip one foot wide, assuming that the line of cleavage of material behind the wall is at a slope of 30 degrees to the horizontal, or that ϕ equals 30 degrees. Hence Rankine's formula for resultant earth pressure becomes,

$P = \frac{w.\ h.^2}{6}$, where h = 2.5, and w = 100 lbs.; and therefore, P = 104 lbs.

For live load pressure we will assume the worst possible case of loading, i.e., when rear wheels of 25-ton traction engine are just off the bridge. This live load of 33,000 lbs. we shall assume to be distributed on 6 linear feet of roadway. Therefore, the load per lin. foot of roadway equals $\frac{33{,}000}{6}$ equals 5,500 lbs.

This live load of 5,500 lbs. per lin. foot of roadway is assumed to be distributed over a distance equal to the out to out dimension of the rear wheels which is 10.5 feet, therefore, the vertical pressure due to live load equals $\frac{5{,}500}{10.5}$ equals 525 lbs. per square foot.

Horizontal pressure equals $\frac{525}{3}$ equals 175 lbs. per square foot. Bending moment of resultant earth pressure assumed to act at lower third equals

$$w.\ l. = 104 \times 10 = 1{,}040 \text{ in. pds.}$$

Bending moment of uniformly distributed live load of 175 lbs. per square inch equals

$$\frac{w.\ l.}{2} = \frac{175 \times 2.5 \times 30}{2} = 6{,}575 \text{ in. pds.}$$

Total moment = 1,040 + 6,575 = 7,615 in. pds.
Hence, from theory of beam, 108 b. $d.^2$ = 7,615; and d = 2.4 inches.

In order to secure against impact, and to protect the steel, this beam is made 6 inches thick.

Amount of steel required = 12 × 2.4 × .008 = .22 square inches per foot of wall. Use ¾-in. rods, (area = .44 sq. ins.) spaced 2 feet centre to centre. Also to resist cross bending, horizontal rods ¾-in. diameter and 15-in. centres are used.

Face Wall.—The face wall is designed as a horizontal beam supported by the buttresses. As buttresses are 17 ft. 6 in. centres, and assumed 4 feet wide, we have a clear span of 13 ft. 6 in. Consider a strip one foot wide at base of face wall, assuming the thickness of footing to be 1 ft. 6 in., the depth of fill at centre of strip equals 22 feet. Hence, $p = \frac{w.\ h.}{3} = \frac{100 \times 22}{3} = 733$ lbs per square foot.

The live load stresses are assumed to have become dissipated in the embankment before reaching this depth. Hence bending moment equals

$$\frac{w.\ l.}{10} = \frac{(733 \times 13.5) \times (13.5 \times 12)}{10} = 160{,}000 \text{ in. pds.}$$

Therefore, 108 b. $d.^2$ = 160,000, from which d = 11.2 ins.
Similarly we shall examine a strip one foot wide at depth of 15 feet. $p = \frac{w.\ h.}{3} = \frac{100 \times 15}{3} = 500$ lbs. per sq. ft.

Bending moment equals

$$\frac{(500 \times 13.5) \times (13.5 \times 12)}{10} = 109{,}500 \text{ in. pds.}$$

Therefore, 108 b. d.^{2} = 109,500 and d = 9.2 ins.

Area of metal required at this point, 9.2 × 12 × .008 = .88 square inches.

amount required to make the beam equally strong in tension and compression. The vertical reinforcement consists of ½-inch round bars at 12-inch centres.

Bridge Seat.—The buttresses are designed to carry the bridge loads directly to the base, hence the bridge seat has no direct load to carry; but it carries a portion of the overturning moment from the parapet wall and

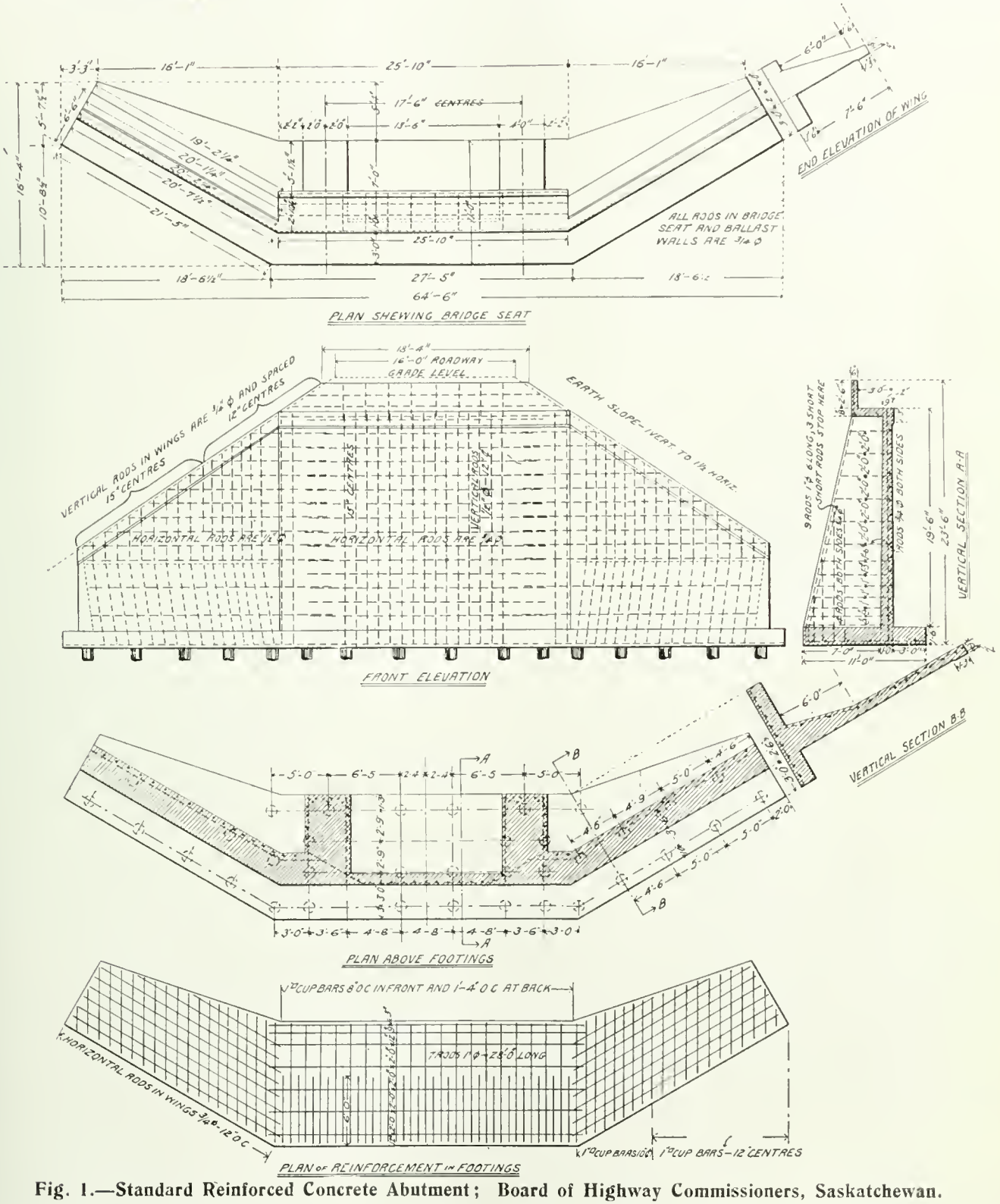
PLAN SHEWING BRIDGE SEAT
END ELEVATION OF WING
ALL RODS IN BRIDGE SEAT AND BALLAST WALLS ARE ¾ Ø
FRONT ELEVATION
VERTICAL SECTION A-B
VERTICAL SECTION B-B
PLAN ABOVE FOOTINGS
PLAN OF REINFORCEMENT IN FOOTINGS

Fig. 1.—Standard Reinforced Concrete Abutment; Board of Highway Commissioners, Saskatchewan.

To ensure against impact and transmitted live load pressures, the face wall is made 9 inches deep at the top, tapering to 12 inches at base. The amount of reinforcement shown in drawing is much less than the theoretical also acts as a bond between the buttresses, thus adding to the stability of the structure as a whole. The depth of 8 inches employed is amply sufficient for these purposes. The vertical bars in parapet wall are bent and continued

across bridge seat, while the longitudinal reinforcement consists of ¾-inch round bars 12-inch centres.

Bridge seats are sometimes designed to carry the load of the girder to the buttress if the girder should be accidentally displaced. This is thought by the writer to be an unnecessary precaution, as when the bearings of the truss are anchored to the buttresses in the usual manner adopted by the commission, nothing short of complete failure would displace the truss. This, however, is not true of railway truss spans where, from the nature of the accidents that may occur, the bridge seat should be designed to sustain a possible displacement.

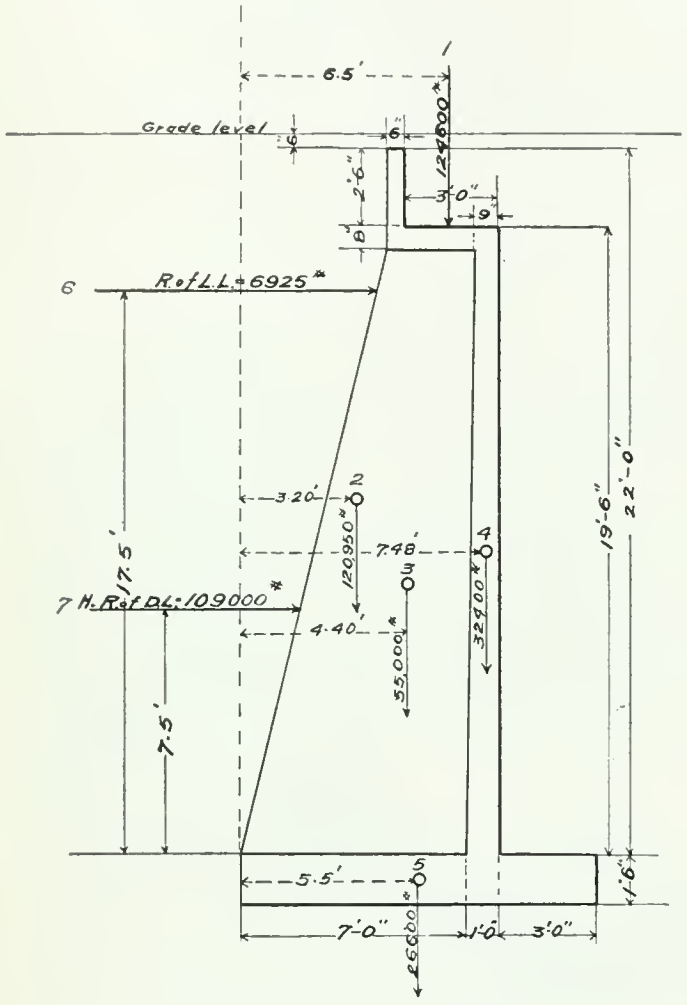

Fig. 2.—Section at Buttress.

Buttresses.—The buttresses are placed directly under the bed plates of the bottom chords of the truss. They are designed as cantilevers fixed at the base and are reinforced by bars placed in the rear, anchored in the base to take care of the overturning moment. The base of the buttress is large to secure the distribution of the abutment reaction over a considerable area of the footing.

Consider the required depth of buttress at the base: Depth to base of buttress = 22.5 ft. Therefore, resultant horizontal pressure on one foot of wall equals

$$\frac{w.h.^2}{6} = \frac{100 \times (22.5)^2}{6} = 8,437 \text{ lbs.}$$

Total width between wing walls equals 25 feet 10 inches.

Therefore, $\frac{25' \ 10''}{2}$ = 12.9 feet of wall supported by each buttress.

Therefore, the resultant dead load pressure on each buttress equals 8,437 × 12.9 = 109,000 lbs.

The bending moment of this resultant acting on an arm equal to one-third of the height equals 109,000 × 7.5 × 12 = 1,308,000 in. pds.

The live load of 5,500 lbs. per lin. foot of road, which, when assumed to be distributed over 10.5 feet giving a horizontal pressure of 175 lbs. per square foot, will decrease in intensity with the depth, but will consequently be distributed over a greater area of the wall. For these reasons we will assume that the total thrust due to live load can be approximated by considering it to act with an intensity of 175 lbs. per square foot at surface over a horizontal distance of 10.5 feet and diminishing to zero at a depth of 15.0 feet. Hence total live load pressure conveyed by face wall to each abutment

$$= \frac{87.5 \times 10.5 \times 15}{2} = 6,925 \text{ lbs.}$$

Distance of centre of gravity of live load pressures from base of buttress = 17.5 feet.

Bending moment of live load = 6,925 × 17.5 × 12 = 1,455,000 in. pds.

Total moment = 1,308,000 + 1,455,000 = 2,763,000 in. pds.

Therefore, 108 b. d.^{2} = 2,763,000 b = 4 feet, and hence, d.^{2} = $\frac{2,763,000}{108 \times 48}$ = 530. Therefore, d. = 23 ins.

Amount of steel required = 23 × 48 × .008 = 8.85 square inches.

Amount of steel from drawing equals 9 bars at 1″Φ = 7.07 square inches. But, in addition the these, there are four vertical bars ¾-in. rounds, placed on each side of the buttresses, which would more than supply the deficiency.

By similarly considering a section of buttress at a depth of about 12 feet, it will be found that approximately half the amount of steel required at base will be sufficient to resist the bending moment. Horizontal reinforcement is also used, but the area of such reinforcement cannot be easily calculated, and probably does not play any definite part in increasing the working strength of the buttress, except, in as far as the buttress may be considered, as a cantilever, supported by face wall, resisting lateral pressures at right angles to the centre line of the road.

No attempt is made to supply the theoretical amount of steel corresponding to the cross-sectional area of the buttress, as it is enlarged at the base to distribute the load within the safe bearing capacity of the foundation. The area of steel required to resist the bending moment can be computed, entirely apart from the required depth of the beam, by dividing the total bending moment by the perpendicular distance of bars from centre of base of face wall. This gives the required tensile strength which, if divided by the working stress per square inch of metal, will give the required area in square inches.

We shall now investigate the stability of the abutment at a section through one of the buttresses. Fig. 2 shows the dimensions at such a section as well as the position and intensity of the various forces due to live load and dead load stresses which act either directly on the buttress or are transferred to it by the base and face wall.

Force (1) = Abutment reaction of truss.

Force (2) = Weight of earth fill resting on buttress and projection of base pertaining to buttress.

Force (3) = Weight of buttress.
Force (4) = Weight of face wall, bridge seat and parapet wall pertaining to buttress.
Force (5) = Weight of base pertaining to buttress.
Force (6) = Resultant of live load pressures.
Force (7) = Resultant lateral earth pressures.

In calculating the intensity of these forces the weights of a cubic foot of earth and concrete were assumed to be 100 lbs. and 150 lbs. respectively, and each buttress is assumed to carry the forces acting on, and the dead weight of, one-half the area of base and face wall, etc., included within the out to out dimensions of the buttress, namely, 10.75 lin. feet.

The relative positions, and intensity of the resultants of the horizonal and vertical forces acting on the buttress were determined by the method of moments, and are shown in Fig. 3. The resultant "R" of these two forces was found by the solution of the triangle of forces, and equals 376,250 lbs. Its line of action cutting the base at a point 2.8 feet from toe. The resultant vertical pressure of 359,550 lbs. we shall assume to be uniformly distributed over a lineal distance of 10.75 feet. This assumption is considered rational on account of the binding action of the bridge seat and face wall being such as to allow of no movement of buttress apart from a displacement of the abutments as a unit. Also from the application of the formula

$$\frac{\overline{p}}{p} = \frac{1}{1 + \frac{x_0 x_1}{K^2}}$$

where $\overline{p}$ = Average pressure over rectangular cross-section
p = Maximum pressure on section
x_0 = Eccentricity
x_1 = Half the dimension of cross-section in the direction of the eccentricity,

we can assume the effective supporting width of the base to be 2.8 × 3 = 8.4 feet.

Therefore, $\overline{p}$ = the average pressure = $\frac{359,550}{10.75 \times 8.4}$ = 3,970 lbs. per square foot, and hence, p = pressure at the toe, = 3,970 × 2 = 7,940 lbs. per square foot, since the eccentricity is assumed to be ⅙ b.

The safe load per pile being assumed as 30 tons, and as area attributed to each pile is approximately 10 square feet, we have a bearing capacity of 6,000 lbs. per square foot due to piling alone. Also, as a conservative estimate we can assume the bearing capacity of the soil under ordinary conditions to be 25 lbs. per square inch, equal to 3,600 lbs. per square foot. Hence, total bearing power of foundation equals 6,000 × 3,600 = 9,600 lbs. per square foot. Therefore, the pressure at the toe of base is not beyond the resisting power of the foundation.

Wing Walls.—The wing walls are designed as cantilevers anchored at the base. Consider a strip of wall one foot wide, where height above footing is 15 feet. As wall is surcharged with material at natural slope the resultant earth pressure, $P = \frac{1}{2}$ w. h.^{2} cos.$^2\phi = \frac{1}{2}$. 100. (15)^2 (.886)^2 = 8,450 lbs.

No live load is considered at wing walls, hence total moment at base of wall = 8,450 × (5 × 12) = 507,000 in. pds.

Therefore, 108 b. d.^{2} = 507,000

$$d.^2 = \frac{507,000}{108 \times 12} = 392$$

d. = 20 in.

Area of steel required per foot of wall = 20 × 12 × .008 = 1.9 square inches.

The area of metal from drawing is only .44 square inches, and is constant from base to top of wall. This is apparently a mistake in design as bending moment decreases rapidly as surface is reached, the amount required at any particular point being determined by the method illustrated above.

Let us investigate the stability of the strip of wing wall under consideration. The dimensions, obtained from Fig. 1, are shown in Fig. 4.

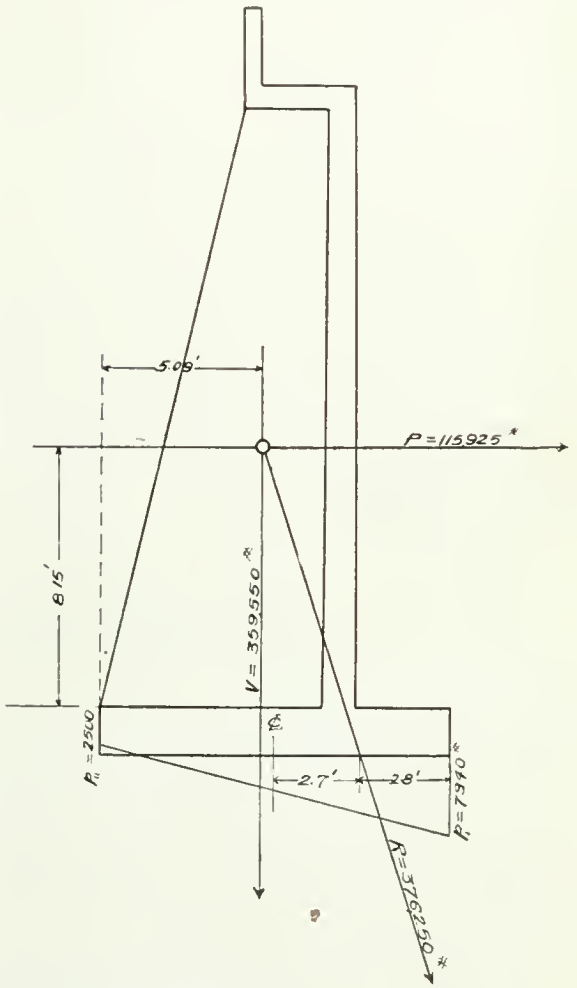

Fig. 3.—Resultant Forces at Buttress.

To find the resultant vertical force due to weight of wall and of area of earth resting on rear projection of base, we divide the wall into two parts, as shown, determining the weight and position of centre of gravity of each, also determining the weight of earth supported and its centre of gravity. The results obtained are shown in Fig. 4, and are based on the previous assumption that a cubic foot of earth and concrete weigh respectively 100 and 150 lbs. In order to find the position of the resultant of the three forces (1), (2) and (3), take moments about a vertical line through the heel.

Moment of force (1) = 8,320 × 2.33 = 19,400
Moment of force (2) = 1,120 × 5.57 = 6,250
Moment of force (3) = 2,370 × 4.65 = 11,000

$\Sigma x = 11,810 \qquad \Sigma m = 36,650$

$$y = \frac{\Sigma m}{\Sigma x} = \frac{36,650}{11,810} = 3.10 \text{ feet},$$

equal distance of resultant vertical force from axis of moments.

The position and intensity of the two forces affecting the stability of the wall are shown in Fig. 5. The resultant, "R," is found by solution of the triangle of forces equal to 17,500 lbs., and cuts the base 2.45 feet from the toe.

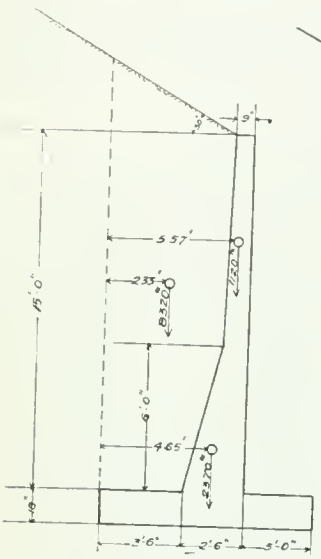

Fig. 4.—Resultant Vertical Force Due to Weight of Wall and of Earth on Base.

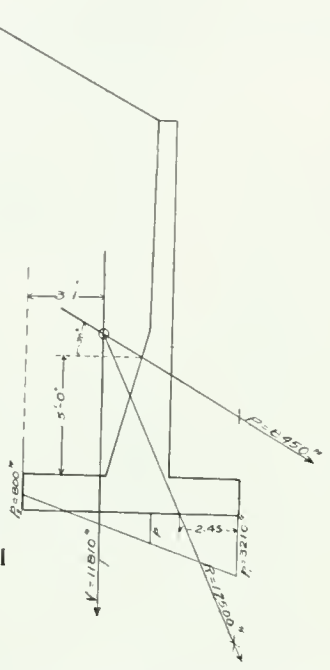

Fig. 5.—Positions and Intensity of Forces Shown in Fig. 4.

To find pressure on foundation at toe of wall, we shall assume, as in parallel case previously considered, that the effective width of supporting base = 2.45 × 3 = 7.35 feet. Hence, average pressure = $\frac{11,810}{7.35}$ = 1,605 lbs. The pressure at the toe equals twice the average pressure = 1,605 × 2 = 3,210 lbs., which is far within the bearing capacity of the assumed foundation.

Base—The base should be of sufficient width to properly distribute the load within the safe bearing capacity of the foundation. At the buttresses or any intermediate point the three-foot projection beyond face wall is subjected to an average upward soil pressure of 6,520 lbs. per square foot. This projection is assumed to act as a cantilever, and as the centre of gravity of the upward forces is found to be 1.58 feet from front of face wall, the moment in clockwise direction = 6,520 × 3 × 1.58 × 12 = 371,000 in. pds. Moment in opposite direction due to weight of projection = 12,100 in. pds. Hence, net moment = 371,000 — 12,100 = 358,900 in. pds. But, 108 b. $d.^2$ = 358,900, from which d. = 16.6 inches, as compared with total depth of 18 inches, as per Fig. 1. Area of steel required = .008 × 16.6 × 12 = 1.60 sq. ins. Area of steel from drawing equals 1-inch square bars at 8-in. o.c., equals 1.5 square inches per foot of base. The proper spacing of steel, according to our investigation, would be 1-in. square bars at 7-in. o.c.

Consider the shear at this section, thickness of base being 18 inches. The average shear on 12 inches equals

$$\frac{6,520 \times 3}{18 \times 12} = 90.5 \text{ lbs.}$$

As this exceeds the allowable shear in concrete, namely, 60 lbs. per square inch, it is necessary to supply shear reinforcement, apart from the area required to resist tension.

The base between buttresses behind the face wall is figured as a beam supported by the buttresses, to resist the upward or downward pressures, as the case may be. At any section between buttresses we have a net upward pressure behind the wall of 1,950 lbs. per square foot, and an average downward pressure of 2,000 lbs. per square foot on rear foot of base. As span is 13.5 feet,

$$\text{moment} = \frac{2,000 \times (13.5)^2 \times 12}{10} = 438,000 \text{ in. pds.}$$

But, 108 b. $d.^2$ = 408,000

$$d.^2 = \frac{408,000}{108 \times 12} = 337$$

d. = 18.35 inches.

Area of metal required = 18.35 × 12 × .008 = 1.76 square inches, as compared with total depth of 18 inches and area of 1.57 square inches of metal supplied, as per Fig. 1.

In order to take care of the reversal of stress in the rear of the footing it would be advisable to place reinforcing steel at the top and bottom of base plate.

The front and rear projections of base, in case of wing walls, are both designed as cantilever beams. Considering the front projection of the section shown in Fig. 5, we find that the average upward pressure to which the projection is subjected, equals 2,550 lbs. per square foot. The centre of gravity of these upward forces is found to be 1.63 feet from the face of the wall. Therefore, moment of upward forces equals (2,550 × 3) × (1.63 × 12) = 150,000 in. pds.

Resisting moment due to dead weight of projection equals (3 × 1.5 × 150) × 18 = 12,100 in. pds.

Therefore, net moment = 150,000 — 12,100 = 137,900 in. pds. But, 108 b. $d.^2$ = 137,900, from which d. = 10.3 inches.

Area of metal required per foot of wall equals 10.3 × 12 × .008 = .99 square inches.

Area supplied in Fig. 1 equals 1 square inch, and total depth of beam equals 18 inches, from which it appears that there is an excess of concrete at this point.

The design of the rear cantilever is exactly similar to the above and, as may be seen from the figure, the pressures are considerably less than in the case of the front projection. Hence it is evident that, if the same section be used throughout, it will be excessively strong, but perhaps permissible as it facilitates the construction.

The Transcontinental Railway Company, Ottawa, Ont., have recently purchased from the International Engineering Works, Limited, six locomotive boilers, 100 h.p. each. These boilers are to be installed in their various stations and roundhouses along the line.

EARNINGS AND INVESTMENT IN TRANSIT FACILITIES.

THE following is abstracted from a report by Mr. Bion J. Arnold on the transportation facilities of the city of San Francisco. The same traffic expert is investigating traffic conditions in Toronto at the present time, and his report concerning the service, etc., of the Toronto Railway Company will no doubt have a good deal to do with the purchase by the city of the Toronto Street Railway and the Toronto Electric Light Company, since it has been stipulated that they cannot be purchased separately. The following extract, which contains the major part of Mr. Arnold's conclusions and recommendations to the city of San Francisco, is likely, therefore, to be of interest:—

An analysis of growth shows that San Francisco is now growing faster than during the five years before the fire, and at a rate of increase of about 145,000 per decade. The real growth of the city, excluding the effect of the fire, has been at the rate of 54% for the last decade, as against 22% shown by the census. At the present time the city contains about 450,000 people. This population, on the conservative basis assumed, should double in 26 years, and should reach 1,000,000 people in 1945, although it may far exceed this.

San Francisco and the commuter district now has a population of 730,000 people, and has increased 48% in the last decade. This population should double in 23 years, reach 1,000,000 in 1919 and 2,000,000 in 1945.

In spite of this rapid growth, other large cities of the Pacific Coast are growing on the average at a rate probably 50% faster than San Francisco.

As a result of the fire, San Francisco lost 100,000 people permanently. The trans-bay cities gained in population by an amount practically equal to San Francisco's loss. But traffic statistics show that Oakland and its surrounding communities are becoming self-supporting to such an extent that the exodus from San Francisco has practically ceased, and that Oakland will go forward at a normal rate as a supplementary community.

One beneficial result of the fire was a general exodus of residents from the congested inner city to the suburbs, amounting to 66,000 people in the last census period. This has necessarily increased railway earnings and should therefore have made possible correspondingly improved service. The present distribution of population within the 30-minute zone is unusually uniform, except Chinatown and Japtown. The outlying distribution indicates that people will live where proper streets and car-service facilities are provided.

The growth and interchange of population within the district shows that the broader movements of population absolutely disregard municipal boundaries. The idea of a metropolitan district control for the development of utilities and industries is therefore of unusual necessity for San Francisco and the Bay cities.

A review of industrial growth shows that the period of great activity occurring just before the fire was practically recovered by 1910, and that commercial operations now generally exceed those of 1905. The fact that bank clearings suffered no perceptible depression during the disastrous year of the fire indicates the sustaining power of the financial credit of the community.

Manufacturing within the industrial district has alone failed to keep pace with the population within the last decade. In this respect the Bay cities have gained directly from San Francisco's heavy loss. The evident need for a more united industrial district points unmistakably to the practical value of the metropolitan district control idea already suggested.

An analysis of railway earnings shows that they are increasing in proportion to the square of the population; that is, when the population doubles, earnings quadruple. United Railroads earnings alone should double in the next 13½ years; that is, should reach $16,000,000 by 1924-25 and should quadruple by 1942. Earnings per capita are now the highest in the country—$20 per capita for all companies.

In extension of track mileage, San Francisco is at least six years behind the necessities of the growth in population. Trackage should extend at least as fast as the population, if not faster. The total track mileage is now about the same as before the fire, due to abandonments, and the last 15 years shows a slower growth than at any period of the city's history.

The present necessities for track extension require about 15 miles per year up to 1920. This will be just sufficient to complete the extension schedule recommended, and is also required to catch up with the normal growth in population. From 1868 to the time of the Market Street Railway Co. consolidation in 1893, track mileage was extended at the rate of 8.1 miles per year, during the maximum period, 16 miles per year. Since consolidation, the rate of growth has only averaged 3.6 miles per year.

The total operating equipment of all companies in 1911 was 676 cars. Prior to the fire there were many more cars reported, but of smaller capacity, averaging about 30 seats, as against 42 seats at the present time. Several hundred obsolete and worn-out cars were retired in 1907.

The total seating capacity at the present time appears to be about the same as before the fire, but it is a question whether the service capacity, in proportion to traffic, is as great in view of the increased schedule speed, owing to the exodus of population from the inner city to the outlying districts within the last census period.

Assuming the new equipment now on order by the United Railroads had been available to rectify the service requirements of 1911, the future growth of the city until 1920 will require an average addition of from 40 to 50 cars per year. This is a minimum schedule that can be carried out without materially diluting the net earning capacity, as San Francisco has already the highest earning rate from its equipment of any large city in the country. From 1889 to 1896, an average of 67 cars per year was added to the system, with maximum rates of increase within the period of from 140 to 200 per year.

The only way the above increase in equipment called for may be reduced is through the more efficient use of available car-miles by improved routing and by further increase in schedule speed. The size of the car units has about reached a maximum for the streets of this city.

That the extension schedule of track and cars called for here is not unreasonable is further indicated by the fact that out of the annual budget of investment predicted, about 25% will remain up to 1920 for betterments of existing property over and above the investment in new extension and equipment.

An analysis of the purchasing power of the city with respect to its utilities shows that the underlying property valuation is increasing at a slower rate than the necessary railway investment; that is, as the 1.7 power of the increase in population, instead of the square as in the case

of earnings. At the very lowest estimate, $3 of capital must be invested for every $1 earned. Under the present bond limit, therefore, the city's ability to purchase or build is becoming more and more inadequate, thus requiring a progressive refunding basis.

The present available purchasing power of the city is approximately $51,000,000 for all purposes, including water supply. By 1930 the total railway investment required will be $62,000,000; by 1950, $123,000,000. This means that over one-third of the total bonding capacity of the city on its present 15% basis would be continually preempted for railway investment alone, assuming the city entirely free from debt.

If the city of San Francisco declines to accept the assistance of private capital in financing its utilities both for the present and the future, the conclusion cannot be evaded that a revision of the bond limit must be secured immediately in order to provide the capital necessary for preserving the normal rate of growth of the city as herein predicted.

ADVANTAGES OF OIL FUEL.

Admiral H. I. Cone, United States Navy, in a statement regarding the relative values of oil and coal for steam-raising in the navy, makes clear the following points:—

The advantages of oil as compared with coal are:—

An evaporation per pound of fuel in the ratio of about 14 to 9 (15.5 to 10) and per square foot of heating surface in about the ratio of 10 to 8 (12.5 to 10).

Fuel can be taken aboard more rapidly without manual labor and without interruption to the routine of the ship. The problem of fueling at sea is solved.

Steam for full power can be maintained as readily as for low power. A vessel burning oil is capable of runs at full speed, limited in duration only by the supply of fuel. There is no reduction in speed due to dirty fires or to difficulty in trimming coal from remote bunkers or to exhaustion of the fireroom force.

There are no cinders and the amount of smoke can be controlled.

A considerable reduction in personnel is possible.

The weight and space required for boilers are reduced, first, by the reduction in heating surface required; and, second, by the shortening of firerooms. Consequent on the reduction in heating surface is a decrease in weight and cost of boilers.

Coal and ash-handling gear is eliminated. This renders unnecessary the piercing of the hull for coal trunks and dischargers from the ash-expellers or ash-ejectors.

The stowage and handling of oil are much easier than of coal, and will result in a much cleaner ship, with consequent increase in time available for drills.

The mechanical supply of fuel to the boilers gives a prompt and delicate control of the steam supply, permitting more sudden changes in speed than with coal, which is a tactical advantage.

The nature of fuel oil permits utilization of remote portions of the ship and of constructed spaces for its stowage.

These advantages have long been recognized by the navy, and there have been experiments with liquid fuel dating back as far as 1867. All these experiments have confirmed our belief in the considerable military advantages which will accrue from its use, but until recently it has been impracticable to use it extensively on account of the uncertainty as to the adequacy of its supply and the sufficiency of its distribution among the seaports of the world.

AN EFFICIENT METHOD OF ROAD-OILING.

To spread oil on roads for a distance of twenty miles or more from the starting point, and to spread it at a heat of 200 degrees or more, would seem to be an extremely difficult undertaking, requiring a lot of apparatus and a lot of men. But by the ingenious use of a five-ton truck the road commissioners of Los Angeles county accomplish it with one man and one piece of mechanism.

The truck is fitted with a 1,000 gallon oil tank, and this tank is covered with a coating of asbestos two inches thick to retain the heat. Oil is run into the tank 350 degrees Fahrenheit. Owing to the asbestos protection and the speed the truck can make, it is possible to make a trip of 35 to 40 miles before the oil gets too cold for use.

Air pressure of 60 pounds to the square inch is maintained inside the tank by an air-compressor operated by the same mechanism used to actuate a dumping body for sand and gravel.

Heat from the motor exhaust is used to keep the oil-spreader warm, so that the stuff will not thicken and clog up there. The truck travels fifty miles a day, and the driver says that in 2,000 miles only two involuntary stops were necessary on the road—both caused by dirty gasoline stopping up the fuel line.

The largest crane in the world has just been placed into operation in a Hamburg shipyard. This crane is capable of lifting and distributing 250 tons of material over an area of 182,920 feet. It was the city of Hamburg which, in the year 1888, possessed the largest crane in the world at that time, and now it is again the Hamburg shipyard of Messrs. Blohm and Voss which is able to call the largest crane in the world its own. The development of crane building during the past twenty-five years has been enormous. Germany has taken the lead in the construction of high-capacity cranes, and has delivered the majority of the 140 giant cranes which are in existence. The Deutsche Maschinenfabrik A. G. Duisburg are the constructors of this latest giant. Only two men are required for working the crane. The driver works in a cabin arranged under the load arm of the jib. In order that the crane can be worked safely after darkness a searchlight is fitted near the driver's cabin, by means of which the load is brilliantly illuminated.

The record of trade disputes maintained by the Department of Labor shows that, as is usual at this season, the majority of the disputes occurred pending the adjustment of new wage schedules. These were nearly all of short duration. The mining industry on Vancouver Island was seriously interfered with, more than 3,000 men being out during the whole month through the continuance of the dispute at Ladysmith and the Cumberland mines, and the closing down of the mines in the Nanaimo district. A great number of the disputes of the month occurred among workers in the metal trades. The disputes of May affected upwards of 11,500 employees and accounted for the loss of more than 150,000 working days. Disputes affecting the various classes of municipal employees in Vancouver and affecting also the boot and shoe workers in a number of factories in Quebec were satisfactorily adjusted during the month through the instrumentality of boards under the Industrial Disputes Investigation Act. The Department of Labor also assisted in the adjustment of disputes affecting the employees of the Hydro-Electric Commission in Toronto, and affecting also the longshoremen in Montreal and St. John, N.B. In the latter case a board has been established under the Industrial Disputes Investigation Act.

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ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

	PAGE
Editorial:	
Fair-Wage Clauses in Government Contracts..	245
Water versus Rail Transportation Rates	245
Editorial Comment	246
Letters to the Editor:	
An Association for Municipal Engineers	246
Concerning Toronto's Filtration Plant Extension	247
Leading Articles:	
The Design of Central Heating Systems, III...	229
Action of Salts in Alkali and Sea Water on Cements	233
Pavement Sub-grade	235
Electrification of Railways	236
Public Construction Contracts	237
The Design of a Reinforced Concrete Abutment	238
Earnings and Investment in Transit Facilities..	243
Advantages of Oil Fuel	244
Prevention of Landslides in Construction Work	248
The Consulting Engineer and the Municipal Engineer	249
The Rod and Merchant Mills of the Dominion Iron and Steel Company, Limited.	251
Engineers' Library	253
Coast to Coast	258
Personals	260
Coming Meetings	260
Railway Orders	75
Construction News	76
Market Conditions	92-94
Technical and Municipal Societies	94

FAIR-WAGE CLAUSES IN GOVERNMENT CONTRACTS.

It has been the policy of the Government of Saskatchewan to include in all its contracts a fair-wage schedule. The procedure has met with such favor that workmen of the province are agitating the adoption of such a policy in connection with all contracts entered into by cities and towns for civic improvement. The clauses which appear in the government contracts as directly bearing upon this question are as follows:—

1. The contractor shall employ none but skilled Canadian workmen and their apprentices, and shall not pay less than the current rate of wages in the district where the work is being done, and if there is no current rate, then a fair and reasonable rate. In the event of a dispute arising as to what is the current or a fair and reasonable rate, it shall be determined by the fair-wage officer of the government, whose decision shall be final.

2. Contractors shall post in a conspicuous place on public works under construction the schedule of wages, or the fair-wage clause in their contracts for the protection of the workmen employed.

3. Contractors shall keep a record of payments made to workmen in their employ, the books or documents containing such record shall be open for inspection by the fair-wage officer of the government, at any time it may seem expedient to the minister to have same inspected.

In contracts that are to be carried out in cities and towns a schedule is inserted, setting forth the minimum rate of pay and hours of the various trades and crafts to be employed on the contract. The schedule is based on the current rate of wages for each particular craft in the locality, and is obtained through the courtesy of the contractors and the labor unions interested, and in each case the current wage which is most generally paid is accepted.

The government naturally has control over the rates of wages only on works undertaken by itself or aided by provincial funds; nevertheless, the fact that all contractors on such works must pay a fair and reasonable rate of wages has had the effect of establishing a living wage throughout the province and one that is generally accepted by contractors. On private works the government has no control over the rates of wages to be paid. It has, however, power to enact such legislation as will guarantee to the employee his wages by giving him a preferred lien on the work on which he has been engaged and making the collection of wages from delinquent employers an easy and inexpensive proceedure.

WATER vs. RAIL TRANSPORTATION RATES.

Canals have cost Canada $103,400,589. The annual interest charge, reckoned at 3½% would be $3,619,021. In 1912 the cost of maintenance was $1,725,738, making a total of $5,344,759. This means a government contribution of 76.99 cents per ton on the whole Canadian freight tonnage of 1912, or .140 cent per ton mile. Adding to these amounts the actual freight rates, viz., 91.04 cents per ton, or .194 cent per ton mile, gives a total of $11.68 per ton, or .334 cent per ton per mile.

Mr. J. L. Payne, Controller of Statisties, Ottawa, makes the following comparison between rail and water rates, basing his remarks upon the transportation of

wheat between Fort William and Montreal, via both routes.

The average rate on waterborne wheat between these points in 1912 was 5.774 cents per bushel, of $1.92 per ton. To this should be added the contribution by government of .140 cent per ton per mile, equal to $1.72 per ton, making the total $3.64 per ton. The rail rate of the Canadian Pacific Railway between Fort William and Montreal is uniformly $4 per ton, or .402 cent per ton per mile. The average rail rate of all the railways of the West on wheat is not higher. On a longer haul, say, from Winnipeg to St. John, New Brunswick, it is even lower; so that the comparison is fair. Thus, we have on this statement of facts a water rate of $3.64 per ton as compared with a rate of $4 per ton by rail. That comparison, however, is based on an average water rate on wheat of 5.774 cents per bushel. The maximum water rate for the season of 1912 between the same points was 8 cents per bushel, and at that rate the charges by water were 29 cents per ton higher than were the current charges by rail. A fair conclusion is that, on the whole, the water rate paid by the shipper is lower on certain commodities which are peculiarly suitable for transportation in steamers; but there is not a material difference between water and rail rates when all the facts and conditions are taken into account. The difference in favor of the water rate is created wholly by the fact that a considerable part of the actual cost of transportation by water is paid by the people at large.

EDITORIAL COMMENT.

Notable among the week's proceedings of engineering interest is the government call for tenders, for the Toronto harbor development, the plans and specifications for which are now complete. They pertain to seawall, breakwater, ship canal, turning-basin, retaining walls, etc. The seawall is to be 17,295 feet in length—over 3¼ miles—and is to be built in eleven sections. The structure will be of sheet piling and timber with a superstructure of concrete. The breakwater will be 18,600 feet in length and will be of timber crib work and concrete superstructure. The ship channel and turning-basin will be approximately 16,705 feet long and the whole area will be dredged to a depth of 24 feet. The retaining wall will be 6,894 feet in length.

* * * *

Ottawa and vicinity are interested in the expropriation proceedings recently instituted by the Ontario Hydro-Electric Power Commission in connection with the water-power rights at Chats Falls, on the Ottawa River, some thirty miles west of the city. A private company holds the present power rights by government lease granted two years ago. The price of relinquishment asked by them is some seven times the amount offered by the Ontario Government. The Ontario Railway and Municipal Board has the case before it, and evidence will be heard in September.

It is the intention of the Commission to use the power at Chats Falls as an Ottawa Valley and Eastern Ontario extension of the provincial system, over 100,000 horse-power being available for development in the district.

LETTERS TO THE EDITOR.

An Association for Municipal Engineers.

Sir,—Mr. R. O. Wynne-Roberts' letter in your issue of the 15th inst., has spoken the mind of many municipal engineers now engaged in the Dominion, and he evidently speaks from a knowledge of inter-communication between engineers, as I can trace his name through many English engineering associations.

Your editorial, sir, conveys a suggestion with reference to the Canadian Society of Civil Engineers, and one that every trained municipal engineer welcomes, the more so that he would be enabled to join an established and recognized community of engineers whose branches reach far out in the engineering world, and who possess amongst its members the eminent engineers of Canada.

The Dominion is developing rapidly, townships are springing up like mushrooms and the demand for public utilities in water, sewerage and roads, electric lighting and power, etc., and every other necessity for public health is being asserted in no unmistakable manner, that the time has come when none but the qualified theoretical and practically trained man can be looked upon as the successful candidate, and the competition for the appointments should lie amongst such men.

This branch of engineering is so important to the public well-being, both financially and administratively, that some steps should be taken to have it set upon a better recognized basis. Its members are men with Canadian experience, geological and climatic, whose training has been conducted upon sound scientific and practical lines, and whose experience has been gained by constant and businesslike study.

The question of the establishment of such an association or institution is surrounded with difficulties which can be overcome the more easily by subdivision. I mean that the Dominion is so extensive that the ordinary salaried engineer cannot afford to travel from coast to coast each year to attend conferences. This can be met, I suggest, by a central body representative of the provinces, whose labors shall be directed by the provincial branches; these branches, for economy's sake, to hold their meetings at various cities within their province.

If the institution could become a recognized body by the government by charter, it would materially increase its value and importance, and the aid which would be rendered from government engineering officials would add prestige to its personnel.

Under such conditions it would be a matter of easy negotiation to put forth legislation in favor of municipalities bearing the costs of their engineer's attendance at conferences throughout the Dominion, within reason, of course, i.e., an annual meeting of three to six days' period.

The status of the individual as a member should be taken care of, and various degrees of membership established—say, for a period of one year from the date of formation, chief municipal engineers would be admitted as full members, chief assistants and assistants of eight years' experience as associate members, and younger members of engineering municipal staffs as graduates.

After the first year has expired, examinations for entry as graduates or students on the one hand, and for associate members on the other, should be established. Of course, the latter examination would qualify the associate member for full membership upon his obtaining a town or city engineership.

There is an immense amount of labor to be wrought in the successful launching of such an institution, but I have no fear of its issue if the determination of the engineer is turned to it in the same spirit that he tackles the problems of his district, overcoming many of nature's obstacles, and often harnessing them for the benefit of mankind.

PRO BONO PUBLICO.

Winnipeg, July 21st, 1913.

* * * *

Concerning Toronto's Filtration Plant Extension.

Sir,—In view of the City Council's decision to spend $1,000,000 for a filtration plant at the Island, in order to avoid an expenditure of perhaps $2,000,000 for a new intake or tunnel which the placing of the addition on the mainland would entail, we would like an interesting proposal, which we have made, to appear in the columns of your journal.

It should be pointed out that it has only been made after two years' study of the existing conditions, and after a careful perusal of the various reports published, including that recently issued by Commissioner of Works Harris, Drs. Hastings and Nasmith, appearing on page 184 of July 17th issue of *The Canadian Engineer*. We would make reference particularly to several of the closing paragraphs of this report in which Garrison Common is mentioned as an ideal location for the installation of a mechanical filtration plant; but that the sum that has already been invested in the Island plant necessitated the retention of its use; also the reference to the formation of the Island being such as to render it an undesirable location for permanent construction of this nature, and the very extensive operations, which the Harbor Commissioners purpose undertaking, being liable to imperil the present or any future installation which might be established there. The continuity of a filtered water supply for 365 days per year is stated to be the dominant factor in the consideration of the proposition.

These sections of the report lead one to believe that, if the Island is undesirable for the present $800,000 construction, it will be much more undesirable for a $1,800,000 investment, considering the sand formation and the indefiniteness of the Harbor Commissioners' future operations conflicting with it. Further, the ideal site for the filter plant being on the mainland, it appears to the writer that the present filtration plant might well be retained in connection with the city water supply for use as a basin to effect settlement of the water before filtration, thus removing the troublesome sand problem which must be contended with. The new filter plant could then be installed adjoining the main pumping station, and the raw water filtered after being drawn through the tunnel, thus eliminating a constant source of danger to the pure water supply, viz., the passage of water through the tunnel under the polluted waters of the Bay. Such a plant could be located on the vacant land owned by the city between the present pumping station and the railroad tracks to the north, convenient to the mechanical operators of the former, and in a position entailing a minimum of cost for the transportation of stores and supplies.

The proposal which was recently submitted by the Bell Filtration Company covers the installation of a filter plant of 65,000,000 gallons minimum, and 96,000,000 gallons maximum capacity upon the above-mentioned site, to be installed without delay and to be in operation in about fifteen months. Without going into details of equipment, etc., it might be stated that under the proposed method the water would be first settled by the Island basins, would flow by gravity to the main pumping station, and would then be pumped directly through the filters to the city mains.

The chief advantages attendant upon this scheme are those of insurance against interrupted operation, such as might be occasioned by alterations to the Island, and the safe-guarding of the supply against dangers of pollution by Bay water.

In the event of any change being desirable at any time, the whole of this plant can be removed practically without interruption, thus increasing the value of it as an asset to the city.

H. W. COWAN.

Toronto, July 23rd, 1913.

A REMARKABLE PAVEMENT TEST.

Bereft of its concrete base and of the roadway itself, something like 100 square yards of brick pavement on Dunham Road, near Cleveland, are projecting over the void with nothing to hold them in position but an excellent job of cement grouting between the bricks themselves.

This spectacular test of Cuyahoga County's road-building methods came to pass through the agency of a recent freshet in Tinker's Creek, a small stream skirting the road. Retaining wall 275 feet in length was swept away and the earth undermined for nearly 100 feet. The concrete base was next to go, leaving the brick bare for a distance of 80 feet. The greatest breadth of the brick overhang is seven feet.

Washout Under a 14-Foot Brick Road in Ohio.

So solid was the course of grouted brick that it was a job of no small difficulty to remove two bricks in order to erect posts for a warning fence. After the holes had been made, the engineer in charge did not hesitate to drive his auto upon the overhang and pose beneath it. At first it was planned to break the pavement down and rebuild it after the road had been filled, but the solidarity of the structure has brought about an alteration of plans and now county engineers actually contemplate building the road up to the pavement without disturbing the latter.

Cuyahoga County has over 400 miles of rural brick highway, counting the 50 miles to be installed during the current year. Macadam was long ago abandoned as unsuited to the heavy and growing automobile traffic. The construction of a heavy, solid base and utmost care in the application of a cement grout filler have been the keynotes of successful road construction in Cuyahoga County.

PREVENTION OF LANDSLIDES IN CONSTRUCTION WORK.

By Geo. S. Rice.
Chief Mining Engineer, U.S. Bureau of Mines, Pittsburg, Pa.

THE slides in the Culebra Cut which have so severely handicapped operations on the Panama Canal construction, and the likelihood of them continuing to occur, as such a conclusion may be arrived at from a perusal of the report for 1912 of the Isthmian Canal Commission, suggests the advisability of preventive measures, as far as the geological formation of the isthmus will permit. Mr. Rice suggests the utilization of a process used in shaft sinking and tunnel work—that of erecting an underground retaining wall which would have a tendency to prevent the formation of a slide by taking care of the unbalanced pressures due to deep excavation. His suggestion forms the basis of a paper read before the Western Society of Engineers, Chicago, on May 12th, from which the following abstract is made:—

While the method of filling cavities and rock crevices behind tunnel lining with cement grout has long been employed, a special application called the cementation process has been highly developed in France for sinking through porous and creviced water-bearing strata. Briefly, it consists of drilling a series of holes surrounding the shaft location through the porous strata to the more of less impervious coal measures, and pumping in cement grout under high pressure. The pumping may be either continuous, as the drilling proceeds, or (as in later undertakings was found to be better) in stages at intervals alternating with drilling every 16 ft. By this method a cylinder of cemented material is constructed within which the shaft can be sunk. In the earlier undertakings four drill holes were used, but for later shaft sinkings six holes were employed in a circle of 24 ft. diameter.

To prevent leakage to the surface of the injected grouting, a pit is first dug for each bore-hole through the loose earth and concrete placed tightly about a 12-in. standpipe, the top of which is capped. The cap has a stuffing-box, through which passes a grouting pipe that can be pushed to near the bottom of the hole. The pipe is connected with the pump, and the latter with the cement mixer. Before injection of cement begins, clear water is pumped through.

It has been found necessary to use only the finest ground cement, and employ pressures as high as 750 lb. per sq. in. to insure the thorough permeation of the cement into the small crevices and bedding planes of the strata. The cleaning out of all mud coating on the bore-hole is also found necessary. To this end it is the practice to drill the hole below the standpipe, about 7 in. diameter, and then ream to 10 in.

The water-bearing strata consists of marls or fissured chalks which are sometimes argillaceous. They are soft enough to be bored with an auger drill turned by power. The process has been so successful that it is supplanting the freezing system for sinking through highly water-bearing strata in northern France and Belgium.

Constructing Underground Retaining Walls.—The success achieved with the above process appears to offer possibilities in solidifying the slopes of unstable strata, at least sufficiently to prevent movement from occurring. The holes filled with concrete, reinforced with iron bars, would serve as deep-seated massive piles. Why not extend this principle and drill inclined holes to solid strata, and insert in them heavy reinforcing bars which, when surrounded with cement, would act as diagonals or tension members?

A further development was to "spring" the holes at the bottom by shooting with dynamite. This would open up crevices, permitting a more extensive cementation, and would provide an enlargement which would furnish anchorage for the tie bars. The upper end of the tie bar is to be held by a concrete capping. Thus the combination of vertical concrete posts and inclined metal ties (going deep enough to reach solid strata), with the ground cemented between, would furnish a triangular dam, or retaining wall, which should have great strength against lateral pressure.

The nearer the holes, the more thorough would be the cementation. The only limit would be that of cost. The system, if applied extensively, would be costly. But it would only be considered where the cost of repairing damage to an engineering work by an extensive landslide would be vastly greater.

In proposing the scheme for checking, or rather preventing slides, the writer has had three main thoughts in mind: 1, as far as possible there should be drainage; 2, there should be a subdivision of the slopes from which the slides are liable to come; 3, there should be formed an underground dam, to prevent the foot of a slope from moving, and also to keep the water of the canal from circulating through the material. It is very much more destructive to the somewhat soluble walls to have water constantly entering and leaving the crevices through wave action, than if the ground water is merely held quiescent.

The scheme is as follows:—

1. To drill a series of holes along lines parallel with the axis of the canal, these holes to be both vertical and inclined, and go deep enough to reach firm strata below the level of the bottom of the canal. The depth of the holes might need to be 100 ft. or over 150 ft.

2. Cement grout to be forced into these holes under pressures of 750 to 1,000 lb. per sq. in., so that the cement will penetrate all the fissures, making the mass impervious to water, and also binding the rock together.

3. Steel rods, 3 in. diameter or more, to be grouted into the holes.

4. Before the steel bars have been placed, dynamite is to be fired in the bottom of each hole to make an enlarged space in the firm stratum which the holes should reach. These will provide anchorage at the bottom. The rods will thus act as reinforcement to the cemented zone; and the rods in the inclined holes will serve as tension members of the wall. The latter rods will therefore be made much heavier than the others. The rods are to have nuts and washers or to be upset at each end. The upper ends are to be fastened in a concrete capping over the top of the "dam."

This method cannot be applied to ground that has begun to move. It cannot be applied to ground that is actually moving. Moreover, the wall must go sufficiently deep to get into solid strata. But there is nothing except cost to prevent such an underground dam from going as deep as seems desirable, or to make the holes as large or the tie rods as heavy as desired. It would be desirable to try the method beyond the present slide areas in order to determine the obstacles and necessities of the case. The work could be pushed from either edge into the slide area. Intermediate ground walls could be constructed further up the slopes, so as to lessen the weight

and also to prevent water which might enter above from working down into the larger mass below. Accompanying these dams, underground horizontal drifts might in some cases be put into the slopes to drain the ground.

THE CONSULTING ENGINEER AND THE MUNICIPAL ENGINEER.

By H. C. H. Shenton.

THERE should be no antagonism between the consulting engineer and the municipal engineer. They are both members of the same profession, and for that reason should carefully study their common interest. Signs are not wanting that the time is ripe for combination among engineers with the object of improving their standing and general welfare, and a paper read by Mr. Shenton before a meeting of the Institute of Municipal Engineers in London, on June 25th last, has for its object the furthering of such co-operation.

There is absolutely no difference in status between the two branches of the profession. We are all engineers, we all start level, we all receive much the same education and training, and eventually elect to specialize or to take up municipal appointments, or work in some other branch of the profession not under present consideration. Without doubt, a great municipal engineer of long experience is a better man professionally than a consulting engineer of smaller experience, and similarly a great consulting engineer is professionally of more importance than a municipal engineer of lesser attainments. This may be a truism, but it needs to be understood properly in order that, when they have to work together, the senior man (as regards experience and attainments) should take the lead without any feeling on the part of his friend, the consultant or salaried official, as the case may be, that he is being treated with want of proper consideration.

The Engineer's Qualifications.—The combination of all classes of engineers into one body is not beyond hope, but the combination of engineers of a particular class should not only be quite possible, but may well be attempted at the present time. For instance, all engineers holding municipal appointments could combine very easily, but in the author's opinion such combination would be incomplete, because it would leave out a very large number of men who advise as to the construction of some of the most important works of local authorities—viz., the consulting engineers. A difficulty at once presents itself as to who should be included in such an organization and who should be excluded. It is not to be denied that there is a certain number of consulting engineers whose experience does not entitle them to call themselves "specialists," and whose knowledge of the subjects upon which they undertake to give advice is inferior to that of the average municipal engineer; persons whose knowledge on all matters not pertaining to municipal work may or may not be great, but who are looked upon with considerable disfavor, and justly so, by those municipal engineers with whom they may have to work. Any man, however limited his knowledge may be, is at the present time able to write the letters C.E. after his name, take an office and give advice, and if he possesses influential friends and a plausible manner he stands a good chance of obtaining work with which he is quite unqualified to deal. There ought to be some method whereby such persons should be prevented from advising as to the spending of public money. On the other hand (and it is necessary to be perfectly frank) there are many persons holding positions in municipal or district council offices who by no stretch of imagination can be considered worthy of the title of "Engineer." In the author's opinion a district surveyor is, or should be, an engineer; yet in small urban and rural districts, and even perhaps in some boroughs, where the salaries paid to the district surveyors are too small to tempt experienced men to act, men of a very inferior type as regards experience are frequently employed. Ignorant councillors are frequently of opinion that if a man is a good bricklayer or tradesman he is an engineer, and they employ him as their surveyor partly from motives of mistaken economy, and largely because they prefer to have someone to whom they can dictate, and whom they will treat with very little respect, thinking that thereby they, being omniscient in all matters pertaining to the surveyor's department, may have the ruling hand. In this way the dignity of the engineer's position is lowered, and an enormous waste of public money takes place.

The properly trained and qualified man, whether he is a municipal of a consulting engineer, looks with considerable dislike on the two classes of amateur engineer mentioned, and he would like to see the profession so organized that the incompetent person should find it as difficult to call himself an engineer as to call himself a lawyer or a doctor. However, on this point one must carefully avoid coming to a false conclusion. There are many good engineers whose early training was that of a different calling, but who possessed such ability that they forced themselves forward, gaining experience, it may be, in a very humble station, and finally taking their places in the profession as honored members with absolute justice. It is therefore necessary to consider whether many of the men who cause so much annoyance by undertaking work for which they can show no proper qualifications, and by doing it for an entirely insufficient remuneration, are not often persons of considerable ability whom it would be difficult and unwise to treat as being completely outside our ranks. The very fact that they possess the assurance to undertake engineering work suggests the possession of one of the qualities most necessary to all engineers—viz., pluck. These men, whatever their previous condition may have been, may be quite capable of gaining the necessary experience and training to qualify them as engineers, but till they have done so, whatever their age and position may be, they can only be regarded as juniors, and should be treated accordingly. In that case the local authority who tried to employ such unqualified persons in chief positions, or as consultants, should be prevented in the same way as they could be prevented from appointing a medical student to the position of medical officer. Leaving out of our consideration the inexperienced class of men on both sides, we may consider the remainder as belonging to one class, and these ought to be able to unite for their common good.

The Engineer's Remuneration.—The most important question at the present time is that of remuneration. No engineer ought to be made to work for insufficient payment. The municipal engineer is sometimes a perfectly competent specialist, and can advise his council better than any consultant upon a given matter outside his ordinary duties, but when he does so without receiving proper fees such as the consultant would charge he is doing the profession serious harm. He is ranking himself with a sort of consultant who prepares schemes for

nothing, or who obtains work by offering to do it at a reduced commission. In the abstract one must condemn such practices utterly, but such is the unfortunate condition of the profession, owing, however, entirely to lack of organization, that the municipal engineer may be forced to do work quite outside his ordinary duties without charge, in order to keep his position, and the consultant may be forced to work for nothing in the hope of being able to make a living some day. This is entirely wrong, but it has been done. There is only one remedy: we, as engineers, should combine and organize for registration, so that the incompetent men may be excluded from the ranks of those who act in chief positions, and when this has been done we shall be able to refuse to work except to a proper scale of charges; and, moreover, we ought to be prevented from doing so. Means must be devised whereby it is made impossible for local authorities to obtain the services of their salaried officials or of consultants except by paying proper salaries or proper fees. In this matter the assistance of the Local Government Board is required, and it is not beyond hope that such assistance would be given if once the profession were properly organized. It is perfectly clear that the board have the greatest dislike to the employment of unsuitable persons by local authorities, and that even at the present time, as far as their powers permit them, they do very good work in refusing to sanction loans for unsuitable schemes prepared by incompetent persons.

It is urged at times that the municipal engineer is unfairly taking up the work of the consultant. This, in the author's opinion, is quite incorrect, for it is obviously the bounden duty of a municipal engineer to give his best services to his employers, and so long as he can do the work, and his remuneration is adequate, the consulting engineer has no grounds for complaint. Where a consultant is called in to advise a local authority, his work should be done in such a way as to assist and strengthen the position of the municipal engineer, and similarly the municipal engineer should work with the consultant so as to ensure the success of his work in every possible way, both sides avoiding doing anything likely to bring the profession into disrepute. In the author's experience these relations are generally quite satisfactory, but it would be of considerable interest to learn the experience of others upon this point.

A consulting engineer is sometimes called in by an authority whose surveyor is a man of knowledge and experience, but whose services are entirely undervalued and underpaid by his council, and whose position is the reverse of pleasant. It is possible in such a case for the consultant to insist upon proper respect being paid to such a man, and he should make it his business to do so and to help him to advancement in every way possible, as the council are likely to attach importance to the action of the consultant and to the degree of respect with which he treats the surveyor.

It may be asked whether it is possible, after all, to make an exact distinction between the man who is an engineer and the man who is not? In the author's opinion there is no difficulty whatever in deciding whether a man is a qualified municipal engineer. It is not at the present time a question of examinations passed, of pupilage, or of membership of societies and institutions. It is simply and solely a matter of training and experience, and unless a man has been occupied for an extended period on municipal engineering work he cannot by any possibility be rightly called a municipal engineer. A civil engineer is not necessarily a municipal engineer any more than a doctor is necessarily a medical officer. Similarly with regard to consultants the consulting engineer is a specialist, and this implies that he has made a special and extended study of some particular branch of engineering, such as waterworks, sewerage, or electrical work. He is an expert in some particular work, and it is obvious that he is sailing under false colors if he calls himself an expert unless his knowledge and experience of the particular work he undertakes are extensive. It is very desirable that engineers in private practice who undertake to do work upon which public money is spent should be carefully registered, not simply as engineers, for that term is too vague, but as water engineers, gas engineers, sewerage engineers, tramway engineers, etc., as the case may be. It is, after all, a simple matter for a man who poses, say, as a gas engineer, to show that his experience is such as to qualify him to give advice on that subject; if he cannot he is not fit to advise as to the spending of public money on gasworks. Municipal engineers can help their consulting brethren on this point greatly by urging their authorities to see that their consultants on any particular work are really specialists for that work, and not for something else. They can also assist very materially by joining energetically as a body in any scheme for combination which may be forthcoming for the better organization of the profession.

Points for Discussion.—(1) The proper qualifications of the municipal engineer.

(2) The proper qualifications of the consulting engineer.

(3) How to prevent local authorities from employing: (*a*) Incompetent persons in municipal engineers' positions: (*b*) Incompetent persons as consulting engineers.

(4) The inclusion or exclusion on municipal work of persons whose training and experience is insufficient to qualify them as engineers. Should these persons be considered as juniors qualifying for the position of engineer, or how should they be regarded?

(5) The position of the municipal engineer who is doing consulting work without receiving proper payment.

(6) The position of the consulting engineer who works without receiving proper payment.

(7) The ways in which the consulting engineer and the municipal engineer may help each other.

(8) The better remuneration of municipal engineers, and the combination of both classes of engineers for the improvement of their profession.

The area of the Forest Reserves in the Union of South Africa in December, 1911, was 1,799,550 acres. Besides this, there were also 42,587 acres reserved for growing railway ties, on which railway funds alone were expended, making a total reserved area of 1,842,137 acres. Forest surveys are being made for the demarcation of new reserves, and existing reserves are being protected from fire by burning or cutting fire-belts around the reserves and by planting up their perimeters with trees of the less inflammable species. As a result of these precautions there were burned during the season of 1911 only seven hundred acres, or 0.04 per cent. of the total area.

The fourth International Road Congress will be held at Munich in 1916, as a result of an invitation from the Imperial German Government, seconded by a representative of the Bavarian Government.

THE ROD AND MERCHANT MILLS OF THE DOMINION IRON AND STEEL COMPANY, LIMITED.

Believing that all readers of *The Canadian Engineer* are interested in the progress and development of the Dominion Steel Corporation, now the largest metallurgical enterprise in Canada, we have arranged for a series of descriptive articles, each one of which will be devoted to some particular unit or group of units that goes to make up the complete plant, which now includes facilities and appliances of the most modern description for all purposes, from the winning of coal and ore to the manufacture of quite highly developed forms of steel products.

Instead of taking these in the sequence of the processes to which they relate or of the time of their installation, we propose to take some of the newer items first, grouping with them some of the earlier parts of the plant which are closely related to them.

The plan which accompanies this article shows the layout of the Steel Company's rod and merchant mills. The rod mill was built in the year of 1904, has since been in practically continuous operation, has turned out over half a million tons of rods, and has incidentally made what are believed to be world's records for production for a day, a month and a year.

This mill is of the type known as the Morgan continuous rod mill. The roll trains consist of six stands of 12-inch roughing rolls and eight stands of 10-inch finishing rolls. The roughing train is driven directly from the engine by a system of pinions geared to the main shaft. The finishing train is driven by a pair of 48-inch double belts from a 22-foot flywheel. The engine was built by Ehrhardt & Sehmer, and is compound condensing, with cylinders of 35½-inch and 59-inch by 51¼-inch stroke.

The rods are delivered from the finishing mills through tubes to four reels, upon which they are coiled hot. From these reels they are dropped upon a flat, motor-driven bundle conveyer inclining upwards from the point where it receives the coils, below the main floor level, to the end of the bundle conveyer, about 150 feet distant. Here they are transferred to the bundle-cooling carrier, which conveys them about 375 feet to the bundling shed. By the time this is reached the rods are cool enough to handle and are tied up for shipment.

Rods of all sizes, from No. 5 wire gauge to ⅜-inch in diameter, are rolled in this mill.

The billets used are 30 feet long by 1¾ inches square, made in the company's billet mill, which will be described in another article.

Parallel with the rod mill is the new merchant mill, which is not only the latest of the finishing units to be put in, but is also from the very latest designs of the Morgan Construction Company, of Worcester, Mass., who constructed both mills. It consists of one train of six 12-inch continuous roughing stands and three Belgian trains of two stands each, one with a pair of 9½-inch and the other with a pair of 10½-inch rolls.

The roughing mill is equipped with feed-rolls, emergency shear, etc., and is driven by a system of pinions geared direct to a 36-inch by 48-inch simple engine.

The finishing mill is driven by two 52-inch double belts from the flywheel of a 24-inch by 48-inch twin simple engine.

Both engines were built by the Robb Engineering Company, Limited, of Amherst, N.S., and are of the piston valve type, designed to run at speeds varying from 60 to 100 R.P.M., and are fitted with Schutte-Koerting engine safety stop valves.

The finishing mill is equipped with automatic repeaters on the delivery side, emergency shears, etc., and is arranged to deliver either to a cooling bed or to pouring reels.

The pouring reels are similar to those used on the rod mill, but can take squares up to ¾ inch and rounds up to ⅞ inch. They deliver the coils to a motor-driven, flat bundle conveyer 100 feet long. This is beneath the floor, and passes diagonally across the mill and inclines upward to the bundle cooling hook carrier, which is driven from the same motor, and automatically picks up the bundles and conveys them 554 feet to the bundling shed. The bundle carrier has a capacity of 88 bundles, and speed can be varied to suit the stock, giving ample time for it to cool thoroughly by the time it reaches the coil-bundling shed, from which it is shipped. Part of the smaller rods, which are made into wire or nails, is transferred by a second bundle carrier to the cleaning department of the wire mill, which will be described later in an article upon the wire and nail mills. These conveyers are much the same design as those in the rod mill.

The cooling-bed is the Edwards inclined mechanical escapement type, with a capacity for eighteen pieces 360 feet long. The pieces are conveyed to the upper side of the cooling-bed on a cone roller conveyer, and are delivered to the shear by a roller table conveyer on the lower side. Both conveyers extend the full length of the bed. The pieces can be cut to any length. After shearing the pieces are pushed by a steam kick-off to the scale, which is beside the shear-table, and is provided with suitable cradles to hold the bars.

The shear is vertical, motor-driven, and has a capacity of fifteen bars ¾-inch in diameter, or their equivalent.

The whole mill floor is commanded by an 85-foot electric overhead travelling crane of fifteen tons' capacity. This is used for all the purposes of the mill, including the carrying of finished stock from scales to bundling floor or to cars for shipment. Among the other accessories of this mill are a five-spindle motor-driven bar-twister, built in the company's shops, and a motor-driven shear for cutting cold bars from stock. A standard gauge railway track extends about 400 feet into the mill building, upon which cars are run in for loading direct from the stock floor.

Billets used are either 1¾ inches square or 2½ inches square, according to weight of bars or other sections to be produced, and are all 30 feet long.

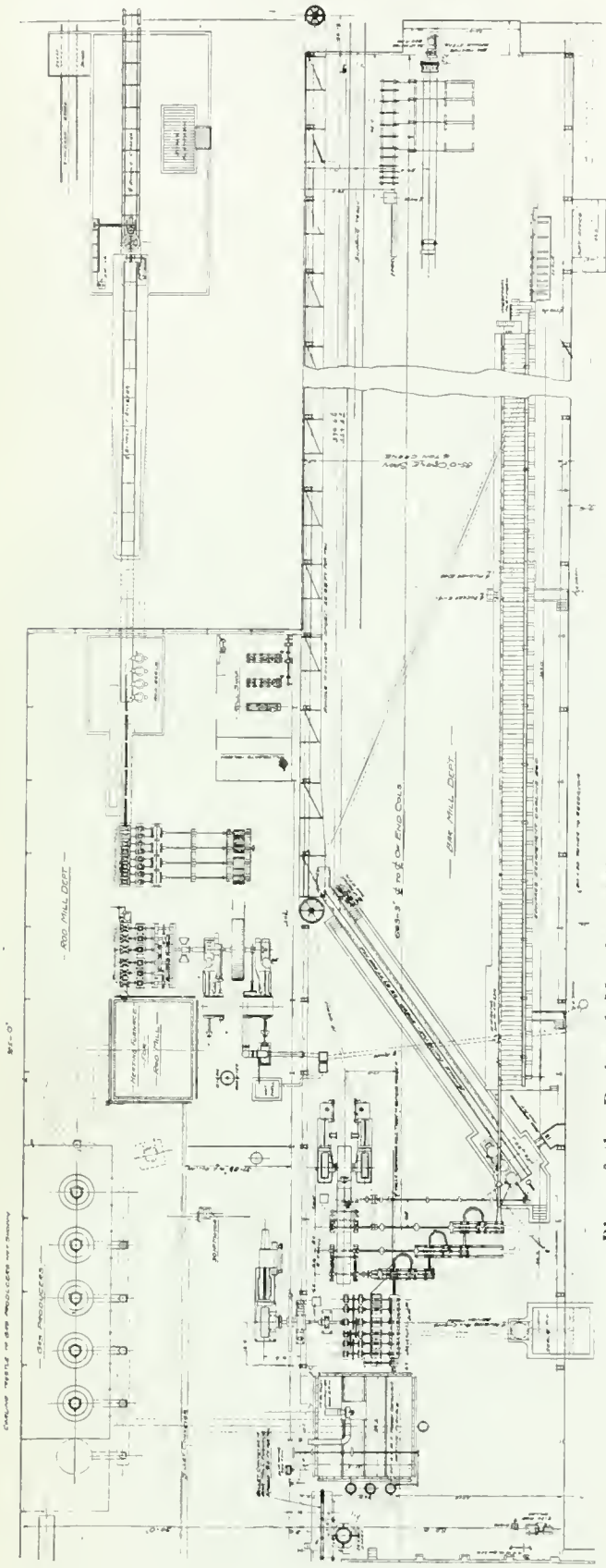
The output of the mill may be in a variety of forms. Coiled squares or rounds can be finished from ¼-inch to ⅞-inch, or the equivalent. Round and square bars from ¼-inch to 1½-inch can be finished, straightened and cut to any length. Flat bars can be made from ½-inch by ⅛-inch up to 3 inch by ½ inch, as well as the equivalent of this range of sizes in half-round, oval or special shapes of various sections. It is well adapted for rolling angles up to 2 inches by 2 inches by ⅜ inch and channels up to 3 inches.

Each of these mills is provided with a continuous gas-fired heating furnace of the Morgan suspension roof type, with a working hearth 32 feet wide and long enough to take 90 2½-inch or 162 1¾-inch billets. Both furnaces are supplied with gas from Morgan automatic gas producers, of which there are five connected up in one battery. Coal is delivered direct to the charging floor from cars placed upon an elevated trestle parallel with the producer building and connected with the main track system.

Billets for use in these mills are stored in a yard adjoining the end of the mill buildings, and served by an overhead travelling crane 36 feet span, with runway 325 feet long. The bridge and trolley are motor-driven, and lift and carry ten billets at once. From this yard they are transferred by motor-driven roller conveyers to the heating furnaces.

The roll-turning department is conveniently located in the south-west corner of the rod mill building, and serves both the rod mill and bar mill. Steam for the mill engines is provided principally from a newly-constructed boiler plant provided with automatic stokers, chain grates, etc. A full description of these will be given in an article upon the

power system. Mill-cooling water is impounded in a cooling reservoir, the return water flowing in an open flume arranged with baffles, and is repumped to the mills. This will be described in a later article under Water System.



Plan of the Rod and Merchant Mills of the Dominion Iron and Steel Company.

Fresh water is used on the furnace coolers, this being sufficient to act as a make-up for the losses due to evaporation and leakage. Great care was exercised in designing the waste water conduits beneath the rolls to make them self-cleaning. All the scale is carried to the scale-pit and deposited in a self-draining scale-box, which is lifted by crane and discharged to cars. The overflow water from the scale-pit returns to the cooling reservoir.

Small scrap is balled in a scrap-balling machine, while cobbles and the larger scrap is sheared up and all loaded direct into charging boxes in readiness for use in the open-hearth furnaces.

The buildings in which these mills are housed are of standard steel construction. The rod mill building is 90 feet span by 325 feet long, and the merchant mill building 88 feet 6 inches span by 663 feet 3 inches long. The side walls of the rod mill building are covered with reinforced concrete. The side walls of the merchant mill building and the roofs of both buildings are covered with corrugated galvanized iron. Both are well provided with light, especially the merchant mill, which has continuous windows 10 feet wide of heavy wired glass extending full length of the building, and set high up in the wall so as to give the maximum of light with the minimum of breakage.

KAMINISTIQUIA POWER COMPANY

The decision of the Kaministiquia Power Company to carry out further extensions to its plant at Fort William, thus increasing its power capacity is another evidence of the unusually active growth which is taking place in the advantageously-located twin cities of Fort William and Port Arthur.

The Kaministiquia Power Company was incorporated in 1905, when it purchased from the Ontario Government the Kababeka Falls on the Kaministiquia River, 18 miles from Port Arthur and Fort William, Ont., and immediately commenced the development of this water power. The initial development was completed in December, 1906, and subsequently has been added to. There are now installed three electrical units of 3,750 kilowatts, each making a total equivalent to about 15,000 horsepower. The hydraulic development may possibly have been made in three units, of about 7,000 horsepower each.

The present hydraulic development is equal to a round 20,000 horsepower, of which there was added in 1911, one unit of 7,000 horsepower capacity in turbines, generators, etc., and the extension was made to the power house to accommodate this extra equipment.

It will be seen, therefore, that at the present time the company has a hydraulic development with a capacity of 20,000 horsepower and plant and machinery installed with a capacity of 15,000 horsepower. It is the intention to proceed with a hydro-development of 10,000 additional horsepower, making a total development of 30,000 horsepower. At the same time it will install an additional unit of electrical machinery with a capacity of 15,000 horsepower, thus doubling the present electrical capacity and making a total of 30,000. The company will thus be able to take advantage of the entire power at its disposal. It is said that the undertaking will involve an additional expenditure of about $1,000,000. It is the intention to begin work in the immediate future and it is expected that the undertaking will be completed at the close of 1915.

The Kaministiquia Power Company is in a somewhat unusual position in this that it does not enter into competition with the Hydro-Electric Power Commission of Ontario. Instead, it supplies the power to the Commission, the Commission in turn supplying current to the city of Port Arthur for municipal and industrial purposes. The Kaministiquia Company supplies Fort William direct.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

Book Reviews:

Gas Engines and Producers 253
Logarithms for Beginners 253
Theory of the Flexure and Strength of Rectangular Flat Plates Applied to Reinforced Concrete Floor Slabs 253
Rivers and Estuaries 254
Electric Interlocking 254
The D'Este Steam Engineers' Manual 254
The Concrete House and Its Construction 254
Electricity for the Farm and Home 254
Elementary Principles of Reinforced Concrete Construction 255
Steel Rails 255
Publications Received 256
Catalogues Received 257

BOOK REVIEWS.

Gas Engines and Producers.—By Lionel S. Marks and Samuel S. Wyer. Publishers, American School of Correspondence, Chicago. 151+62 pages; 6 x 9 inches; illustratd. Price, $1.00.

This book is divided into Parts I. and II., dealing with gas and oil engines, and Part III., which treats of gas producers.

It will no doubt be news to many to learn that as long ago as 1678 the Abbé Hautefeuille suggested a form of internal combustion motor in which gunpowder was to be utilized; but 1860 was the earliest date at which any really practicable motor of this type was devised.

The first part of the book, following a brief historical sketch, is devoted to a description of several different makes of engines, and illustrations are given which clearly show their action.

The introduction states that this publication is "designed to present theoretical and practical information in such form as to appeal both to the engineer and to the untrained person, who is merely interested in the subject," but, from the language employed, the latter would need to have a moderate acquaintance with engines, and also of elementary physics and algebra, in order to read it intelligently and derive any benefit from it. For example, on page 25 an equation for finding the temperature of a charge of explosive mixture at the end of compression, assuming a certain initial temperature is given, in which the assumed initial temperature of 60° F., is reduced to an absolute temperature by adding 461 to the Fahrenheit reading, but no mention is made of what the quantity 461 denotes, or why it is thus added.

In the section to which the foregoing paragraph refers the book would be somewhat improved by stating clearly in a table what the various symbols P_1, P_2, P_3, V_1, V_2, V_3 etc., represent.

The arrangement followed is not particularly good. The time-worn method of dividing into chapters has been abandoned for a less effective one, and, further, the reader is jostled about from a description of types of engines and some of their parts, to theory, then to ignition and governors, followed by a section on gas-producers, which, though in the title relegated to Part III., are treated briefly in Part II., this section being obscurely located in between a description of the various kinds of gases which are utilized for power purposes and a section in which large gas engines are described.

On the first page of the "Contents" occurs a printer's error as in "Magnetic, make and break," the last word being spelled "brake."

In Part III., which, by the way, is better arranged than its predecessors, the absurdity of certain expressions which have come into rather common use is rightly pointed out. "Siemens Gas," "Dowson Gas," "Mond Gas," etc., are instanced, and these are compared with what would be perfectly analogous expressions applied to steam works. For instance, the steam generated in a Stirling boiler might, on the same principle, be called "Stirling Stam."

The illustrations throughout the book are good, clear and well chosen, while the subject matter is reliable. The question of arrangement is largely a matter of opinion after all. As a text book for a correspondence school from which students can obtain information on points which may not be quite clear it should prove to be very useful.

Logarithms for Beginners.—By C. N. Pickworth, Manchester. Published by D. Van Nostrand, New York City, and Emmott & Co., Manchester. 50 pages; 5 x 7 inches; cloth binding. Price, 30 cents net.

The author gives a detailed explanation of logarithms and their numerous applications, superior to that to be found generally in academic texts. As such the book should be welcomed. The fact that the newly published edition is the fourth speaks strongly in its favor.

The treatment is complete, with examples, exercises and answers, and with four-place tables of logs and antilogs. The chief feature of the fourth edition is a table of hyperbolic logarithms and an explanation of their use. One is again reminded that logs to base e (2.71828), called hyperbolic, or natural, logarithms, are not the Napierian logarithms, the assumption being erroneous that such logs were employed by Napier, and that, in reality, they were afterwards deduced from those invented by him.

Theory of the Flexure and Strength of Rectangular Flat Plates Applied to Reinforced Concrete Floor Slabs.—By Henry T. Eddy. Published by Rogers & Company, Minneapolis. Cloth; 6 x 9 inches; 104 pages; illustrated. Price, $5.00 net.

This treatise embodies the results of a mathematical analysis of the mushroom system of floor-slab design, invented and patented by Mr. C. A. P. Turner. Dr. Eddy, the author, has here given a rigid application of the mathematical theory of elasticity to the problem presented by multiple-way reinforcements.

In the introduction to the book Mr. Turner states that this discussion is intended as an advance chapter or two of a more comprehensive treatise on Concrete-Steel Construction, in which it is intended to treat somewhat fully concrete columns, beam and slab construction, wall panels, etc., as well as flat slabs, and to introduce the results of experimental work now under way to determine the value of Poisson's ratio for different combinations of steel and concrete. This treatise will then represent the joint efforts of a professional

mathematician accustomed to treating these problems and a professional builder and designer of reinforced concrete with many years of practical experience behind him.

Rivers and Estuaries.—By W. Henry Hunter. Published by Longmans, Green & Company, 39 Paternoster Row, London. Canadian agents, Renouf Publishing Company, Montreal. Cloth; 6 x 9½ inches; 66 pages.

This little volume, which comprises an elementary study of "Rivers and Estuaries," is to a large extent based upon lectures on this subject, which were delivered by the author in the beginning of 1911 at the desire of the Council of the Institution of Civil Engineers, and under the Vernon-Harcourt bequest, to the students of the Institution in various parts of Great Britain; and upon further lectures on the subject of "Streams and Tides," delivered in the University of Manchester to the students in the Department of Engineering there.

The treatise contains a great deal of valuable information on the behavior of rivers under natural and artificial conditions, much of which information has been compiled from the author's personal experience. Some idea of the treatment of the subject may be obtained from the headings of the various chapters, viz.: Difficulties of the Subject, Physical Difficulties, the Pursuit of Information, Flow around Bends, Mouth of the River, River Improvement Works, Some European Examples, Some American Examples, the Mersey Estuarial Models.

The book is well written in clear and simple language, and forms a valuable addition to the literature of the subject.

Electric Interlocking.—(First edition.) Published by the General Railway Signal Company, Rochester, N.Y. 435 pages; 4 x 7 inches. Price, $3, postpaid.

"Electric Interlocking" is a handbook that will be of service in switch and signal practice, containing in well-printed, well-illustrated and durably-bound form a careful treatment of electrically-operated interlocking mechanisms and appliances. The handbook contains 284 illustrations, and many tables similar to those found in ordinary handbooks. Some of its illustrations and wiring diagrams have the current-carrying wires printed in red ink, making them readily distinguishable when referred to in the text. Sections are devoted to the installation and operating data of the various appliances, to wire and conduit work, installations in concrete, including general information covering methods of mixing and tables of volumes of materials required. Various sections also are devoted to standard signals, nomenclature of units, wires, etc.

The book will prove itself generally useful to railway men, not only for the newer instruction it contains, but for its concise form for reference and its carefully compiled index, covering in detail the entire work. The index is one of the distinctive features of the handbook.

The D'Este Steam Engineers' Manual.—Published by the Julian D'Este Company, Boston, Mass. 480+54 pages; 4½ x 7 inches. Price,

The manual is in two sections, Steam and Electrics. It contains a carefully selected mathematical introduction leading to the manipulation of logarithm and of steam tables, etc. The first part then covers mechanical details, such as the heating of feed water, shafting, size of pulleys, and the like, clearly and concisely, and, although we are of the opinion that the space devoted to elementary mechanics is somewhat unnecessary to the text, still it is largely a question of opinion, and is atoned for by the admirable treatment of mechanical energy and power transmission. The handbook also contains sections relating to internal combustion engines, mechanical refrigeration briefly.

Peculiar to this latest edition, which is the second, is an electrical appendix by Charles Penrose, E.E., which occupies some 360 pages, and is entirely distinct from the steam section. It is to be pointed out that the latter comprises a valuable addition of material not contained in the first issue of the manual, but that the electrical appendix outclasses the steam section to such a degree that the title of the book as given above hardly seems applicable.

The electrical section contains 240 illustrations of electrical equipment and diagrams, and no phase of electrical work that would be of interest to steam engineers has been overlooked. The section is, on the whole, well arranged as to prove itself of value for electrical engineers as well.

One feature which the book lacks is a suitable index. That relating to the steam section is buried in the midst of the text, illustrations are not indexed at all, and the index to the electrical appendix is scant. Overlooking these deficiencies, the manual is, as stated, greatly enhanced by the additional sections, and will prove itself almost indispensable to steam engineers. An attractive feature is in the comprehensive bibliography which supplements the steam section.

The Concrete House and its Construction.—By Maurice M. Sloan. Published by the Association of American Portland Cement Manufacturers, Philadelphia. 224 pages; 6 x 9 inches; illustrated; cloth binding. Price, $1.00 net.

This book endeavors to make clear the advantages of concrete in the construction of buildings. It compares in its preface the fire losses of American and European countries, and attributes the lack of fireproof construction to a mistaken idea of cost. It goes into detail with concrete construction as applied to houses, and should be particularly valuable to the architect.

Chapter I. deals with the advantage of concrete over other materials for house construction. Architectural design is dealt with in Chapter II., and in this chapter, as well as throughout the book generally, the illustrations are for the most part new and unique, certainly displaying a wide adaptability of cement in both the interior and exterior. Details, such as types of floor construction and reinforcement, roof and wall construction, are dealt with superficially in Chapter III., which is followed by general suggestions regarding construction operation, including the laying of reinforcement, the treatment of concrete surfaces, etc. The determination of strength and design of reinforced concrete in house construction suitably well covered, little of a technical nature being attempted, only sufficient to bring out general proportions of various members as called for by the loads to which they will be subjected.

Chapter VII. contains a number of tables for use in the design of reinforced concrete construction, giving resistance moments of floor beams or slabs, etc., for various diameters of reinforcing rods and spacings. Concrete block houses are lightly dealt with in the closing chapter, included in which are a number of illustrations showing the attractive character of concrete, even in its use as plain block, no ornamentation or pretentious manner being attempted.

The book is well printed and very handsomely illustrated, and the qualities which concrete construction possesses by way of durability, sanitation, fire resistance, etc., are carefully outlined.

Electricity for the Farm and Home.—By Frank Koester, A.M.A.I.E.E. Publishers, Sturgiss & Walton Company, New York. 279 pages; 5 x 7 inches; 35 illustrations; cloth. Price, $1.00 net.

Frank Koester's books generally lend themselves to careful reading by reason of the continued interest which is created as one progresses, and his latest book is no ex-

ception. He begins by pronouncing electricity as the greatest agent of agricultural problems, of vital importance to the city dweller as to the farmer. He devotes a chapter to the idea of central station service for farms and another to the generation of electric power by water steam, internal combustion, wind, storage battery, etc., and its distribution, turning then to the subject as viewed from the application of electric motors. A chapter on costs gives in concrete form valuable information for farmers, basing his data on a farm 100 acres in size. The manufacture of farm by-products, the preservation of farm products in general and their transportation are fully treated from the standpoint of electrical power utilization. The manipulation of farm machinery and divers applications is followed by a similar treatment respecting the household, such as electric heating, lighting, etc. An interesting chapter is that concerning electric power in irrigation and pumping system, and one even more interesting is the closing chapter devoted to the stimulation of vegetation by electricity, which, although it deals only with light experimental work and contains little practical information shows an application of electricity not generally known, but highly absorbing.

The book is well illustrated, and, although a great many of the cuts are reproduced from periodicals, the choice is very creditable.

Elementary Principles of Reinforced Concrete Construction.—By Ewart S. Andrews, B.Sc., Lecturer in Theory and Design of Structures at Goldsmith's College, New Cross, London. Publishers, Scott, Greenwood & Son. Cloth; 4½ x 7 inches; pages xi. + 195; 57 text figures. Price, $1.00 net.

Of the various elementary texts in reinforced concrete this is one of the best. The author has the faculty of being able to state the essentials of his subject in a clear and convincing manner to those whose knowledge of mathematics is limited. This is partly due to simplicity and directness of statement and partly to the excellent word-illustrations of the joint action of concrete and steel in a reinforced member. Numerous numerical examples are also given which will undoubtedly reassure the beginner in his application of the formulas to actual problems.

The introductory part of the book comprises a brief historical review of the use of reinforced concrete, and a lengthy statement of the notation employed—that of the Concrete Institute—after which the author proceeds with a discussion of the properties of concrete and steel, loads, working stresses, bending moments, and the distribution of loads on slabs. The latter is covered particularly well for a short text book. After this, direct compression and bending on reinforced concrete members receive full attention, adequate consideration being given to double reinforcement, an important feature of arch ribs, walls and chimneys. Chapter IX. contains an interesting and somewhat novel graphical treatment of reinforced concrete beams, based on the methods of Professor Mohr. While only of academic interest in the case of simple sections, it will be found of use in handling irregular or unusual ones. The closing chapters concern shearing stresses, deflections, columns, leading systems of construction and twenty typical exrcises. A few common mathematical tables are also included.

Apart from the disadvantage of a notation differing considerably from that now regarded as practically standard on this side of the ocean and the characteristic British terminology, the book is thoroughly acceptable. Some slight errors exist, as in the use of the word "strain" for "stress" on page 22, the numbering of two figures the same (22), and a few misspelt words. On the whole, the author's work ought to prove very useful and helpful to the young designer in reinforced concrete.

Steel Rails.—By William H. Sellen. Published by D. Van Nostrand Company and Constable & Company. 523 pages; 7¼ x 10¼; 361 illustrations and 33 folding plates. Price, $12.50 net.

Reviewed by T. R. Loudon.

Since the introduction of the use of the steel rail, no other steel commodity has received so much attention, both by the railway companies and the steel manufacturers. It is not so long ago that the worst possible confusion existed as to the proper section of rail for a given traffic condition. Of late years, however, more or less uniformity has been reached, but this state was not brought about without a tremendous amount of discussion. At the present time, so heavy are the traffic conditions that the question of proper rail specifications is again giving rise to another important series of discussions. All this discussion, past and present, is so widely distributed throughout the technical literature that it is an almost insurmountable task to begin to follow any given phase from the beginning up to the present time. To those familiar with the manufacture of the steel rail, this is only too well known. To pick and choose and intelligently synopsize the above referred to discussions is a work that is worthy of note. This is a task that has been undertakeo and carried out in an extremely creditable manner by the author of this book. From the historical standpoint alone the information compiled in this book is invaluable.

The first chapter is written with the evident purpose of tracing the evolution of the present-day rail section. The purely historical data is interesting. Apart from this, the matter is so put together that the reader sees very clearly the reasoning that has led to the use of the modern rail section. In summing up this chapter, the author points out very properly that the ability of a rail to resist the loads to which it is subjected is dependent as much upon the character of the metal as upon the section. The point is very properly made, coming, as it does, in the first chapter. These last two paragraphs could stand being more prominently set up.

Chapter II. deals with the pressure of the wheel on the rail. In this section of the book the author goes into the additions that must be made to the static wheel loads in order to arrive at the actual load under running conditions. The effects of the various factors, such as the lack of balance in the reciprocating parts of the locomotive, of irregularities in the track, rocking of engine, flat spots on wheels, are considered in detail. The data given is exceedingly extensive and well presented. While it is always possible to arrive at a definite figure for the unbalanced forces due to reciprocating parts of a locomotive, it is not very easy to arrive at a definite method of analysis of the other known causes of excess pressure on a rail. The author quotes the various theories and tests in a very interesting manner. The information given on electric cars and upon ordinary cars is extremely up to date.

Chapter III. is devoted to supports of the rail. The first part of this chapter is taken up with the description of the various forms of ties used. The descriptions are brief, and the reasons for and against the use of the various forms of ties are to the point. A large portion of this section is devoted to the discussion of the ordinary wooden tie. Some interesting data is given on forestry as applicable to the production of railroad ties. A comparison of the half-round ties, which are used a great deal in Europe, with the American form of tie is made, and it is quite clearly shown that not only from the standpoint of desirability for track support, but also from the standpoint of economical production, the half-round should be used. Descriptions of various forms of tie-plate and fastenings are then given. The last part of

the chapter is devoted to a discussion of the strength of ties under various treatments.

"Stresses in the Rail" is the heading for Chapter IV. The first portion of this chapter is more given over to discussing wear on tires, which is well put together and interesting, but is not very well worked into the subject of the chapter. A statement is made farther on relative to the heating of a rail due to slipping of drivers. It is stated that the running surface is hardened by this overheating and cooling, due to the surrounding metal conducting the heat away quickly. Quite true, the surface of a rail is heated by slipping of drivers. As the author points out, the shower of sparks when slipping takes place attests to this, but even though a small portion of the rail were heated, there is no doubt that the surrounding metal cannot conduct the heat away quickly enough to produce hardening. Certainly the effect cannot be as the author states: "Similar to quenching steel from high temperature in water, etc." In cold or moist weather some effect might be noticed, but this would be doubtful. In the discussion of bending and shearing stresses and the efficiency of rail joints a great deal of very accurate information is quoted. For use as splice-bars, the author favors oil-treated steel, presumably about fifty points of carbon. The statement is made that "oil-treated steel is as much in advance of high-carbon steel as is the latter over soft steel." Presumably this refers to the higher carbon steels being oil-treated. The point is not clear. The context, however, quotes a fifty-point carbon steel used by Cambria Steel Company. The information quoted on Rail Splices is well worth careful consideration.

In Chapter V. the strength of the rail is taken up. A great deal of information on repeated stresses is given and applied to the case of a rail under service. It might have been as well to have gone more carefully into the discussion of the internal structure of steel than is done at the beginning of the chapter. The subject is one requiring careful consideration or it had better be left alone. The discussion of what constitutes a crystal and what is referred to by a crystalline grain in steel is one which is very confusing unless the reader is familiar with the study of alloys, and the iron carbon series in particular. The chapter also deals with the effect of temperature on the strength of a finished rail and on the methods of testing.

The Influence of the Detail of Manufacture is discussed in Chapter VI. The first portion of the chapter is taken up with a description of the methods of manufacture of steel and the influence of certain elements on steel. There are certain inaccuracies in the descriptions that are inevitable in a synopsis. For instance, in the description of the Bessemer process it is stated that, "The combustion of this carbon (in the molten pig iron) increases the heat of the metal, and the flame . . . is at first red, but rapidly becomes brighter, etc." No mention is made of the burning of the silicon, which, in our present Acid Process, is the most important element in maintaining the temperature of the process. The first "flame" while the silicon is burning as a matter of fact is not a true flame. This is doubtless what the author had in mind, but the description is loose. In discussing the treatment of the ingot the author has gone to considerable pains in collecting the most up-to-date information. The section on mechanical work is also very well put together.

The last chapter is made up of various rail specifications, and on account of the wide range given is valuable.

As stated before, there are a number of plates. The drawings show up well on the dead white paper, the dimensions being very clear.

The book is a credit to the author, and is evidently the result of an enormous amount of labor in gathering information.

PUBLICATIONS RECEIVED.

Canadian Railway Club.—Official proceedings of the club, Montreal. James Powell, secretary.

Cloth Pinions.—Illustrated bulletins. Issued by the Canadian General Electric Company, Limited, Toronto, Ont.

Air Compressors.—Illustrated bulletin. Issued by the Canadian General Electric Company, Limited, Toronto, Ont.

Map of Cowganda Mining Division.—Issued by the Geological Survey of Canada, and covering twenty-eight townships in that district.

Forest Products of Canada.—Statistics as compiled by R. G. Lewis, B.Sc.F., on pulpwood. Issued by the Department of the Interior, Canada.

Electricity in Excavation and Construction Work.—Illustrated bulletin, 28 pages. Issued by the Canadian General Electric Company, Limited, Toronto, Ont.

Ontario Agricultural College.—Thirty-eighth annual report. Issued by the Ontario Department of Agriculture, Toronto.

Inspectors of Factories.—Twenty-fifth annual report of inspectors. Issued by the Provincial Government, Toronto, Ont.

Report of City Engineer, Hamilton.—Annual report for year ending December 31st, 1912, of Mr. A. F. Macallum, city engineer.

Queen Victoria Niagara Falls Park.—Twenty-seventh annual report of the Commissioners. Issued by the Provincial Government, Toronto, Ont.

Prisons and Reformatories.—Forty-fifth annual report of the Inspector of Prisons and Public Charities. Issued by the Provincial Government, Toronto, Ont.

Rain Statistics, Compiled by the Department of Trade and Commerce for the Year ended March 31st, 1912.—Part V. of the annual report of the Department.

The Analysis of Black Powder and Dynamite.—Technical bulletin by Walter O. Snelling and C. G. Storm. Issued by the United States Bureau of Mines, Department of Interior.

The Currents in the Entrance to the St. Lawrence, from investigations of the tidal and current survey in the seasons of 1895, 1911, and 1912. Published by the Department of the Naval Service at Ottawa.

Revenues and Expenses of Steam Roads in the United States for the Month of April, 1913.—Bulletin No. 53, prepared by the Division of Statistics, and issued by the Interstate Commerce Commission.

The Determination of Internal Temperature Range in Concrete Arches.—By C. S. Nichols, B.C.E., and C. B. McCullough, B.S. Bulletin No. 30 of Iowa State College, Engineering Experiment Station.

Trade and Navigation Statements.—Unrevised monthly statements of imports entered for consumption and exports of the Dominion of Canada for the month of April, 1913. Issued by the Minister of Customs, Ottawa.

The Inspector of Prisons and Public Charities' Report.—Forty-fifth annual report on hospital for feeble-minded and epileptics for the year ending October 31st, 1912. Issued by the Provincial Government, Toronto, Ont.

The Theory of Loads on Pipes in Ditches, including Tests of Cement and Clay Drain Tile and Sewer Pipe.—By A. Marston and A. O. Anderson. Bulletin No. 31, Engineering Experiment Station of Iowa State College.

Topographical Surveys Branch Report.—Contains the annual report of the topographical survey branch for the year 1911-1912. 260 pages. Illustrated, and includes 17 sketch and topographical maps. Issued by the Department of the Interior, Ottawa.

Report of the Railway, Telegraph and Telephone Department of the Province of Saskatchewan for the year ending February 29th, 1912.—A pamphlet containing over

sixty pages of reports from officials in charge of the several branches of the department.

The South African Institute of Electrical Engineers.—Contains transactions of the Institute and copies of papers read by members, among them an interesting paper on "Water-power Plants," by W. Eldson-Dew. Issued by the Institute. The Corner House, P.O. Box 4563, Johannesburg.

Technical Paper No. 44, United States Bureau of Mines.—A paper by H. H. Clark on Safety Electric Switches for Mines, based on study and investigation of causes of mine accidents, and dealing with the design of switches to prevent gas ignition upon operation under load.

Transactions of the Institute of Marine Engineers.—Contains copy of papers on "Thermodynamics and Refrigeration." By G. James Wells, and lecture on "Refrigeration," by Robert Balfour. Issued by the Institute, 58 Romford Road, Stratford, Eng.

Engineering Experiment Station.—Bulletin No. 31.—Illustrated. Contains papers on "The Theory of Loads on Pipes in Ditches," and "Tests of Cement and Clay Drain Tile and Sewer Pipe," by A. Marston and A. O. Andrews. Issued by the Iowa State College of Agriculture and Mechanic Arts, Anus, Iowa.

Engineering Experiment Station.—Bulletin No. 30.—Illustrated with maps inset. Contain papers on "The Determination of Internal Temperature Range in Concrete Arch Bridges," by C. S. Nichols and C. B. McCullough. Issued by the Iowa State College of Agriculture and Mechanic Arts, Anus, Iowa.

Engineering Experiment Station.—Bulletin No. 31.—Illustrated. Contains papers on "The Theory of Loads on Pipes in Ditches" and "Tests of Cement and Clay Drain Tile and Sewer Pipe." By A. Marston and A. O. Anderson. Issued by the Iowa State College of Agriculture and Mechanic Arts, Anus, Iowa.

Progress of Stream Measurements.—Report by F. H. Peters, C.E., for the Department of the Interior. A 310-page book, with 62 plates and numerous maps and tables covering the work accomplished by the Department in the measurement of stream flow during the year 1911, by P. M. Sauder, C.E., chief hydrographer.

Ohio State Board of Health.—Monthly bulletin containing articles relating to public health, the significance of occupational diseases, and a brief outline of the two new divisions of the State Board of Health recently created by legislative action. Prepared by E. F. Campbell, Ph.D., M.D., and issued by the Board, Columbus, Ohio.

United States Bureau of Mines.—Report No. 37.—Containing a paper by Irving C. Allen on "Heavy Oil as Fuel for Internal Combustion Engines." A 36-page pamphlet presenting the result of an extended research for some means of more effectivly burning heavy asphaltum oils as fuel for steam-raising and for engines of internal combustion type.

Report of the Minister of Public Works.—Report on the Ottawa River storage and notes on a visit to the Panama Canal; also on geodetic levelling between Stephens, Minn., and Winnipeg Beach, Man., and between Trenton, Lake Ontario, Orillia and Lake Couchiching, Ont. Fully illustrated. Issued by the Department of Public Works, Ottawa.

United States Bureau of Mines.—Bulletin 62.—Dealing with the Mine Rescue and First Aid Conference, held last September in Pittsburg, Pa., containing addresses and discussions and reports of sub-committees. The bulletin also contains resolutions adopted at the Conference and the proposed constitution for a permanent national mine rescue and first aid association.

Progress of Stream Measurements.—Report of F. H. Peters, C.E., on stream measurements for the calendar year of 1911. The report gives a brief outline of the methods of obtaining and compiling data, and gives in a tabulated form almost all of the records of stream flow during 1911.? Illustrated, and contains map showing the gauging stations in Alberta and Saskatchewan. Issued by the Department of the Interior, Ottawa.

Super-heated Steam Engines. Economical and reliable generation of power by over-type super heated steam engines from a paper read by W. J. Marshall, A. M. I. Mech. E., before the British Association at Portsmouth. The descriptions and data relative to the construction and operation of the Garrett engine, manufactured by Messrs. Richard Garrett & Sons, Limited, Leiston, Suffolk, are most interesting, and cover twelve pages of 10 x 12 concisely printed type.

The Journal of the Royal Astronomical Society of Canada, May-June number, containing an interesting article by Prof. A. C. Chant on the extraordinary meteoric display observed on the evening of February 9th, 1913. The article deals very scientifically with the occurrence, and contains reports of observations from many localities throughout Canada. Another article of interest is by W. F. King, chief astronomer, Ottawa, bearing upon the new reflecting telescope for the Dominion Observatory.

Some Facts about Treating Railway Ties.—Parts I. and II. of which were published in 1912, and were devoted to descriptions to various processes of wood preservation and improved methods of treating railway ties. Parts III., IV., V. and VI, dealing with the mechanical life of ties, a comparison of zinc chloride with creosote for preserving, a history of wood preservation in Europe and America, and a list of treating plants, together with their location, capacity, processes, etc., have just been published. The treatise is bound in three pamphlets, aggregating 200 pages, 6 by 9 inches, and costing $1.50 per set.

CATALOGUES RECEIVED.

Mikado Locomotives.—Illustrated bulletin issued by the American Locomotive Co., New York, U.S.A.

Architecture.—A catalogue of books relating to architecture. Issued by B. T. Batsford, 94 High Holborn, London.

Channon's Review.—Illustrated catalogue of the company's general machinery and supplies. Issued by the H. Channon Co., Chicago, Ill.

Armstrong Drop Forged Steel Wrenches.—A 32-page illustrated booklet covering wide range of wrenches with sizes and prices, of Armstrong Brothers Tool Co., Chicago.

Direct Current Apparatus.—Electrical catechism concerning the conventional questions asked by prospective buyers. Illustrated. Issued by the Fairbanks, Morse and Co., Chicago, Ill.

Alternate Current Apparatus.—Illustrated bulletin containing general information in regard to alternate current apparatus. Issued by the Fairbanks, Morse and Co., Chicago, Ill.

Clyde Iron Works Co.—An original style of catalogue concerning their output of hoisting machinery may be obtained on application to the Clyde Iron Works, Duluth, Minn., U.S.A.

Concrete Machinery.—170 page illustrated catalogue of the different types of concrete machinery manufactured by the company. Issued by the London Concrete Machinery Co., Ltd., London, Ont.

Electric Arc Welding Apparatus.—28-page catalogue, well illustrated and containing a complete description of the new multiple unit arc welding outfit. Issued by the C. and C. Electric and Manufacturing Co., Garwood, N.J.

Comparison Between Low Pressure Water Turbines and Centrifugal Pumps and the inferences applied to the construction of irrigation and drainage installations. Illustrated. Issued by the Escher Wyss and Co., Zurich.

The Labor Saver.—Illustrated catalogue devoted to the automatic handling of materals in construction, published in the interest of efficiency and economy in production. Issued by the Stephens-Adamson Manufacturing Co., Aurora, Ill.

What Users Say About the United States Graphite Company's Mexican boiler graphite. A handsomely-bound, printed and well-edited 64-page booklet dealing with scale in boilers and its prevention by the use of the company's product.

Modern Blue-Printing.—By P. M. Morgan, an 8-page pamphlet dealing with the Pease "Peerless" continuous blue-printing equipment, and abstracted from an article appearing in May 29th issue of *The Canadian Engineer*, published by E. R. Watts, Canada, Ltd., Canadian Agent for the C. F. Pease Co., of Chicago.

Steel Armoured Concrete Pipes for Pressure, Drainage and Water Conduits.—A 20-page catalogue descriptive of Siegwart pipes of reinforced concrete, together with tables of measurement, results of tests and diagramatic illustrations of stresses. The International Siegwart Beam Co., Lucerne, Switzerland, Canadian Agency, F. T. Kaelin, 611 Power Building, Montreal.

Cheap Steam and Machine-Firing.—A 28-page illustrated catalogue containing concise description of the construction and operation of the Gold Medal machine stoker, reports of active tests, and machines in situ on leading types of boilers, the drawings of which should be especially interesting to steam users. Copies may be obtained gratis from G. H. Tod, Manning Chambers, Toronto.

The Explosive Concrete Pile.—A set of bulletins issued by the International Siegwart Beam Company concerning concrete piles "exploded" at the base to afford efficient expansion desirable for foundations on bad ground. Records of trials are contained therein and the bulletins are well illustrated, and printed in English, French and German. Canadian agent, F. T. Kaelin, 611 Power Building, Montreal, Que.

L. S. Starrett and Co.—Illustrated catalogue, No. 20, 320 pages, contains interesting descriptions, illustrations and prices of all kinds of tools for machinists, carpenters, draftsmen, engineers, chauffeurs and other mechanics. In addition there are many pages of data and tables such as metric conversion tables, decimal equivalents, weight computing tables, tapers and angles, wire gauge tables, etc. The arrangement of the catalogue has been somewhat changed from that of No. 19, which makes it easier for reference. Issued by L. S. Starrett and Co., Athol, Mass.

The "Stoney" Sluice and its Application to Water Storage and Control.—144-page catalogue, fourth edition, descriptive of "Stoney" control sluices of which Ransome and Rapier, Ltd., London and Ipswich, England, are the manufacturers. Contains many interesting illustrations of installations and general information relative to water control, ice and flood conditions, general properties of weirs, etc. The work is supplemented by numerous tables and diagrams and the items are carefully indexed making the publication one of value for waterworks' engineers. Issued from the London office of Ransome and Rapier, Ltd., 32 Victoria Street, S.W., London, England.

COAST TO COAST.

Toronto, Ont.—The new custom house planned with other new Dominion Government buildings in this city, will cost $2,000,000 when completed. Yonge and Front Streets will be widened to provide an approach to the new buildings. The new Union passenger station will also cost in the neighbourhood of $2,000,000.

Winnipeg, Man.—Applications have been invited in London, for subscriptions for a city of Winnipeg loan of $3,450,000 at 4½ per cent., the price being 97. The loan, which is redeemable at par in 1963, will be utilized for the extension of the civic water supply and electrical and other public works. Winnipeg's existing liabilities, exclusive of the present issue, amounts to nearly $35,000,000.

Halifax, N.S.—The Halifax Automobile Association has inaugurated a good roads movement along unique lines. On the 23rd inst., all the auto-owners in the city will start out in their cars with over-all laborers in each, and a plan to thoroughly repair a bad stretch of some twenty miles of road outside the city. Finding that previous financial efforts have failed, the owners now intend to devote their own muscle to improving the highways.

Victoria, B.C.—Plans for the harbor work for this season at Victoria have now been completed by the engineering branch of the Public Works Department at Ottawa, and as soon as the specifications are printed tenders will be called for. The work calls for the building of two peirs, one of a thousand feet and the other eight hundred and seventy feet in length. They will be built of concrete and crib work, and will provide three berths for the largest liners. The estimated cost of the work is around two million dollars, and it is said that Victoria will be made a real national port, capable of handling the largest steamers and of taking care of the development which is looked for with the opening of the Panama Canal.

Ottawa, Ont.—Early developments are expected in connection with the Chats Falls water power which the Ontario Hydro-Electric Commission is endeavoring to secure Mayor Ellis and members of the commission are at Chats Falls looking over the location, and it is understood that immediate action will be taken to hurry matters along. The commission has already served formal notice of expropriation on the private owners of the water powers. But a more important movement is that which it is understood is contemplated by the Dominion Government, the making of complete investigations with a view to cancellation of the transfer by the Laurier government of the most important part of the water power. Ottawa is vitally interested in the matter, as if the Hydro-Electric Commission secures the water powers at Chats Falls, the current for the municipal electric department will come from the plant which would be erected there to serve eastern Ontario.

Victoria, B.C.—The proposal of Sir Richard McBride that the governments of Canada and the United States shall unite in constructing a trunk line of railway that will connect the Alaskan and Canadian lines, is being received with favor wherever it is mentioned. In a private letter from Hon. J. F. A. Strong, Governor of Alaska, he expresses his hearty sympathy with the proposal and his willingness to do whatever he can to promote the mutual welfare of Canada and Alaska. Speaking generally, the proposed railway would be a main artery carrying the life blood of progress to an area of more than three-quarters of a million square miles

of territory rich in natural resources of various kinds. Northern British Columbia and the Yukon Territory contain, by careful estimate, sufficient arable land to support a million people by agriculture. The Alaskan Agricultural Bureau, after careful investigation, has reported that "the total tillable and pasture land of Alaska is estimated at 64,000,000 acres," and adds, "all the crops that can be raised in Sweden, Finland and the northern provinces of Russia—potatoes, root crops, barley, oats, carrots, beets, turnips and celery—can be raised there." The bureau also says that "there is more agricultural land in the Lanaux Valley than is now under cultivation in the corresponding regions of Norway, Sweden, Finland and the four northern provinces of Russia." The mineral wealth of the whole region is enormous. This imperial area, which is almost equally divided between Canada and the United States, is at present absolutely cut off from land communication with existing railway systems, and can only be reached by a sea voyage of several days' duration, which militates very greatly against its development. There are already between five hundred and six hundred miles of railway, either constructed or in the course of construction, in this great and only meagrely exploited region.

Montreal, Que.—The financial stringency will have little effect, it is expected, on the city's programme of public works for the summer. No attempt has yet been made to raise the new $13,000,000 permanent loan, for which authority was secured some time ago. The city is not now in actual need of the money, and to place a new loan on the market at a time when it is not likely to meet with success, would, it is felt, only damage the city's credit unnecessarily. "We shall have no difficulty in raising any money we may need on temporary loans," J. Pelletier, City Comptroller and Auditor, said recently, "and then when the market improves we can float a permanent loan and pay off the temporary ones. We have not enough money actually in hand to meet the year's programme, because we naturally borrow money as we need it to save the interest. Besides, it is impossible to say beforehand how much of the work will be done. A few week's rain, for instance, might interfere with the programme very materially. But there is no danger of work being held up for lack of funds, so far as Montreal is concerned. We can always secure all we need on temporary loans." The city, however generously inclined, it was stated by a city official, has no authority to give financial assistance to outside municipalities, where work has had to cease for lack of money.

Montreal, Que.—The duties of a road engineer in Montreal are no sinecure—according to John R. Barlow, the city road surveyor. Montreal, according to Mr. Barlow, is built on a strange geological formation and is subjected to extraordinary climatic conditions which make the construction of roads very difficult. "Running right under the city," he said, "are great belts of blue clay and quicksand. During prolonged rains, these belts expand forcing the surrounding earth outwards. When the hot weather comes, they contract and there is a subsidence of the surrounding earth. If this occurs under a roadway, it does not take an expert to see what will happen. Every street in Montreal has to be built according to its own peculiar conditions. Permanent paving is to my mind the only solution of the street problem in Montreal. There should be a good foundation of concrete to prevent the roadway from sinking. Just to illustrate our difficulties. We sometimes find in repairing a permanent pavement, that the earth underneath the concrete bed has been completely washed away, leaving a concrete bridge from side to side of the street, and this has to support the full weight of the traffic. The macadamized road cannot last long in Montreal. You may build a road as well as you like, but if you have a keen winter the frost will sink into it as much as six feet and when that frost comes out in spring it will break up the road. There has been some criticism lately with regard to the stone we use on our macadamized roads. We are charged with wasting money on limestone. As a matter of fact we have never used limestone, except perhaps on a back street or two near a quarry. The greater part of the stone we use is scissel, which has a closer grain even than granite and has been pronounced by experts to be one of the best macadamizing stones on the continent.

Quebec, Que.—The necessity of completing the work of dredging the north channel of the St. Lawrence below Quebec as soon as possible is receiving the attention of the Marine Department. For this purpose in a very short time an additional dredge, one of the largest in the world, which will be capable of discharging into barges or its own hoppers will be put into commission. The work will thus be completed in a shorter time. Representations for the early completion of the work have been made by the Quebec board of trade on the ground that as new and larger vessels are being continually added to the St. Lawrence route the north channel should be finished. In order to obtain a 35-foot channel at extreme low tide with a width of 1,000 feet by way of the north channel below Quebec from St. Jean Island of Orleans to Goose Cape, 18,000,000 cubic yards of material will have to be removed. Of this amount 3,000,000 cubic yards have been dredged up to date. With the new plant it is expected that all the work will be concluded in four more years. The completion of the dredging of the north channel will greatly enhance the value of the St. Lawrence route for it is much superior to the south channel. With the proposed aids to navigation the north channel will be easier to navigate than the south. It will have a very short length of 35 feet and will not require buoys and lightships as the present long and tortuous channel. It will also be easy to navigate in the winter months.

Ottawa, Ont.—Fairly satisfactory is the way Mr. Joseph Race, city bacteriologist, sums up the results of the tests made of the city water during June. During the month 904 samples were examined, this number being made up as follows: Water city supply, 187; wells, general, 72; well, Ottawa Dairy Co., 19; water from carts, 14; water, miscellaneous, 15; milk, 462; cream, 6; hypochlarits, 120; sputum, 5; diptheric swabs, 4; total, 904. The bacterial contents of the ward samples of water has been above the average during the past month but it is now again normal. No adequate reason can be found for this. The city samples, on the whole, have been fairly satisfactory. The only change made during the month as to hypochlorite was to increase the amount added at Queen Street from 100 to 150 lbs. per day. The private wells examined during the month have generally shown a marked increase in quality but a number of those previously reported as contaminated still contain organisms indicative of past pollution. In connection with the bacteriological examination of well water or any description of water, Mr. Race points out that the tests employed in the direction of the detection of organisms of farcal or escremental origin and that the presence of such organisms does not necessarily imply that the sample containing them is injurious to health. If the organisms are derived from a healthy person or animal no ill effects would be observed, but if the sewage is that of a person suffering from typhoid

or dysentery the water would be infected and would produce disease in a susceptible individual. It is this difference between an infected water and a contaminated or polluted water that must be borne in mind. A polluted supply is dangerous because it may become infected at any time by a person suffering from typhoid or by a carrier.

PERSONAL.

Mr. BION J. ARNOLD, of Chicago, assisted by Mr. G. W. MOYES, of this city, has commenced the investigation of street railway traffic conditions in Toronto.

E. F. BRADLEY has been appointed manager of the Toronto office of the International Engineering Works, Limited.

K. S. MACLACHLAN, B.A.Sc., has recently been appointed superintendent of the Metals Chemical Company, of Welland, Ont., ore smelters and refiners.

Mr. WILLIS CHIPMAN, of the firm of Chipman & Power, Toronto, has been called into consultation by the city of Edmonton, Alta., in regard to the site of the proposed filtration plant.

Mr. J. G. S. HUDSON, consulting mining engineer, Department of Mines, Ottawa, is at present in Nanaimo, B.C., on an investigation trip concerning explosives. It is understood that one of the measures to come before the Federal House next session is a new Explosives Act.

ARTHUR H. BLANCHARD, M. Can. Soc. C.E., Professor of Highway Engineering in Columbia University, has been retained as Consulting Highway Engineer by the Department of Efficiency and Economy of the State of New York.

PREVOST HUBBARD, in charge of the Division of Roads and Pavements of the Institute of Industrial Research, Washington, and lecturer in Engineering Chemistry in Columbia University, has been retained as Consulting Highway Chemist by the Departmnt of Efficiency and Economy of the State of New York.

Mr. W. ARMSTRONG, Canadian manager of the Canadian P. J. Mitchell Company, Limited, has resigned his position in order to become managing-director of the newly-formed Armstrong-Kerr Company, of Vancouver, contracting engineers. Mr. Armsstrong is now en route to Vancouver, having returned last week from England, where he secured several desirable agencies for his new firm.

Mr. D. EWART I.S.O., chief architect, Department of Public Works, Ottawa, is on a tour of official inspection across the Dominion. Mr. Ewart will stop at all places where important public works are in progress. The Department at present has several large undertakings under way in the west, and more of them planned, such as large dry-docks on the Pacific coast and storage elevators at various western points.

Mr. RICHARD V. LOOK, of Louisville, Ky., formerly vice-president of the American Creosoting Company, has been elected president of the Canada Creosoting Company, Limited, and will move to Toronto this week to assume his duties. Mr. Look's office will be in the company's head office in the Canadian Pacific Railway building, Toronto. As president of the company he succeeds Mr. Hurt, the president of the American Creosoting Company, who acted temporarily as president of the Canada Creosoting Company, Limited, during its organization.

Mr. A. E. GRANT has been appointed managing-director of the Canadian British Insulated Company, Limited. For the last twelve or thirteen years Mr. Grant has been with the British Insulated and Helsby Cables, Limited, England, which company is the chief stockholder in the Canadian firm. Since 1906 he has been manager and chief engineer of the Cardiff office, which controls the firm's business in the south-western counties of England and in South Wales. He is a brother of Mr. Lawford Grant, president of the British Insulated Company, Limited, who recently resigned his former position as managing-director in order to accept an important post with the Eugene Phillips Electrical Works, Limited.

COMING MEETINGS.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelfth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Annual Meeting in Regina, September 16th, 17th and 18th. General Secretary, Major Drum, Ottawa; Local Secretary, Dr. Murray, Regina.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.C.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Meeting to be held at Lethbridge, Alberta, on August 5th and 6th, 1913. Secretary, Norman S. Rankin, Calgary, Alta.

AMERICAN CONCRETE INSTITUTE.—First Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

READERS SHOULD NOTE THE REMOVAL OF THE LIST OF CANADIAN TECHNICAL AND MUNICIPAL SOCIETIES FROM THIS PAGE TO PAGE 94, IN THE REFERENCE SECTION OF **THE CANADIAN ENGINEER.** BY THIS CHANGE, ALMOST AN ENTIRE PAGE OF READING MATTER IS ADDED WEEKLY

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for smal fee.

19752—June 30—Approving revised plan (G.T.R.), marked "C," of subway on Peter street, town of Port Hope, Ont.; and rescinding Order No. 19105, dated April 22nd, 1913, in so far as it approves of subway on Peter street, as shown on plan marked "B."

General Order No. 107—July 4—Prescribing Rules and Regulations governing fire guarding by railways under the Board's jurisdiction; and rescinding Order No. 16570, dated May 22nd, 1912.

19753—July 5—Authorizing C.P.R. to construct extension to existing spur for R. Home Smith, Toronto, in Lot 10, Con. C., Co. York, Tp. Etobicoke, Ont.

19754—July 4—Amending Order No. 2119, dated Nov. 28th, 1906, by striking out words "Grand Trunk" in fifth paragraph of operative part of Order and substituting therefor words "Applicant Company."

19755—July 4—Directing that Salisbury & Albert Ry. put guard rails on all bridges 50 feet or over in length, on its railway; work to be completed by August 20th, 1913.

19756—July 2—Directing that, within 90 days from date of this Order, C.N.O.R. install improved type of illuminated electric bell at crossing of Sidney street, Trenton, Ont., and thereafter maintain bell at its own expense.

19757—July 7—Authorizing C.P.R. to open for traffic portion of Kootenay Central Ry. between mileages 0.00 and 41.00, Golden to Spillimacheen, B.C.

19758—July 7—Authorizing C.P.R. to construct bridge No. 10.7 near Asphodel Station, Ont., and bridge No. 30.8 near Kendry Station, Ont.

19759—July 4—Granting leave to Hamilton Street Railway to cross, at rail level, T., H. & B. Ry., serving Steel Co. of Canada, Ltd., on Base Line between Broken Front and First Concession, Tp. Barton, now in city of Hamilton, Ont., subject to and upon certain conditions.

19760—July 5—Extending, until July 31st, 1913, time within which G.T.R. install gates required to be installed at crossing of Lake Shore Road, Vaudreuil, Que.

19761—July 5—Authorizing C.P.R. to construct branch lines for P. Burns & Co., Ltd., Calgary, Alta.

19762—July 8—Extending, until July 20th, 1913, time within which C.P.R. install gates at Bartlett avenue, Toronto, Ont., required to be installed under Order No. 18698, dated Feb., 1913.

19763—July 4—Approving revised location G.T.R. connecting track, from its line to the T., H. & B. Ry. line serving Steel Co. of Canada, Ltd., Hamilton, Ont.

19764—July 4—Authorizing T., H. & B. Ry. to construct two spurs in the city of Hamilton, crossing Hamilton Radial Electric Ry. and highway known as Burlington street (formerly Gilkinson street), to and into lands of the Steel Co. of Canada, Ltd., subject to and upon certain conditions. Spurs to be completed within three months from date of this Order.

19765—July 7—Extending, until Sept. 30th, 1913, time within which C.P.R. install gates at Osler Ave., North Toronto, Ont., required under Order No. 19229, dated May 10th, 1913.

19766—July 7—Extending, until Dec. 31st, 1913, time within which C.P.R. complete spur for Dominion Bridge Co., Ltd., at Islington, Ont., authorized to be constructed under Order No. 18998, dated April 5th, 1913.

19767—July 4—Authorizing C.P.R. to cross, at grade, with a side track on its Saskatoon Sub. Div., Saskatchewan Division, certain lanes and streets in city of Saskatoon, Sask., subject to and upon certain conditions.

19768—July 5—Authorizing V.V. & E. Ry. & Nav. Co. to construct three (3) industry tracks from a point on its main line, in Block 82, Dist. Lot 264 A, Vancouver, B.C., westwardly to and connecting with company's existing lines, opposite Block 3, Dist. Lot 200 A, said city; tracks to be completed within three months from date of this Order.

19769—July 3—Directing Quebec Oriental Ry. ballast its line, from Metapedia to New Carlisle, with complete lift of six inches of ballast; fencing, gates, wooden culverts, and all decayed portions of trestles be renewed on said line; work be completed by December 31st, 1913.

19770—July 5—Authorizing G.T.R. to construct siding for British Canadian Canners, Ltd., on Lot 20, Con. 2, Tp. Grantham, Ont.

19771—July 7—Approving C.N.R. plans showing Standard Stations Nos. 8, 5 and 4, for use on Eastern Lines, and its Standard Fourth and Fifth Class Station Buildings.

19772—July 8—Authorizing V.V. & E. Ry. & Nav. Co. to construct across Phillips Ave., municipality of Burnaby, B.C.

19773—July 5—Authorizing C.P.R. to construct spur from a point on northerly limit of right of way of existing spur to a point on Canadian Ingersoll Rand Co.'s No. 4 Siding, in Lot No. Cadastral 1539, city of Sherbrooke, Que.

19774—July 5—Authorizing C.P.R. to construct extension to existing spur for A. Snyder & Co., Ltd., Portage la Prairie, Man., in Lot 69, city of Portage la Prairie.

19775—July 5—Authorizing C.P.R. to construct spur for Benjamin S. Spaulding, Medicine Hat, Alta.

19776—July 8—Relieving C.P.R. of speed limitations on its line between mileage 75.85 and mileage 102.00 and between mileage 102.60 and mileage 112.00 (Weyburn-Lethbridge Branch).

19777—July 8—Authorizing C.P.R. to make two connections with the Otis Staples Logging Ry., at mileage 15.15, near Kimberly, B.C., in Lot 6078, Group 1, East Kootenay Dist., on Co.'s Alberta Division, Kimberly Subdivision.

19778—July 10—Authorizing C.P.R. to construct, by means of a grade crossing, a siding track across roadway between Lots 3 and 4, Con. 1, Tp. Sandford, Dist. Rainy River, Ont., at Minnitaki.

19779—July 10—Authorizing C.P.R. to construct additional track across fourteen (14) highways, mileages 35.8 to 47.9 (zero of said mileage being at Brandon), on main line, Manitoba Division, Broadview Subdivision. After diversion at mileage 46.46 is made and grade crossing constructed in accordance with Regulations of Board, company may close portion of present road allowance to be diverted within limits of its right-of-way.

19780—July 10—Refusing application of L. J. Chevrier to reopen the matter of C.P.R. taking certain lands in village of Rigaud, Co. Vaudreuil, Que.; and Order No. 18721, dated Feb. 13th, 1913.

19781—July 10—Amending Order 19603, dated June 17th, 1913, authorizing C.N.R. to construct spur along lane through Blocks 21 and 31, and to cross Isabella St.; and to construct spur along lane through Block 30, city of Saskatoon, Sask., by adding certain clauses.

19782—July 8—Authorizing C.N.R. to construct additional track across Main St., town of Humbolt, Sask.

19783—July 5—Extending, until July 31st, 1913, time for installing interlocking plant at crossing by C.N.R. of tracks of C.P.R. and G.T.R. Cos., near Ottawa, Ont., provided for under Order No. 11386, dated August 6th, 1910.

19784—July 9—Directing C.N.O.R. to construct suitable cattle passes, with five and one-half-foot clearances, where it intersects Robert T. McLaughlin's farm on Lots 24 and 25, Con. B., Tp. Westmeath, at points to be agreed upon between the parties.

19785—July 7—Authorizing C.N.O.R. to construct bridge across Little Sturgeon River, Tp. Beaucage, Ont., mileage 243.5 from Ottawa.

19786—July 10—Approving proposed Supplement No. 1 to Canadian Classification No. 11, as finally revised and submitted for approval by G. C. Ransom, Chairman of C.F.A., by his letter dated at Montreal, July 8th, 1913, to become effective on 20th day of August, 1913.

19787—July 10—Approving location Essex Terminal Ry. from a point on its line already constructed, on Lot 59, Con. 1, Tp. Sandwich West, to a point on or near Turkey Creek, Tp. Sandwich West, Ontario.

19788—July 10—Authorizing G.T.R. to construct siding from a point on its railway on Lot G, Rideau Front Concession, Tp. Nepean, Co. Carleton, Ont., now in city of Ottawa, into premises of Silicate Brick Co., under lease from Dominion Government. To be completed within three months from date of this Order.

19789—July 11—Authorizing G.T.R. to construct siding for Dominion Canners, Limited, on Lot 153, Con. 1, Tp. East Sandwich, Co. Essex, Ont.

19790—July 11—Directing G.T.R., forthwith, to employ watchman, to be on duty at crossing, on road leading from Beaconsfield to Ste. Genevieve, Que., from 8 a.m. to 7 p.m., until October 15th, 1913, and thereafter from May 15th, to October 15th, in each and every year until further order of Board; two-thirds of cost of said watchman to be paid by Ry. Co., and one-third by Municipality.

19791—July 10—Directing C.P.R. to employ watchman to be on duty at crossing of road leading from Beaconsfield to Ste. Genevieve, Que., from 8 a.m. to 7 p.m., until October 15th, 1913, and thereafter from May 15th to October 15th, in each and every year, until further Order of Board; two-thirds of cost to be paid by Ry. Co., and one-third by Municipality.

19792—July 11—Authorizing C.L.O. & W. Ry. (C.P.R.) to construct its railway at mileage 153.76 from Gleo Tay, across road allowance between Lots 28 and 29, Con. 1, Tp. Darlington, Co. Durham Ont.

19793—Approving revised location portion C.P.R. main line, Thompson Subdivision, from Station 341.87.6, in S.E. ¼ Sec. 18-20-18, W. 6 M., at mileage 6.76, to Station 392.45.8, in S.E. ¼ Sec. 13-20-19, W. 6 M., at mileage 7.72; and from Station 432.17.1, in N.W. ¼ Sec. 13-20-19, W. 6 M., at mileage 8.46, to Station 448.02.5, in N.W. ¼ Sec 13-20-19, W. 6 M., at mileage 8.67, zero of said mileages being at Kamloops, B.C.; and authorizing said company to construct additional track (double track), by means of grade crossings, across following highways; 3rd Ave., and 2nd Ave., Kamloops; road allowance in Sec. 12-20-18, W. 6 M.; road allowance in Lot 435, P.G.S.; and road allowance in Lot 346, P.G.S., both in Range 18.

19794—July 10—Authorizing C.L.O. and W. Ry. (C.P.R.) to construct across four (4) highways, Tp. Sidney, Co. Hastings, Ont., namely; mileages, (from Glen Tay), 79, Lot 33, Con. 1, Cemetery Road; 70.04, Lot 33, Con. 1, Kingston Road; 70.19, Lot 32, Con. 1, Forced Road and 79.61, highway between Lots 30 and 31, Con. 1, road allowance.

19795—July 11—Authorizing C.P.R. to construct proposed bridge across Red River, on its Kildonan Cut-off near Winnipeg, Man.; and rescinding Order No. 18618, dated February 3rd, 1913.

19796—July 16—Amending Order No. 19644, dated June 19, 1913, by striking out figures "11738.77" where they occur in recital and operative parts of said Order, after words "File No.," and substituting therefor figures "11738.73."

19797—July 15—Authorizing C.P.R. to construct road diversion in Sec. 7-12-23, W. 3 M, Sask., and construct main line, Alta. Division, across said diversion, by means of a grade crossing. After such diversion is made and grade crossing constructed company may close portion of present road allowance between Secs. 7 and 8-12-23, W. 3 M., within the limits of its right-of-way.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

PLANS AND SPECIFICATIONS ON FILE.

The following plans and specifications are on file for reference only, unless otherwise noted, at the office of *The Canadian Engineer*, 62 Church Street, Toronto:—

BIDS CLOSE	NOTED IN ISSUE OF
4-8—Construction of sewers, Welland Ontario.	24-7

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Bassano, Alta., sewage disposal works	Aug. 15.	July 17.	86
Carlyle, Sask., waterworks and electric lighting	Aug. 1.	July 10.	86
Cobalt, Ont., municipal building	Aug. 15.	July 24.	86
Galt, Ont., drill hall	Aug. 5.	July 17.	80
Halifax, N.S., dredging	Aug. 1.	July 24.	80
Kerrisdale, B.C., incinerator	Aug. 18.	July 24.	80
Ottawa, Ont., cables and induction regulators	Aug. 14.	July 24.	78
Ottawa, Ont., steel steamer	Aug. 28.	July 24.	80
Renfrew, Ont., drill hall	Aug. 8.	July 24.	82
Sudbury, Ont., public building	Aug. 6.	July 24.	82
The Pas, Man., wireless telegraph equipment	Aug. 1.	July 24.	80
Toronto, Ont., abattoir, equipment	Aug. 5.	July 24.	84
Toronto, Ont., bridge	Aug. 6.	July 24.	84
Toronto, Ont., painting bridge	Aug. 5.	July 24.	86
Toronto, Ont., culvert	Aug. 6.	July 24.	86
Toronto, Ont., cutting pulpwood	Aug. 15.	July 19.	78
Toronto, Ont., Toronto harbor works	Aug. 25.	July 17.	84
Vancouver, B.C., wharf	Aug. 21.	July 17.	80
Victoria, B.C., residences	Aug. 5.	July 17.	80
Welland, Ont., construction of sewers	Aug. 4.	July 24	84
Winnipeg, Man., motor generator	Aug 9.	July 10.	76

RAILWAYS—STEAM AND ELECTRIC.

+—Ottawa, Ont.—The contract for the construction of twelve miles of the Morrisburg and Ottawa railroad, from Ottawa to Greely was awarded to R. J. TIERNEY AND COMPANY, Ottawa, at a special meeting of the shareholders. The cost of construction will average between ten and twelve thousand dollars a mile.

Vancouver, B.C.—Following a conference held between J. J. Warren, president of the Kettle Valley Line, and L. C. Gilman, of Seattle, vice-president of the Great Northern Railway, the announcement was made that tenders for the construction of the unfinished link across the Hope mountains from Coquehalla summit to Hope, on the Fraser River, a distance of about sixty miles, will be called for shortly. An early start on construction is assured as the time limit for receiving tenders will be short, and various prominent contracting firms have already inspected the route with a view to submitting tenders for the work.

BRIDGES, ROADS AND PAVEMENTS.

Arden, Man.—Tenders will be received up till the 6th of August, 1913, for the construction of steel truss bridge over White Mud River. Plans and specifications may be obtained from the Department of Public Works, Winnipeg and M. E. Broughton, secretary-treasurer.

+—Barrie, Ont.—The Town Council has awarded Messrs. CURRAN & CLEMENT the contract for the construction of pavement. The contract price is $1.23 per square yard for pavement and 25c. per lineal foot for curb.

Dundas, Ont.—Tenders will be received up till the 4th of August, 1913, for concrete work on a bridge. Plans and specifications may be obtained from John S. Fry, Town Clerk.

Halifax, N.S.—Tenders will be received up till the 2nd of August, 1913, for the construction of several bridges and culverts in the County of Hants. Plans and specifications may be obtained from the Department of Public Works and Mines, Halifax. E. H. Armstrong, Commissioner.

Halifax, N.S.—Tenders will be received up till the 8th of August, 1913, for the construction of several bridges and culverts in the County of Colchester. Plans and specifications may be obtained from the Department of Public Works and Mines, Halifax. E. H. Armstrong, Commissioner.

Huntingdon, Que.—Tenders will be received up till the 2nd of August, 1913, for the macadamizing of four miles of streets. Plans and specifications may be obtained from R. S. Feeny, secretary-treasurer.

+—Lindsay, Ont.—The Town Council has awarded Messrs. FOLEY & GLEESON the contract for paving William Street.

Montreal, Que.—Tenders will be received up till the 5th of August, 1913, for the construction of granite block pavement on Cote Street, Paul Road. Plans and specifications may be obtained from the Board of Commissioners. L. N. Senecal, Secretary.

Ottawa, Ont.—Provided the city's equipment is capable of carrying out the work most of the asphalt paving to be laid on lower town streets this year will be carried out by the city itself. City Engineer Currie has estimated for the work in each case a price lower than the tenders which have been submitted to the Board of Control. The following were the figures of the tenders received:—Clarence Street, Ottawa Construction Company, $7,430; Union Construction Company, $7,138; city engineer's tender, $7,030. Dalhousie, Cathcart to Sussex, Ottawa Construction Company, $18,400; Union Construction Company, $19,158; city engineer, $18,610. Spadina Avenue, Ottawa Construction Company, $5,500; Union Construction Company, $5,196; city engineer, $5,110. Dalhousie Street, St. Andrew to Cathcart, Ottawa Construction Company, $7,100; Union Construction Company, $7,533; city engineer, $7,270.

Regina, Sask.—Tenders will be received up till the 9th of August, 1913, for the construction of a grade across White Heron Lakes. Plans and specifications may be obtained from the Board of Control. A. J. McPherson, chairman.

Regina, Sask.—Tenders will be received up till the 9th of August, 1913, for the construction of a grade across Buffalo Coulee. Plans and specifications may be obtained from the Board of Control. A. J. McPherson, chairman.

+—Saskatoon, Sask.—The Canadian Pacific Railway has awarded Messrs. ALN & BLOOM the contract for a steel bridge with concrete abutments on Seventh Avenue. The contract price is $20,000.

Tarvia

Preserves Roads
Prevents Dust~

Atwater Avenue, Montreal, Quebec. Constructed with Tarvia Modern Pavement.

Tarvia vs. Plain Macadam

THE right-hand side of the above roadway was built with "Tarvia X." The left-hand side is plain macadam. The tarviated side is adequate to cope with the traffic. The plain macadam side is in persistent disrepair.

In previous years this roadway washed and gullied very badly in the spring and many tons of macadam were dislodged from different parts of this hill and deposited at the bottom by the spring rains.

Now, after a rain, the tarviated side drains quickly and easily to the gutter. The plain macadam side gets muddy and stays so for some time.

The tarviated side gets more than its share of the traffic because it affords superior traction, yet it is free of dust except for what is blown upon it from its dusty neighbor on the other side of the tracks.

As to maintenance, the tarviated side needs no attention, while the plain macadam is in frequent need of care. The cost of upkeep in the long run will be considerably greater for the plain macadam, and the results will be very inferior.

The initial cost of the plain macadam may have been a little lower, but the high maintenance more than wipes out the saving.

"Tarvia X" which was used on half of this road is a dense, viscid coal tar product which is immune from damage by water and frost. It forms a dense, plastic matrix about the stone, prevents internal movements of the roadway, and by reason of its plasticity, develops a surface that grows smoother with traffic.

Booklets Free on Request

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

+—Springfield, Ill.—The DOLARWAY PAVING COMPANY have been awarded the contract for the construction of 16,000 square yards of pavements.

St. Catharines, Ont.—As soon as a special committee appointed by St. Catharines makes a report favoring the contribution of that city towards the construction of a railway bridge over the Welland Canal, the Canadian Northern will seriously consider entering into an arrangement with the Canadian Pacific whereby both companies may jointly construct and use the bridge.

+—St. Thomas, Ont.—The Board of Works have awarded Mr. A. E. PONSFORD the contract for the concrete pavement on Southwick Street. The contract price is $1.25 per square yard.

▲—Toronto, Ont.—Tenders will be received up till the 6th of August, 1913, for the construction of a reinforced culvert. Plans and specifications may be obtained from Frank Barber, County Engineer.

▲—Toronto, Ont.—Tenders will be received up till the 6th of August, 1913, for the construction of a bridge. Plans and specifications may be obtained from Frank Barber, County Engineer.

Toronto, Ont.—Tenders will be received up till the 5th of August, 1913, for the construction of pavements. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Mayor.

Toronto, Ont.—According to the plans now prepared by Assistant City Engineer Powell, the city will expend $3,000,000 next year in bridges. The Bloor Street viaduct is the chief work planned and will consume a large amount of the sum named. The Gerrard Street bridge, the C.P.R. viaduct, Poplar Plains Road, Avenue Road and other bridges of less importance, make up the balance. The test holes for the Bloor Street viaduct and the Gerrard Street bridge have been sunk and the contracts for this work will be awarded late in the fall.

▲—Windsor, Ont.—The SARNIA BRIDGE COMPANY have been awarded the contract for three new bridges in the county. The contract prices being $7,300, $4,500 and $4,200 respectively.

LIGHT, HEAT AND POWER.

+—Lindsay, Ont.—The Hydro-Electric Power Commission has awarded BOVING & COMPANY of CANADA LIMITED, the contract for supplying large turbines and governors for the power plant at Wasdell's Falls. These units will be of similar size to those recently supplied by Boving and Company for Dams Nos. 2 and 5, in the Trent River, which have a combined capacity of 10,000 horsepower.

Toronto, Ont.—The Hot Point Electric Heating Company which has its central plant at Ontario, Cal., will locate a plant in this city. The estimated cost is $250,000.

GARBAGE, SEWAGE AND WATER.

▲—Bassano, Alta.—Tenders will be received up till the 15th of August 1913, for the construction of a sewage disposal works. Plans and specifications may be obtained from the John Galt Engineering Co., Ltd., consulting engineers and Geo, B. R. Bond, secretary-treasurer.

Edmonton, Alta.—By-laws authorizing an issue of $519,760 debentures for waterworks and an issue of $1,692,149 debentures for sewer extensions this year to be borne by the city at large, and an issue of $98,491.69 debentures to be expended on sewer extensions to be assessed to local improvements, have been passed by the city.

Montreal, Que.—Messrs. Hering and Fuller, of New York, the consulting engineers who drew up the plans for the filtration plant, have been asked to come here at once, This move, it is understood, is being made so that expert advice on the best manner of proceeding with the work on the plant may be obtained. It is likely that Mr. McLeod, the contractor in charge, will be asked to finish the work, though an extension of time will, of course, be necessary for the completion of the contract.

McLeod, Alta.—The $336,000 secured recently from the sale of town debentures will be spent as follows:—For the construction of a filtration plant and the improvement and extension of the waterworks system, $81,000; for the construction of a sewerage disposal plant in connection with the sewerage system, $50,000; for the extension of the sewerage, $36,000; for the construction and extension of the waterworks system and the extension and enlargement of the electric light system, $46,000; for the construction and extension of the municipal system of sewers, $23,000; and, for the erection and equipping of a building to be used for municipal purposes, $100,000.

Port Arthur, Ont.—Tenders will be received up till the 4th of August, 1913, for the excavating and refilling of trenches for sewers and water mains. Plans and specifications may be obtained from J. J. Hackney, commissioner of utilities.

St. Catharines, Ont.—The city's debenture issue of $45,000 for a new trunk sewer in the north-eastern end of the city has been sold in Toronto.

▲—Toronto, Ont.—Tenders will be received up till the 5th of August, 1913, for the construction of a number of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Chairman.

▲—Toronto, Ont.—Tenders will be received up till the 19th of August, 1913, for the construction of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Mayor.

Toronto, Ont.—Tenders will be received up till the 5th of August, 1913, for the laying of a 36-inch water main. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

Toronto, Ont.—The City Council have received a proposal from the Bell Filtration Company, Toronto, to install the new mechanical filtration plant. According to the offer of the company, they are prepared to install such a plant, which would be manufactured in Manchester, England. The plant would have a minimum capacity of 65,000,000 gallons and a maximum of 96,000,000. The equipment would include buildings erected by the company on foundations and excavations supplied by the city, consisting of basin, ground floor and one story, large enough for the addition of another 20,000,000 gallons, if necessary, to contain stores, laboratory, etc., with pipes three feet on each side for connection with the city pumps and mains. The plant would be tested to a pressure of 100 pounds to the square inch and they agree to put in a complete plant at a cost of $1,500,000.

▲—Welland, Ont.—Tenders will be received up till the 4th of August, for the construction of sewers. Plans and specifications may be obtained from *The Canadian Engineer*, 62 Church Street, Toronto, and James Hughes, Chairman Sewerage Committee.

+—Winnipeg, Man.—The DES MOINES BRIDGE AND IRON WORKS have been awarded the contract for the new 125,000 gallon reservoir to supply water to the Agricultural College. The contract price is $12,700.

INDUSTRIAL WORKS.

Cheverie, N.S.—Tenders will be received up till the 14th of August, 1913, for the construction of a wharf. Plans and specifications may be obtained from W. P. Morrison, Halifax, E. G. Millidge, Antigonish and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Dorchester, N.B.—Tenders will be received up till the 18th of August, 1913, for the reconstruction and enlargement of a wharf. Plans and specifications may be obtained from Geoffrey Stead, Chatham, N.B., J. K. Scammell, Fredericton and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Fort William, Ont.—The City Council has awarded Mr. M. H. BRADEN the contract for the erection of the new incinerator. The contract price is $12,990. The JOHN INGLIS COMPANY, Toronto, were awarded the contract for supplying the steel. The contract price is $3,550. Other firms tendered for the incinerator as follows:—Seaman and Penniman, $15,383; Moran Construction Company, $18,950; J. G. Pickard, $19,995.

48 in CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire Machine Banded

WOOD STAVE PIPE

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RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

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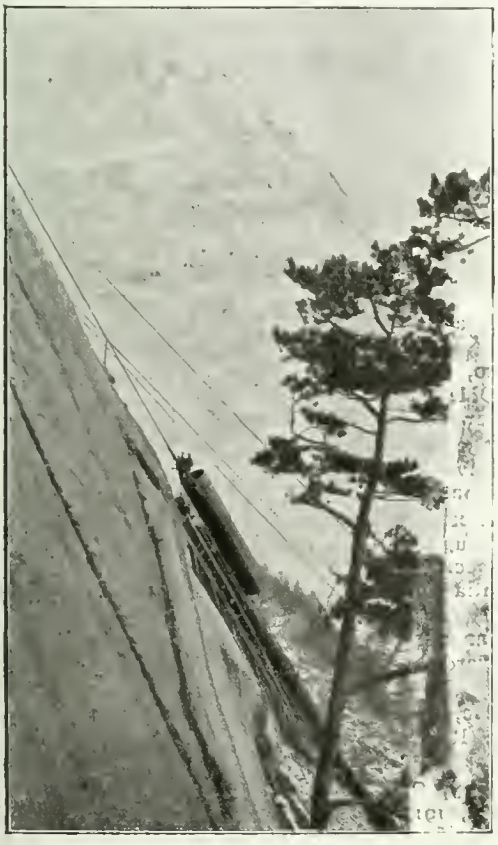

MANNESMANN STEEL TUBES

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Superheater, Stay and Boiler Tubes, Refrigerating Coils.

Gas Cylinders in Seamless Steel for Carbonic Acid, Oxygen, etc.

Mannesmann Tube Co., Limited

51 VICTORIA SQUARE, MONTREAL

Hull, Que.—The A. H. Coplan Company will locate a foundry in this city. The estimated cost is $50,000.

Island River, N.B.—Tenders will be received up till the 5th of August, 1913, for dredging Island River, Gloucester Co., N.B. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Kenora, Ont.—Tenders will be received up till the 14th of August, 1913, for the construction of a wharf. Plans and specifications may be obtained from F. Y. Harcourt, Port Arthur, J. G. Sing, Toronto and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Kerrisdale, Point Grey, B.C.—It was announced at the municipal hall this morning that the time for receiving tenders for the incinerator has been extended till August 18th.

+—Kingston, Ont.—The City Council has awarded Messrs. McKELOEY & BIRCH the contract for installing the new steam heating system in the city's buildings. The contract price is $10,729. Messrs Symmons Bros., tendered $11,064 and Taylor and Hamilton, $12,198.

Little Current, Ont.—Tenders will be received up till the 12th of August, 1913, for dredging required here. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—New Westminster, B.C.—The Department of Public Works has awarded MESSRS. BROLEY & MARTIN, Vancouver, the contract for the construction of jetties at the Sandheads, at the mouth of the Fraser River.

Prince Albert, Sask.—The Imperial Steel and Iron Co. have located a plant in this city which will employ from 600 to 700 men. Modern machinery will be installed in the several departments. The company intends manufacturing horse shoes, plates for bridges, iron and corrugated sheeting.

+—Quebec, Que.—MESSRS. QUINLAN & ROBERTSON have been awarded the contract for the damming of the St. Charles River.

Rainy River, Ont.—Tenders will be received up till the 12th of August, 1913, for dredging required. Plans and specifications may be obtained from the Department of Public Works, Ottawa R. C. Desrochers, secretary.

+—Saskatoon, Sask.—The City Commissioners have awarded Messrs. McKENZIE & THAYER the contract for supplying 20,000 tons of coal. The contract price is $175,000.

St. John, N.B.—Tenders will be received up till the 5th of August, 1913, for dredging in St. John's Harbor. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

▲—Toronto, Ont.—Tenders will be received up till the 5th of August, 1913, for the equipment of the civic abattoir. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Mayor.

Toronto, Ont.—Tenders will be received up till the 19th of August, 1913, for the supplying of portable sewage pumping engines. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Chairman.

▲—Toronto, Ont.—Tenders will be received up till the 5th of August, 1913, for painting several bridges. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

▲—Toronto, Ont.—Tenders will be received up till the **25th of August, 1913, for the construction of a sea wall,** breakwater, ship channel and retaining walls. Plans and specifications may be obtained from the District Engineer and the Harbor Commissioners, Toronto; H. J. Lamb, Windsor; J. L. Michaud, Montreal; and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Vancouver, B.C.—H. E. Elgee, who is in charge of the breakwater scheme for the Sir John Jackson Company, will put in a tender for the government wharf, to be built in Burrard Inlet at a cost of $1,800,000.

+—Victoria, B.C.—The city has awarded the following contracts for supplies:—To MUSSENS, LIMITED, for dump cars; to the CANADIAN FAIRBANKS-MORSE COMPANY, for ventilating fans; to the HINTON ELECTRIC COMPANY for two 2 H.P. motors; to Mr. A. F. NYE, two hoisting outfits; to MUSSENS, LIMITED, for two drills; to HOLDEN COMPANY, LIMITED, one giant rock drill.

Walkerton, Ont.—Tenders will be received up till the 4th of August, 1913, for the construction of a concrete breakwater. Specifications may be obtained from A. E. McNab, Chairman of Committee.

MISCELLANEOUS.

+—Armstrong, B.C.—The Dominion Government has awarded Messrs. CAMPBELL & WILKIE the contract for the construction of a drill hall. The contract price is $11,800.

+—Belleville, Ont.—The Government has awarded Messrs. T. MANLEY & SONS the contract for the new dormitory for the Deaf and Dumb Institute. The contract price is $80,000. Mr. S. F. WHITAM has the contract for the other building.

▲—Cobalt, Ont.—Tenders will be received up till the 15th of August, 1913, for the erection of a three-story concrete and municipal building. Plans and specifications may be obtained from R. L. O'Gorman, town clerk.

+—Collingwood, Ont.—The Dominion Government has awarded MESSRS. HERRINGTON, BRYAN & HEALY the contract for the new federal building. MESSRS. BULL BROTHERS have been awarded the contract for the cement work.

+—Edmonton, Alta.—Mr. Geo Scath, Vancouver, has awarded the A. J. GILLIS COMPANY the contract for a business block. The contract price is $75,000.

+—Edmonton, Alta.—The A. McDonald Company have awarded Mr. A. J. GILLIS the contract for the erection of their warehouse. The contract price is $55,000.

Edmonton, Alta.—The Woodland Dairy Company will locate a plant in this city. The cost is estimated to be $50,000.

+—Fort Francis, Ont.—The Government has awarded MESSRS. SEAMEN & PENNIMAN the contract for the erection of a court-house. The contract price is $55,000.

+—Galt, Ont.—The Canadian Pacific Railway has awarded Mr. JAMES S. WEBSTER the contract for the construction of the company's freight sheds here.

+—Lethbridge, Alta.—The Lethbridge Industrials Ltd. have awarded MARINARO BROTHERS, Fernie, the contract for their factory building.

New Westminster, B.C.—Tenders will be received up till the 12th of August, 1913, for the erection of a public building. Plans and specifications may be obtained from Wm. Henderson, Victoria, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

North Vancouver, B.C.—Tenders will be received up till the 11th of August, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

+—Orono, Ont.—The Dominion Government has awarded Mr. THOM, of Collingwood, the contract for the erection of the new Armories. The contract price is $12,000.

+—Portage la Prairie, Man.—MESSRS. BEDMAN & OSBORNE have been awarded the contract for the erection of the parish hall. The contract price is $16,000.

Prince Albert, Sask.—Tenders will be received up till the 11th of August, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence. Eugene Fiset, Deputy Minister.

+—Regina, Sask.—Messrs. MELVILLE & DOWELL have been awarded the contract for the erection of a Jewish synagogue.

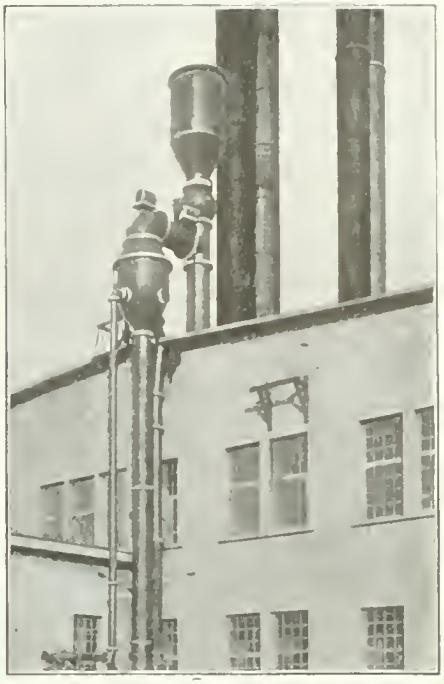
+—Simcoe, Ont.—The Dominion Government has awarded Mr. ROBERT E. GUNTON the contract for the erection of the Armories. The contract price is $30,000.

▲—Sudbury, Ont.—Tenders will be received up till the 6th of August, 1913, for the erection of a public building. Plans and specifications may be obtained from Thos. Hastings, Toronto, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

CONDENSING APPARATUS

specially designed to secure

GREATER STEAM ECONOMY



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THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

The Hampton Sedimentation Tank

Used in connection with an electrolytic hypochlorite treatment, the process is **ABSOLUTELY ODORLESS** and the effluent is free from disease germs.

Nine years of operation in large and important installations in England have demonstrated that an effluent exceptionally low in suspended solids and as free from odor as the entering sewage may be obtained with The Hampton Tank

The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction of the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

Sterilization Co.

Union Building, Clinton Street

NEWARK, N.J.

Also engineers for the electrolytic treatment of water.

A Perfect Weir Gage

Carries an unusually large card and will register without any reduction through a variation of two feet or on a two to one reduction through a variation of four feet.

Can be applied anywhere where fluctuation is within limit named and where great accuracy is desired.

In use on weirs, sewage disposal plants, irrigation and stream gaging.

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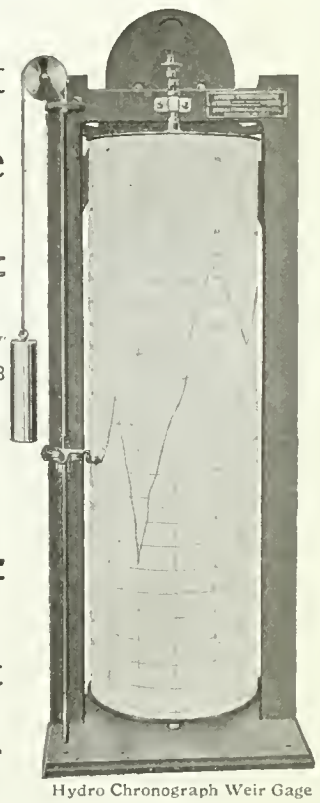


Hydro Chronograph Weir Gage

Hydro Manufacturing Co.

700 BULLITT BUILDING, PHILADELPHIA, Pa.

Swift Current, Sask.—Tenders will be received up till the 5th of August, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

+—Temiskaming, Ont.—The Government has awarded MESSRS. P. H. SECORD & SON the contract for the erection of the court-house and registry office. The contract prices were $52,500 and $10,500 respectively.

Vegreville, Alta.—Tenders will be received up till the 4th of August, 1913, for the construction of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

Victoria, B.C.—Tenders will be received up till the 4th of August, 1913, for the erection of a school. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffith, Public Works engineer.

+—Winnipeg, Man.—The J. McDIARMID COMPANY have been awarded the contract for the new Pantages theatre. The contract price is $180,000.

+—Winnipeg, Man.—The city has awarded Mr. G. W. AIKINS the contract for the erection of a public swimming bath. The contract price is $29,000.

+—Winnipeg, Man.—The Smart-Woods, Ltd., have awarded G. H. ARCHIBALD & CO., LTD., the contract for the erection of their new building. The contract price is $200,000.

+—Winnipeg, Man.—The Metallic Roofing Company have awarded WORSWICK BROTHERS the contract for the erection of a warehouse. The contract price is $32,500.

Winnipeg, Man.—Tenders will be received up till the 4th of August, 1913, for the erection of two fire stations. Plans and specifications may be obtained from the Board of Control. M. Peterson, secretary.

+—Winnipeg, Man.—MESSRS. CARTER-HALLS & ALDINGER have been awarded the contract for the new Quebec Bank building. The contract price is $225,000.

CURRENT NEWS.

Montreal, Que.—W. H. Grant, manager of construction on the Canadian Northern Railway, east of Port Arthur, arrived in the city recently, accompanied by Colonel Greenwood, assistant chief engineer of the same division. The two have just completed a tour of inspection of all the bridges being constructed along the Canadian Northern Railway. They report that the portion around the north of Lake Superior is one of the most interesting parts of the whole road, as it traverses the famous clay belt. There are three divisions on this section, comprising a distance of 550 miles, of which 335 miles of track is completed.

Winnipeg, Man.—Construction work preliminary to the driving of the C.P.R. double-track tunnel through Rogers' Pass, B.C., at the summit of the Selkirk Range, has just begun. Plant, including excavating machinery and general supplies, is making its appearance on the scene of alterations, and the new tracks and approach cuts will be gone ahead with immediately. The work is estimated to cost in the neighborhood of $5,000,000, and will require some three and a half to complete. The tunnel is over five miles in length. The eastern portal of it will be located at Beaver Creek, and the western portal at a point below the Loops, west of Glacier Station. The tunnel will cap the mountain at a point 565 feet below the highest point attained by the existing line that crosses the Rogers' Pass divide. Two miles of track at the east end and three miles at the west end will be required leading to approach cuts, each a quarter of a mile in length. It is not likely that these cuts will be finished much before the end of the year, when the axle driving of the tunnel will be commenced. The double track approaches to the eastern portal of the tunnel will be twenty-two miles in length, but this work will not be started until next season. Excavation will be carried on both sides of the range, and both ends will be driven simultaneously. The tunnel itself will be 22 feet high and 32 feet in width, and a new type of drill known as the Leyner air drill will be used, three of which may work along side one another as permitted by the width of the tunnel. The amount to be estimated will be 250,000 cubic yards. Messrs. Foley, Welch and Stewart are the railway contractors who are undertaking the work, which will be under personal supervision of Mr. A. C. Dennis, manager for the company in Western Canada.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received:—635.—A large firm manufacturing horizontal gas engines and suction producer gas plants up to 200 H.P., wishes to appoint agents in Canada for the handling of these engines, and also of horizontal oil and petrol engines up to 25 H.P. 643.—A Liverpool firm is open to purchase railway sleepers and would be glad to hear from Canadian manufacturers of same. 649.—An Amsterdam house already representing firms in Canada wishes to obtain agencies for building materials, not conflicting with present engagements. Particulars on application. 651.—An Amsterdam firm is prepared to quote prices to Canadian importers.

The following inquiries relating to Canadian trade have been received:—657.—A firm in London, with large experience, is in a position to act as purchasing agent for Canadian firms or merchants, particularly electrical and general engineering firms. Also has facilities for representing firms engaged in the sale of hardware and soft goods. 661.—A Scotch firm inquires for quotations and samples of Canadian oils. The names of the firms making these inquiries, with their addresses, can be obtained upon application to:—"The Inquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary, and Chambre de Commerce du District du Montreal.

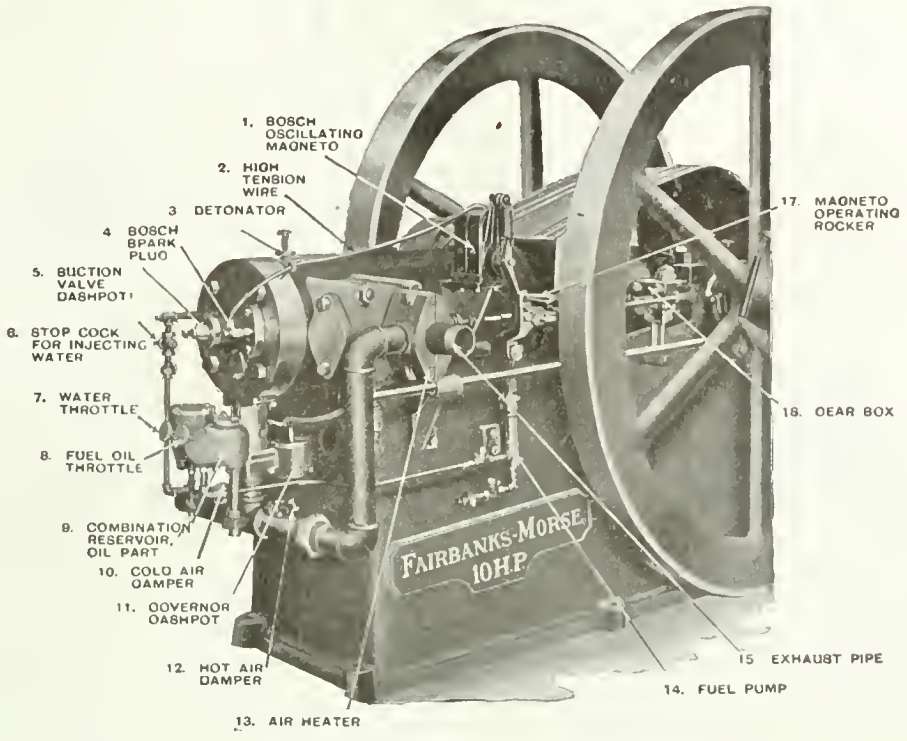
The following were among the inquiries received relating to Canadian trade at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.:—(1) A correspondent in Belgium makes inquiry for the names of Canadian manufacturers of wood pulp, either chemical or mechanical. (2) Inquiry is made by a firm at Brussels, Belgium, for the names of Canadian exporters of timber for use in mines. (3) A Toronto firm manufacturing a liquid carbon remover for removing deposits of carbon from the cylinders of automobile and marine engines, desires to correspond with a firm of automobile accessories jobbers willing to act as their agents. (4) A north of England firm ask to be placed in communication with Canadian producers and shippers of mica.

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Canada.—Alexander Whitton, watermarking apparatus for paper; M. Deacon and W. Gore, apparatus for mixing liquids; Oscar Dyckerdoff, metallurgical treatment of silver ores; Frank Reynolds, safety appliances for pit cages; Minerals Separation, Limited, methods and apparatus for ore concentration; William Blacker, mechanical hammer; R. H. Cox, fly trap; A. Helbronner and Max von Recklinghausen, sterilization of liquids; J. R. C. Hodgson, tire (hoop spring cushion); H. J. Moore, window conservatory; Burrell Rock Drill Co., Limited, drill chuck; W. H. J. Willson and Sydney Moody, non-puncturable pneumatic tire cover.

United States.—A. H. Welker, traction engine; Robert Gardner, apparatus for straightening wash goods before ironing; W. H. Heard, safety clutch for power pumps.



Why Use Gasoline When Oil Is Cheaper?

Especially when you can obtain a highly reliable oil engine that will develop practically as much horsepower, gallon for gallon, from cheap low grade oil as from gasoline.

As gasoline is steadily rising in price, the cost of operating a gasoline engine is becoming a serious problem. You do not have to use gasoline however. You can use oil and greatly reduce your power cost.

FAIRBANKS-MORSE OIL ENGINES

Will operate successfully on 72 per cent. of the oils distilled from the average crude. The cost of oil will continue to be low no doubt for an indefinite period, as it is claimed one oil well on an average is drilled every thirty minutes throughout the world.

As we were pioneers in the development of the gas engine, we are now the leaders in producing oil engines. **Fairbanks-Morse Oil Engines** are usually selected by those who require a thoroughly reliable engine that is economical in fuel cost and attendance, automatic in operation, safe, and easy to handle.

Another strong point in their favor is their being equipped with the famous Bosch Magneto.

The type of engine shown above is built in sizes ranging from 8 to 25 horsepower. We build oil engines in all the common sizes from 2 H.P. up to 200 H.P. Write to us for further particulars.

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The Canadian Fairbanks-Morse Co.

LIMITED

ST. JOHN, QUEBEC MONTREAL OTTAWA
TORONTO WINNIPEG SASKATOON
CALGARY VANCOUVER VICTORIA

TENDERS CALLED FOR

PLANS AND SPECIFICATIONS ON FILE.

The following plans and specifications are on file for reference only, unless otherwise noted, at the office of *The Canadian Engineer*, 62 Church Street, Toronto:—

BIDS CLOSE	NOTED IN ISSUE OF
4-8—Construction of sewers, Welland, Ontario.	24-7

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, August 5th, 1913, for the construction of the following sewers:—

Janet Avenue, from Lansdowne Avenue to Brown's Avenue.

Brown's Avenue, from Paton Road to 470 ft. South.

Langford Avenue, from Danforth Avenue to 1,410 ft. North.

Stanton Avenue, from Hastings Avenue to 204 ft. East.

Sawden Avenue, from Hastings Avenue to 196 ft. East.

Sproat Avenue, from Hastings Avenue to 200 ft. East.

Colina Avenue, from Eastern Avenue to Minto Avenue and Minto Avenue, from East end to West end.

Agnes Street, from University Avenue to Centre Avenue.

Berwick Avenue, from Yonge Street to 523 ft. West.

Queen Street, from 117 ft. West of Morley Avenue to 247 ft. further west.

Lane 1st E. Logan Avenue, from Victor Avenue to Simpson Avenue.

Lane 1st N. King Street, from Tecumseth Street to West end.

Lane 1st S. College Street, from Palmerston Blvd. to Markham Street.

Lane 1st W. Palmerston Blvd., from Ulster Street to Harbord Street.

Carey Road, from Cuthbert Crescent to Tullis Drive.

Belsize Drive, from Tullis Drive to Wharram Place.

Cuthbert Crescent, from Belsize Drive to Manor Road.

Manor Road, from Tullis Drive to 54 ft. E of Servington Crescent.

Carlaw Avenue Storm Sewer, section No. 2.

Bracondale Hill Road, from Davenport Road to Turner Road.

Glenholme Drive, from Clendennan Avenue to Fairview Avenue.

Colbeck Avenue, from Runnymede Road to Jane Street.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the Commissioner of Works, Toronto.

Tenderers shall submit with their tender, the names of two sureties (approved of by the City Treasurer, not members of the City Council or officers of the Corporation of the City of Toronto), or in lieu of said sureties, the bond of a Guarantee Company approved as aforesaid.

The usual conditions relating to tendering as prescribed by City By-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, July 23rd, 1913.

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, 19th August, 1913, for the construction of the following works:—

Midway Sewer System.—Outlet via Hiawatha Avenue, Gerrard Street and Morley Avenue.

Division No. 2, West Toronto.—Woodville Avenue.

Balsam Avenue, Queen Street to Kingston Road.—East Toronto, section A, outlet.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the Commissioner of Works, Toronto.

The tenderers shall submit with their tender, the names of two sureties (approved of by the City Treasurer, not members of the City Council or officers of the Corporation of the City of Toronto) or in lieu of said sureties, the Bond of a Guarantee Company approved of as aforesaid.

The usual conditions relating to tendering as prescribed by City by-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, July 24th, 1913.

TENDERS.

Will be received by the undersigned up to Friday, August 15th, 1913, for the erection of a three-story concrete and brick municipal building for the town of Cobalt, approximately 43 feet x 100 feet, according to plans and specifications prepared by Messrs. Angus and Angus, architects, North Bay.

Contractors are required to enclose a marked cheque along with each tender for 5 per cent. of the amount of same, the lowest or any tender not being necessarily accepted.

Work to commence immediately on award of contract.

Plans and specifications may be seen at the office of the architect or at the office of the undersigned.

R. L. O'GORMAN,
Town Clerk.

Cobalt, Ont.

TENDERS FOR BRIDGE CONSTRUCTION.

Sealed Tenders plainly marked as to contents will be received by the undersigned up to NOON of WEDNESDAY, AUGUST 6th, 1913, for the construction of a reinforced concrete beam bridge on Yonge Street, just north of Aurora, in the County of York.

Plans and specifications and all necessary information may be seen at the office of the undersigned, 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
County Engineer.

Toronto, July 22nd, 1913.

(For further Tenders see page 86.)

When designing

structures do you pay sufficient attention to the various matters that govern insurance ratings?

Not only can you add greatly to the fireproofness of buildings by adopting our suggestions, but it is very likely that you can do so without the improvements costing anything ultimately. They will be paid for by the lower insurance rates.

Correspondence solicited. We have a staff of engineers and inspectors trained in this highly specialized line. Make use of our services.

E. M. SELLON & CO.
LIMITED

INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

In making sewer pipe

many pieces come from the kilns with imperfections. They are rendered imperfect by having pieces broken out of the socket or spigot end, or having fire cracks at either end or extending partly through the body of of the pipe. Or they may be imperfect in shape, out of round or not straight; not thoroughly vitrified or glazed; or with blisters or scales blown off the outside. Such pieces cannot be classed as strictly first-class pipe. When buying pipe from us one can rest assured that we will never deliver pipe with imperfections such as above unless "seconds" are particularly asked for by the purchaser.

Round Pipe and Square Dealings *Write for 1913 Catalogue*

The Ontario Sewer Pipe Co.
LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

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MONTREAL

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WEBB—**Economics of Railroad Construction.**

By Walter Loring Webb, C.E. Small 8vo, viii+339 pages. 34 figures. Cloth, $2.50.

The preparation of this edition has required a very extensive revision and even the rewriting of revised tables in order to make the computations correspond with the classification of operating expenses now used by the Interstate Commerce Commission.

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By Walter Loring Webb, C.E. 16mo, xvii + 767 pages, 217 figures. Morocco, $4.00 net.

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FISH—**Earthwork Haul and Overhaul.**

By J. C. L. Fish, Mem. Amer. Soc. C.E., Professor of Railroad Engineering, Leland Stanford Junior University. 8vo, xiv + 165 pages, 66 figures. Cloth, $1.50 net.

Presents answers to all questions on computation of overhaul, and on the use of the mass curve in planning distribution. Includes the discriptions of bases and methods of computation of overhaul which bring about a definite understanding with railroad engineers as to the way in which the overhaul is to be computed.

ORROCK—**Railroad Structures and Estimates.**

By J. W. Orrock, C.E., Structural Engineer. 8vo, vi + 270 pages, 93 figures. Cloth, $3.00 net.

Covers in brief and concise form the numerous subjects that enter into the engineer's estimates of railroad building.

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned and endorsed "Tender for Public Building, Sudbury, Ont.," will be received at this office until 4.00 P.M., on Wednesday, August 6, 1913, for the work mentioned.

Plans, specification and forms of contract can be seen and forms of tender obtained at the office of Mr. Thos. Hastings, Clerk of Works, Postal Station "F," Yonge St., Toronto, at the Post Office, Sudbury, Ont., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to five per cent. (5%) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, July 16, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—45139.

TENDERS FOR THE CONSTRUCTION OF SEWERS.

Sealed tenders will be received by Mr. C. M. Webber, Town Clerk, Welland, Ontario, up to 5 p.m. on Monday, 4th August, 1913, for the construction of Separate Sewers on the following streets:—

Maple Avenue; William Street; Oakland Avenue; Asher Street; River Road; Duncan Street; Cady Street; John Street.

Specifications and tender forms may be had at Engineer's Office, Welland. Plans and specifications may also be seen at the office of *The Canadian Engineer*, 62 Church Street, Toronto, on or after 25th instant.

A marked cheque for 10 per cent. of the amount of the tender must accompany each tender, or an acceptable bidder's bond of same value will be accepted.

The lowest or any tender not necessarily accepted. The tenders may be awarded separate or in bulk.

JAMES HUGHES,
Chairman Sewerage Committee.

Welland, July 22nd, 1913.

TENDERS FOR BRIDGE CONSTRUCTION.

Sealed Tenders plainly marked as to contents will be received by the undersigned up to NOON of WEDNESDAY, AUGUST 6th, 1913, for the construction of a reinforced concrete culvert on Yonge Street, at Langstaff, opposite Lot 36, Markham, in the County of York.

Plans and specifications and all necessary information may be seen at the office of the undersigned, 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER.
County Engineer.

Toronto, July 22nd, 1913.

TENDERS FOR BREAKWATERS.

SEALED TENDERS, plainly marked as to contents, will be received by the undersigned up to 6 p.m. of **Monday, August 11th, 1913,** for the construction of:—

1. Breakwater at the north-east corner of Lambton Mills Bridge, on Dundas Street, over Humber River.

2. Breakwater at north-east corner of Scarlett Road Bridge over the Humber River.

Plans and specifications and all necessary information may be obtained at the office of the undersigned, 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
County Engineer.

Toronto, July 30th, 1913.

(For further tenders see page 84).

Agent Wanted

We are open to negotiate with a reliable firm to act as agent for Canadian business.

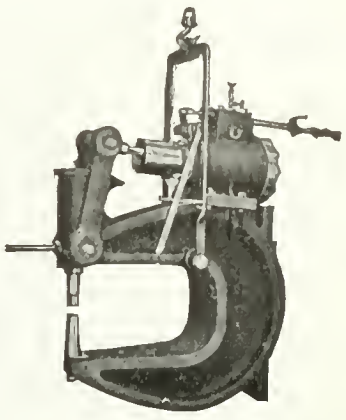
W. H. ALLEN, SON & CO.
LIMITED
Queen's Engineering Works
BEDFORD - - ENGLAND

Engineers and Builders of
STEAM, HYDRAULIC, AND
D.C. ELECTRIC MACHINERY

Address firm's representative:
A. LEO MIEVILLE,
c/o Box 92, *Canadian Engineer*,
62 Church Street, Toronto.

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES—IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

Whatever the Riveting — there's an "ALLEN" for the Job



ALLEN JAW RIVETER

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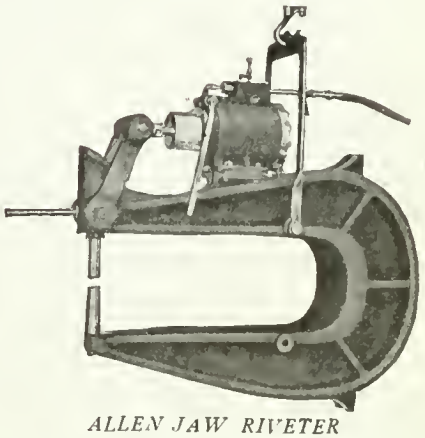
This riveter is most suitable for all descriptions of bridge and building construction work. By a special patented device any desired change in the distance between the dies is easily effected.

Allen "Alligator" Riveter

This riveter is especially adapted for all types of steel car construction riveting work. Suspended on a double axis, machines of this pattern can be arranged in any position, thus making them indispensable for work of this character.



ALLEN JAW RIVETER

Allen "Compression Lever" Riveter

This riveter is built expressly for heavy bridge, beam and girder work and is widely used for this purpose.

Allen "Stake" Riveter

This riveter is built expressly for close channel column work where flanges are turned in and measures only 3¾ inches at the widest section of stake.

Allen "Boiler" Riveter

This riveter is built expressly for boilers, tanks, stacks, etc., and may be constructed with any desired distance between arms.

Merit is built into every part of these machines and if you use them you may be sure of the FASTEST and TIGHTEST riveting at the LOWEST cost.

Special Riveters to meet all Requirements

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Lieber and W. U. Codes:—"RIVETER."

SECOND-HAND MACHINERY

Second Hand Contractors' Machinery

Why not use second hand equipment on the next job? We have a large stock of machinery ready for delivery

Nearly Good as New

Get the details on these items:—
1—24" x 24¼" x 30" "Ingersoll-Sergeant" compressor, Class A
1—20" x 20¼" x 24" "Ingersoll-Sergeant" compressor, Class A
1—14" x 14¼" x 18" "Ingersoll-Sergeant" compressor, Class A
1—No. 2½ "Smith" concrete mixer
1—No. 5 "Gates" gyratory crusher, style K
1—30" x 14" "Buchanan" crushing roll
1—35 H.P. "Farquhar" combined engine and boiler
2—No. 15 "Morris" centrifugal pumps with engines

L. F. SEYFERTS' SONS, Inc.
437 NORTH THIRD ST., PHILADELPHIA, U.S.A.

FOR SALE—almost new, differential tackle and track; carry two tons. Canada representatives, 193 Spadina Avenue, Toronto.

FOR SALE—almost new, two 700-gallon cypress wood tanks with fittings, and 4 one hundred-gallon tanks on castors. Canada representatives, 193 Spadina Avenue, Toronto.

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

FOR SALE at a snap: 60-H.P. Cowan and Co. engine and 80-H.P. Cowan and Co. boiler. Write for particulars, J. F. Barnard and Son, Spencerville, Ont.

CORLISS ENGINE—16 x 36—new two years ago; very reasonable. Box 82, *The Canadian Engineer*, Toronto.

FOR SALE.—Steam Barge, sand dredge, 2 deck scows, 1 barge. For full particulars apply to Box 88, *The Canadian Engineer*, Toronto.

FOR SALE.—3 second-hand contractor's Dinky Vulcan Locomotives in first-rate condition. One 9 in. x 14 in. and two 10 in. x 16 in. Also a 50-ton Steam Shovel, and some contractor's Dump Cars. Apply to The Canadian Fairbanks-Morse Co., Limited, 444 St. James St., Montreal.

WANTED.—A second-hand centrifugal pump, 6,000 to 10,000 gallons capacity, electric motor or gasoline driven, direct connected. Address Box 90, *The Canadian Engineer*, Toronto.

PILING WANTED—Forty pieces of second-hand steel sheet piling, about 20 to 22 feet in length. Address Box 94, *The Canadian Engineer*, Toronto.

"PITTSBURGH" STEAM SHOVEL DIPPER TEETH and Attachments (Canadian patent dated August 22nd, 1911), for sale by Standard Steel Construction Company, Welland, Ontario, Canada.

NEW INCORPORATIONS.

Munson, Alta.—Wilsons Limited, $50,000.

Burton, B.C.—Arrow Lakes Cannery Company, $10,000.

North Vancouver, B.C.—North Shore Coal Company, $25,000.

Samsonton, Alta.—Crossfield and Samsonton Mutual Telephone Company, $3,000.

Fort William, Ont.—Varlow Foundries, $40,000. H. J. Varlow, C. Varlow, C. Gray.

Galt, Ont.—Canadian Motors Company, $40,000. G. A. Dobbie, F. S. Scott, E. J. Getty.

Cobalt, Ont.—Sharon Mines, $500,000. R. H. Parmenter, A. J. Thomson, W. S. Morlock.

Redcliff, Alta.—Brittain-Plewes Company, $40,000. Redcliff Construction Company, $40,000.

Ottawa, Ont.—Langford-Feldheim, $40,000. W. Y. Bennison, E. F. Holcombe, J. H. Barker.

Vancouver, B.C.—Dominion Iron Works, $50,000. Farr Brass Manufacturing Company, $50,000.

Lethbridge, Alta.—Lethbridge Industrials, $25,000. E. T. Broad Contracting Company, $25,000.

Tofield, Alta.—Tofield Foundry and Machine Company, $50,000. Dominion Brick Company, $10,000.

Edmonton, Alta.—Edmonton Pure Water Company, $25,000. Fraser Wright Coal Company, $250,000.

Ruthven, Ont.—Ruthven Cold Storage and Forwarding Company, $40,000. M. Whaley, C. R. Wigle, G. Fox.

Hamilton, Ont.—Artisan Land and building Company, $100,000. J. W. Gage, J. W. Bonsfield, G. Boulter.

Napinka, Man.—Napinka Manufacturing Company, $60,000. W. N. Crowell, W. J. Ronoghan, H. D. Yeomans.

The Pas, Man.—Mineral Point, $75,000. W. H. Morrow, V. W. Inglis, W. Bartholomew, both of Winnipeg.

Sault Ste. Marie, Ont.—Andrews Lumber Company, $150,000. J. R. Andrews, H. R. Andrews, I. C. Jennings.

London, Ont.—Dominion Metal Specialities Manufacturing Company, $40,000. C. E. Santo, J. S. Ferguson, B. L. Santo.

Winnipeg, Man.—Commercial Power, Light and Coal Company, $250,000. F. M. Burbidge, R. C. McPherson, R. W. Killey.

Roxton Falls, Que.—Roxton Concrete, $45,000. F. Dieulefet, Farnham, W. Poirier, J. H. Provost, both of Roxton Falls.

Montreal, Que.—Administration and General Construction Company, $100,000. P. Bonhomme, G. Bonhomme, J. B. Bonhomme.

Calgary, Alta.—Calgary Sand and Gravel Company, $10,000. North Western Engineering and Construction Company, $15,000. Cullon Patent Manufacturing Company, $10,000.

Toronto, Ont.—International Steel Corporation, Ltd., $100,000. D. A. MacRae, T. W. Lawson, H. E. McKitrick. Canadian Oil and Fuel Company, $10,000. A. J. Reid, R. H. Montague Temple, W. L. Pinkney. Premier Mica, $50,000. W. J. Morrison, J. Legault, H. J. Baldwin. Sutherland-Davey, $50,000 (marble dealers). C. F. Ritchie, J. H. Oldham, A. E. Knox. Crow Lake Ironclad Company, $100,000. F. Smith, Elk Rapids, W. F. Bowen, Mamora, J. Parker, Toronto. J. H. Sherrard Manufacturing Company, $1,750,000. A. J. Thomson, W. S. Morlock, N. B. Wormwith. Re-enforced Concrete Post Company, $50,000. G. Cooper, W. K. Fraser, F. A. A. Campbell. Progressive Builders, $200,000. E. C. Ironside, W. J. McLarty, C. M. Brearley.

The only building material that has not increased in price is

CANADA Portland CEMENT

It makes concrete that can be depended upon for satisfactory results, whether used for bridges or for foundation-piers.

Canadian architects and engineers have confidence in the uniformity of Canada Cement.

They know that—by reason of our twelve mills all working under the same conditions—they can get the same high quality now or in the future as they obtained in the past—the same high quality no matter in what part of Canada the work is undertaken.

CANADA CEMENT COMPANY

Limited

MONTREAL

SALES OFFICES AT:

MONTREAL TORONTO WINNIPEG CALGARY

Write for a free copy of our handsomely illustrated book—
"FACTORIES AND WAREHOUSES OF CONCRETE."

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

CONSTRUCTION SUPERINTENDENT WANTED.

Superintendent of construction wanted for paving small town in Eastern Canada. Give full particulars in application, regarding education and experience and state wages for three months' job beginning about the middle of August. Apply to Town Engineer, c/o Box 96, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

WHO WANTS to employ a man who has finished his third year in civil department at University of Toronto? Box 86, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

SAND AND GRAVEL WANTED—In car lots, f.o.b., Ottawa Gas Company's plant, Ottawa, Ontario. Address quotations to H. E. Porter, The Weber Chimney Company, 1452 McCormick Building, Chicago, Ill.

NEW INCORPORATIONS.

Swift Current, Sask.—Connaught Court, $125,000.

Nelson, B.C.—Steelite Explosives (Canada), $150,000.

Regina, Sask.—Saskatchewan Industrial Development, $100,000.

Saskatoon, Sask.—Anglo-Canadian Building and Construction Company, $20,000.

Medicine Hat, Alta.—Medicine Hat Planing Mill Company, $50,000. Industrial Iron Works, $40,000.

Bradford, Ont.—Watson, Ltd., $100,000 (general manufacturing). E. Watson, J. G. Smith, N. Sinclair.

Windsor, Ont.—Vincent Steel Process Company of Canada, $150,000. J. E. Campbell, Hepworth, R. J. Lillico, G. A. Penson, both of Toronto.

Moose Jaw, Sask.—Moose Jaw sand and Gravel Company, $100,000. Joseph Brothers, $10,000. Blair & Tweeney, $100,000.

Medicine Hat, Alta.—Western Canada Threshing Machine Company, $100,000. Western Clay Products Company, $200,000.

Victoriaville, Que.—La Compagnie Immobiliere de Victoriaville, $19,000. A. Blais, Bic, J. C. Tribeault, Victoriaville, A. Beaupre, St. Fabien.

Edmonton, Alta.—Zenith Construction Company, $50,000. A. E. Aitken, $20,000. Dickson Steele and Bridge Company, $100,000. Gainford Collieries, $1,200,000.

Calgary, Alta.—Calgary Polar Water Company, $15,000. Yoko Valley Marble Development Company, $10,000. Alberta Gravel Company, $24,000. Riverside Fuel Company, $10,000.

Winnipeg, Man.—Canadian Contractors, $100,000. S. A. Sigurdson, F. Spaven, W. J. E. Parker. Western Mausoleum Company, $1,000,000. W. Bartholomew. V. W. Inglis, G. M. Duncombe.

Toronto, Ont.—Eureka Cement Pressed Brick Company, $40,000. T. H. Cooper, J. M. Ferguson, J. M. Adam. Colombian Syndicate, $150,000 (mine prospectors). R. W. Hart, P. Stokes, J. Spracklin.

Currie's Station, Ont.—Oxford Evaporating Company, $40,000. A. Ayles, Woodstock, G. H. Ficht, D. D. Haylow, both of East Oxford.

St. Catharines, Ont.—Bissell Motor Company of Canada, $50,000. F. Bissell, R. Sheldon, both of Toledo, W. P. Good, St. Catharines.

Montreal, Que.—Wilson Carbon Paper Company, $200,000. E. C. Budge. A. Falconer, both of Westmount; R. Fleet, Montreal. Stowell Screw Company, $50,000. A. Decary, P. A. Decary, E. Marier.

The Western Canada Irrigation Association will hold its seventh annual Convention in Lethbridge, August 5th, 6th and 7th. An excellent programme has been arranged, including fifteen papers by prominent irrigation men, based upon the value of such work and the up-to-date methods in use in Western Canada and the United States. Delegations from the large Irrigation Congresses in the Western States will be in attendance. The president of the Association is the Hon. Duncan Marshall, Minister of Agriculture, Alberta; the secretary, Mr. Norman S. Rankin, Calgary. A notable feature of the literature of the association is the epigram "Intelligent men no longer pray for rain—they pay for it."

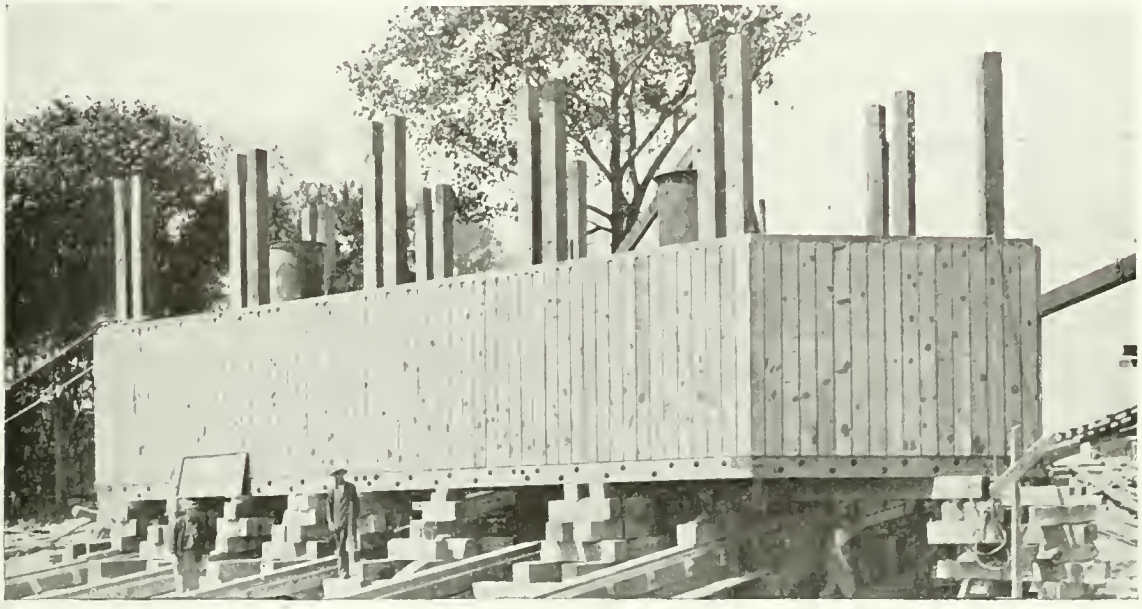
The contract for the first section of the new Welland Canal has been let by the government to the Dominion Dredging Company at three and a half million dollars, the lowest tender. This is for section one of the new canal, beginning at Lake Ontario. It is the intention of the government to let the contracts for the work section by section. The new canal is to be finished in five years, and will cost approximately fifty million dollars. Work on section one will be commenced at once by the successful tenderers.

W. H. Allen, Son and Company, of Bedford, England, engineers and builders of steam, hydraulic and direct current electric machinery, are open for negotiation with a reliable firm to act as agents for Canadian business. The company's direct representative in Canada is Mr. A. Leo Mieville, who can be addressed care of Box 92, *The Canadian Engineer* Office, Toronto.

THE FOUNDATION COMPANY
LIMITED

MONTREAL
Bank of Ottawa Building

VANCOUVER
Dominion Trust Building



Caisson ready to launch.

AN INTERESTING STEP

in the Construction of foundations
for a large bridge for the
Canadian Pacific Railway

BY PNEUMATIC CAISSONS

Our Scope

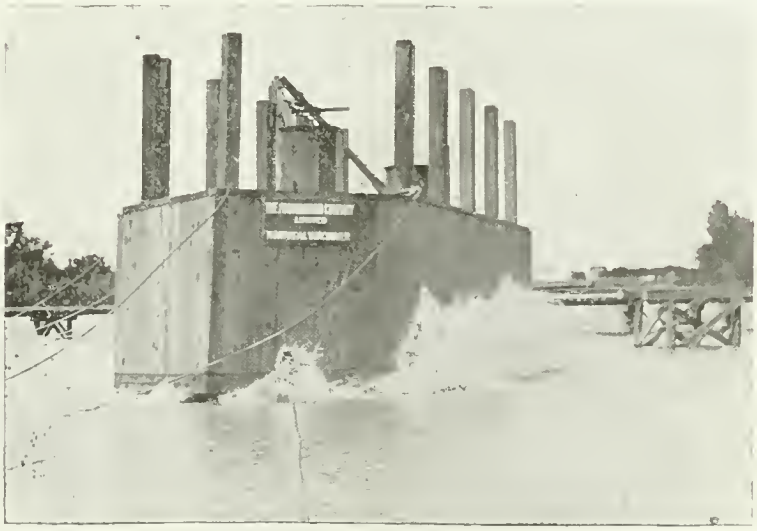
Bridge Piers

Heavy Building Foundations

Water Power Developments

and

All Kinds of Difficult Work



Caisson being launched.

Our Plant

is complete;

Our Organization Thorough.

This Produces Speed, Economy and Efficiency

MARKET CONDITIONS

Montreal, July 26th, 1913.

Prices hold very steady, being again unchanged, as follows:—

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-10., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Copper.—Prices are 16¾c. Excellent demand.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are: Queen's Head, $4.35; Colborne Crown, $4.25; Apollo, 10¾ oz., $4.25. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lead.—Prices are firm at $5.35.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is active and strong:—$36 for 6 and 8-inch pipe and larger; $37 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 73½ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black and 63½ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, July 30th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound, 1 to 9-case lots, 50 lbs to case. For each additional in per cent. nitro-glycerine add 1¼c. per hundred. For 10-case lots and over deduct ¼ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1¼ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ⅝-inch, $3.45; ¾-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $6, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.20; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, July 29th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. plts, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.25; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

Volume 25 Toronto, August 7, 1913

Contents of this issue on page 277

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

NOTES ON TUNNELLING FOR SEWERS

SOME INSTANCES INVOLVING DIFFICULT CONSTRUCTION THROUGH UNFAVORABLE GROUND — IMPROVISED METHODS TO COPE WITH UNSTABLE SOIL, HEAVY SURFACE TRAFFIC, ETC., MEETING WITH SUCCESS.

By J. M. M. GREIG, A.M.I.C.E.

IN the laying of sewers, according as the ground varies so must the systems of placing temporary and permanent support be changed to meet the particular conditions. It has been the author's good fortune to be connected with tunnels driven through all gradations of stability, from hard rock, shale and boulder clay down to glacial mud and quicksand. In the firmer ground the usual methods, such as top heading with crown bars, cap and leg, and so on, were adopted with brickwork and concrete as the permanent lining of the tunnel, but more difficult circumstances necessitated other means.

The low-level intercepting sewers of Glasgow were almost all near, and parallel to, the River Clyde, and on a grade below high tide level, while in the streets along which they passed there was very heavy traffic. In this case, when unstable ground was met with, a permanent construction of cast iron segments with a finishing inside lining of concrete was adopted.

Iron Segments or "Plates."—This form of cast iron tunnel is shown in Fig. 1, and sewers from 3 ft. 6 in. to 9 ft. in diameter were built of these "plates." Each tunnel ring measured 1 ft. 6 in. in length, and consisted of five or seven plates and a key, all having 5-inch flanges; the lower plates having radial flanges and the two upper ones each a non-radial flange to admit of the key being pushed up from below. The key had parallel flanges. The metal was ¾ in. thick and the flanges 1 in. thick, stiffened with feathers cast between the bolt holes. Both the plates and the key had a 1-in. diameter hole in the centre, to admit grout under pressure. The horizontal and vertical flanges had a fillet 1½ in. wide and ⅛ in. thick cast on the outer edge to form a joint of iron to iron. In the space, ¼ in. by 3⅞ in., between the flanges a slip of white pine ⅜ in. thick was placed, and as the bolts were tightened up this was compressed, forming a fairly close joint. All joints were bolted with 1 in. diameter bolts having hexagon nuts and a grummet of tarred string below each washer at the head and nut. Oak wedges 2½ in. by 2 in. were driven into the white pine packing at all joints which leaked, serving well the purpose of stopping these leaks.

On curves of sharp radius (50 feet) special radiated rings were used, but on those of flat radius the necessary curvature was obtained by double packing the outer side of the curve; or, if this gave the iron too great a lead, a strip of felt was used. Longer bolts were required on curves. Felt was also used to raise or depress the rings, and with double packings on curves a good deal of adjustment was necessary to keep the tunnel to gradient.

Excavation in Glacial and Mud.—This clay was of a brownish grey color, very finely divided, entirely free from stones or grit, and very uniform except as to the amount of water it contained. It varied a little in toughness, but in no case could it be got to drain. When freshly cut, this clay would stand for a very short time

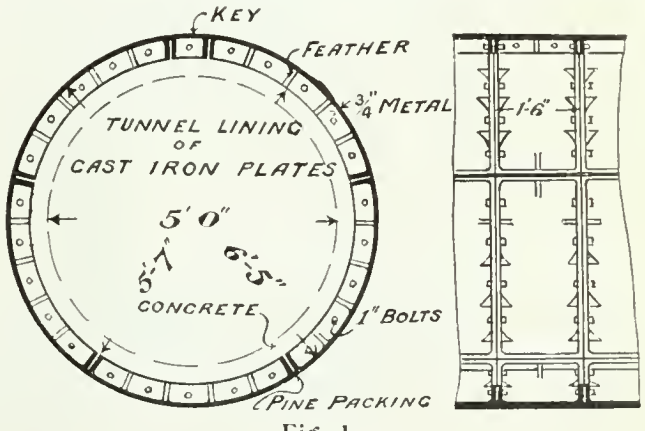


Fig. 1.

with a narrow face, five or six feet in height, but with exposure to air or the slightest amount of working, it became a tough slurry into which the miners sank to knees.

At the start of one section (5-ft. sewer) the miners, not being familiar with the good points of iron rings, attempted to take out a length of 9 feet on timbers instead of opening out ground for one ring at a time. The result was most unsatisfactory. It took them four or five days to get out a length, while a great deal of timber was used and unnecessary excavation removed, causing surface subsidence with a cover of 20 feet. The miners next tried a shorter length, sufficient excavation for two rings only being taken out, and the working conditions improved considerably, much lighter timber being used. After tak-

ing out a few lengths in this fashion it was found that, by excavating 1 ft. 6 in. forward and building up a ring at once the face would stand with little or no timbering, whereupon the rate of progress increased from 9 ft. to 40 ft. per face per week, and in one case 66 feet of iron was placed in one face in a week, of course, working night and day. In tunnelling this clay, the important point was to keep the face constantly moving as exposure to the air or unnecessary vibration converted it into mud, so fine that it ran through between the poling boards where a knife blade would not go.

The miners, when working for one ring, did not require to stand on the clay at all, which kept it in a fairly stiff condition in the bottom.

length of open-cut long enough to construct air locks in, it was necessary to drive sheet piles, 6 inches thickness, well below formation all round, and to pole the bottom throughout. Within the piling two lengths of sewer were built each way off a centre opening, and air-tight doors, etc., were built in to form air locks for driving the tunnels in both directions. Before filling in above these lengths, the piles which crossed the line of sewer were bored off about top level of tunnel, and horizontal piles were driven in to form a roof for the miners breaking away, and to prevent, if possible, escape of air up the sides of the vertical piles.

This was quite effective and no trouble was experienced in breaking away from the open-cut. With suf-

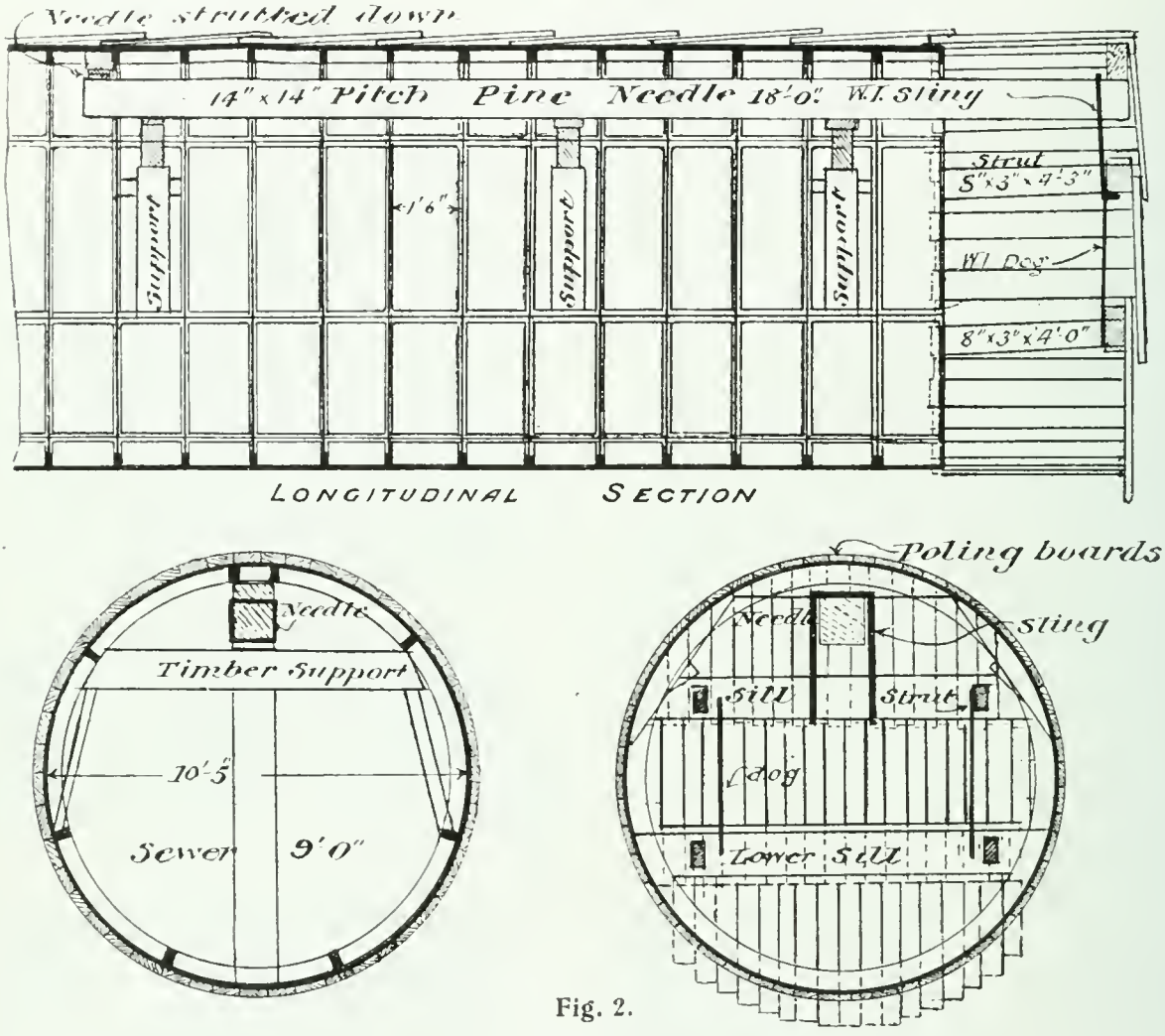


Fig. 2.

On another sewer, 9 ft. diameter, where the ground was getting very near to a condition necessitating air pressure, a considerable length of tunnel was driven by timbering for two rings at a time, with the entire face constantly close poled. Here, however, a difficulty arose through the weight of ground carried, by the end ring giving it a dip. To get over this the "needle" shown in Fig. 2 was used. As soon as the upper part of the face was excavated this "needle" was thrust forward, transferring the weight back to the second ring instead of on the leading one. This arrangement turned seeming failure to success.

About half a mile of this 9-foot sewer was through ground too unstable for any method but that with compressed air. In fact, to get down to grade and form a ficient air pressure to keep the face dry there was no difficulty in completing this tunnel and good progress was made. The effect of air pressure on the ground all round was remarkable.

Previous to going in for air pressure a narrow shaft had been sunk, with great difficulty, in the neighborhood, the ground being so soft that planks 9 in. by 3 in. and 12 ft. long. were driven to the head with a hand maul. When later it was necessary to sink onto the completed tunnel for a manhole, the ground which had been subjected to air pressure was dry and stiff, so that little timbering was required in sinking.

With air pressure and cast iron segments there is not much difficulty in tunnelling through this clay, so long as it is not so liquid as to refuse to support the

weight of the finished sewer. Of course, if the tunnel is of considerable diameter there is difficulty in a pressure sufficient to keep the bottom in place being too strong for the top and causing blow-outs and a general lowering of pressure. This is more apt to occur in sand, however, and it may then be necessary to use a shield with separate compartments.

Tunnelling in Sand and Gravel.—In another instance about 1,500 feet of 4-foot diameter sewer lay below a street along which ran four lines of rails. Several engineering works had frontage on these streets and much heavy freight traffic passed along the rails. Coarse sand and gravel containing a varying quantity of mud was found here, but although much charged with water, it drained freely. Undoubtedly this ground would have lent itself to cap-and-leg tunnelling had it not been for the hammering action of the trains above a cover of 15 feet. A brick-lined tunnel would have necessitated dependence on the timbering alone for too great a time, and in consideration of the danger to traffic that might arise through any subsidence, it was decided to build the sewer in iron.

A great quantity of water drained into the tunnel and in places the gravel was overlaid with a bed of earthy mud containing decayed vegetable matter. This loose top became exceedingly troublesome during a spell of very wet weather, and to combat the difficulties it presented the method of timbering shown in Fig. 3 was adopted. The peculiarity of this system lies in the iron rib used as a temporary support for the head piles.

Assuming the length has been taken out for two rings, the procedure is as follows: The three lower plates for two rings are bolted in position and the piles are driven over the iron rib under the cross-head tree and raking side trees round the top. The remaining plates of the two rings are keyed up, the leading ring gripping the ends of the piles and thus relieving the rib which may then be taken down. One face leg at a time can now be taken down and, after excavation, re-erected on a foot block under shelter of the piles. The lower half may be either poled circularly with horizontal boards or piled vertically.

Erection of Iron.—As all plates weighed about 300 pounds, or under, no difficulty was experienced in handling them and no special appliances were used. In getting in the key it was usual to put the upper plates in position and, while they were lightly held by their bolts, a screw jack 8 in. long was inserted in the key space and used to press them outwards. Then they were bolted tightly and, on withdrawing the jack, the key could be pushed up from below. By easing the upper plate bolts these plates came inwards and gripped the key when all bolts could be tightened up. Each wooden packing slip was tied to its flange by strings through the bolt holes to keep it in position till in place.

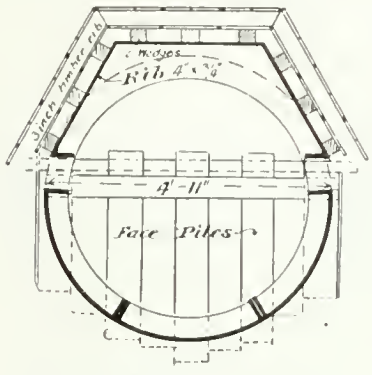
Pressure Grouting.—After erecting from eight to ten rings the face was poled up while these rings were grouted with lime under a pneumatic pressure of from 30 to 40 pounds per square inch. Air for grouting was supplied by small compressors used for this purpose alone. The usual type of grouting pan with paddles was used, its diameter being 1 ft. 6 in. and its overall length 3 ft.

In small tunnels a very low truck or bogie should be provided for the pan, to give free room above for filling in lime quickly as it is important to do this with all speed, for the lime that was used set very quickly.

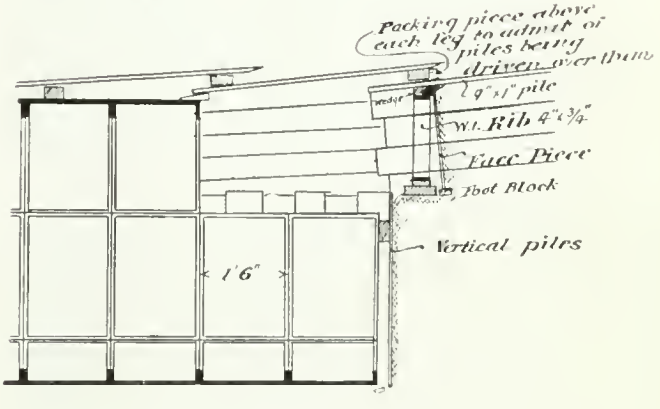
The quantity of lime varied very much, according to the ground and the method of tunnelling it.

In grouting rings 6 ft. 5 in. diameter which had been driven through clay with timbering, only two to four bags of lime were necessary, but no less than eight were used for each ring (5 ft. 5 in. external diameter) in the timbered excavation through sand and gravel. As all water from the face drained over the lower plate to the shaft, it was difficult to locate open joints before grouting, and a certain quantity of grout found its way back into the tunnel through the lower joints.

Lining With Concrete and Granolithic.—When the tunnels had been driven through from shaft to shaft, all dirt was removed from between the flanges. This, of course, meant lifting and re-laying the rails.



ELEVATION OF FACE



LONGITUDINAL SECTION

Fig. 3.

The lining concrete consisted of one part cement, two parts sand, and one part whinstone or chert, broken to pass through a 1¼-inch diameter ring.

Starting from a point midway between two shafts, the bottom plate was fitted, the road being lifted but not the rails. This occupied a few days, by which time the concrete in the mid-length had set hard. A length of rails (12 feet) was lifted at the mid-point and fresh concrete laid on, bringing the surface up to 1 inch below water-run. Laggings 3 inches thick were laid upon this, and circular iron ribs erected on these laggings, the ribs being kept in position by distance pieces from the flanges. Above the bottom plate concrete was packed in as each lagging was run in from the end, until the key was reached, when block laggings were used, the latter being of varying width, to give greater freedom at cross-flanges. The block laggings were 1 ft. 6 ins. long and were placed transversely to the axis of the tunnel and rested on the two last longitudinal laggings which were grooved to receive them.

This method was very successful, there being but few defects or vacant spaces in the concrete when the

laggings were removed. As a rule, the concrete was allowed to set for two days before striking the ribs.

Granolithic.—Granolithic, consisting of one part cement and one part finely ground granite dust, was used to form the finished invert. On the arch a little sand was mixed with the granite (about one of sand and three of granite) to toughen the granolithic and give it a smoother finish. The total thickness of one inch was put on in three layers, without the use of centering, the last layer being polished with plasterers' tools. Nails were driven in the concrete at springer level by the engineers, every ten feet, and a light strut was fixed with wedges to this level by the plasterers. Then, with a centre on this piece an arm was used to sweep out the finished circle of the sewer.

The plasterers made a narrow fillet of cement at each length to the finished diameter and, after these had set, used them as profiles to test their work with a straight-edge. A part of the invert, 1 ft. 6 in. wide, was left unfinished until the entire length from shaft to shaft had been lined, when fresh levels were given on the invert by forming fillets across the 1-ft. 6-in. space at each 10-foot length. This method gave the men a space to stand on while working the sides, and ensured the absence of traffic while the invert was setting.

The concrete and granolithic proved quite effective in stopping any leakage left in the iron joints, and formed a water-tight sewer with a hard and smooth invert.

The writer had occasion to remove a portion of sewer constructed similarly to the above which had been in position for a dozen years or more. In it the concrete lining was exceedingly hard and smooth, while the iron segments completely retained their black coating. The sewage had had no effect upon the granolithic beyond forming a slimy skin upon it.

CANADIAN IMPORTATIONS OF STONE.

The imports of stone are classified as building stone of all kinds, except marble, manufactures of granite and other stone, and marble and its manufactures. The total value of the imports during the calendar year 1911, according to statistics contained in the annual report on mineral production in Canada by J. McLeish, B.A., was $1,140,846, as compared with a value of $845,123 in 1910, showing an increase of $295,723, or about 35 per cent. Of the total imports in 1911, $392,868 in value was classed as building stone, and included 21,356 tons of rough stone, valued at about $3.98 per ton, and 52,908 tons of dressed stone, valued at about $5.82 per ton. The imports of sawn granite, manufactures of granite, and manufactures of stone N.O.P., were valued at $207,836; paving blocks, $64,676; marble and manufactures of, $384,252. There was also an importation of refuse stone of 226,122 tons, valued at $91,214.

During 1910 the imports of building stone were $311,595; manufactured granite, $192,213; paving blocks, $74,100, and marble, $267,215. The imports during both years were derived chiefly from the United States and Great Britain, the United States supplying building stone, paving blocks, and marble principally, and Great Britain mainly manufactures of granite. Marble is obtained in some quantity also from Italy and other countries. The total value of the imports from the United States in 1911 was $946,624; from Great Britain, $175,169; from Italy, $6,334, and from other countries, $12,719.

The value of the imports from the United States in 1910 was $640,084; from Great Britain, $160,664; from Italy, $31,314, and from other countries, $13,061.

OPPORTUNITIES FOR HIGHWAY ENGINEERING IN CONTRACTORS' ORGANIZATION.

By H. B. Pullar, A. M. Am. Soc. C.E.

THE recent rapid development of paving and road building has opened up a new demand for engineers, and this new demand must be filled by engineers trained along new and specific lines. Until recently a general civil engineering course amply prepared an engineer with sufficient knowledge to take care of any general road or paving work which might come under his supervision, but in this day of specialization it is necessary that engineers entering into this new field be more carefully prepared to successfully meet and solve the numerous and varied paving problems and direct to the best advantage the enormous fund now being appropriated for good roads and pavements. An enumeration of a few of the problems with which a paving contractor has continually to contend, and the place waiting for the highway engineer with respect to their proper solution, are pointed out in Mr. Pullar's paper before the Society for the Promotion of Engineering Education at its convention in Minneapolis in June.

Formerly an engineer desiring to specialize in road and pavement construction was limited in his field of endeavor to accepting positions with the state, county or city, or to act as a consulting engineer to public officials having charge of paving and road work. To-day there is a much broader field, and one in which the opportunities for advancement and the compensation are much greater than they were even a few years ago. This field is the up-to-date contractors' organization. There is a distinct and urgent demand for good highway engineers in contractors' organizations, and the day does not seem to be far distant when public officials will demand that work be given only to contractors having a capable and efficient organization, which necessarily must include a highway engineer.

Practically up until the present time there has never been a demand for highway engineers by contractors, because there were only a few different standard types of pavements and the contractors were familiar with the classes of construction they bid upon and did not attempt to enter into other fields. To-day the problem is entirely different, and in place of the few standard types of pavements and roads there are numerous and varied types which call for different construction.

In nearly every case where contractors to-day wish to bid on paving construction they are confronted with specifications calling for numerous different types of construction. They have not always been educated into the proper method of laying these different classes of pavements, but are usually willing to take a chance, and the result has been that there have been many failures, which have been due to improper handling of materials and improper construction, but which have been unjustly blamed to the new type of pavement or road. As is always the case when any industry is rapidly developing, there are also many new types of paving, both patented and otherwise, which are continually being brought upon the market, some of which will undoubtedly prove a success, but as usual the majority will soon be discarded as being unsuccessful and unsatisfactory.

With the advent of the highway engineer into the contractors' organization, a great per cent. of failures will be eliminated, for if he is properly trained he will be

versed in the different types of construction and will be able to get the best results with the materials with which he must work. He will be able to advise and assist the contractor in developing new and more up-to-date construction, and guard him against taking too many chances. He will, from his training, more carefully look after the details of construction, such as drainage, grades, fills and crowns of the finished roadway, all of which at the present time are given too little consideration by contractors. In case of apparent failure of the work his training will teach him to look for the real cause and not blame it haphazardly upon the new type of construction or on the binding material, such as has been too often the case.

It does not cost a contractor any more to lay high-grade, first-class work than it does to put in careless and unsatisfactory work; in fact, the cost of inefficiency and carelessness in running a great many of the contractors' plants throughout the country would more than offset the cost of turning out uniform and high-grade pavements. The properly trained highway engineer will see these different points and by actual demonstration show the contractor where he can lower his maintenance cost and at the same time give better satisfaction to the officials and property owners. By his work he will eventually be a big factor in eliminating the now too well recognized combination of politics and graft in paving and roadway construction.

Already a number of the most successful and prominent contractors in the country are employing men trained in highway construction and have found it both wise and economical to have these men in their organization to pass upon and keep uniform all details of construction which have heretofore been left to the superintendent and plant foreman.

There is another potent reason why contractors will require the services of highway engineers. It is the fact that on account of the severe competition and rapid development of the road and paving industry, material companies are continually putting out new products and changing the old. It is only fair to state that most of these material companies are doing their utmost to turn out the best possible material for the money. They are, without question, giving valuable co-operation to engineers and chemists in order to get the most suitable materials for the different types of construction and are continually studying and overcoming the problem of paving and road building. However, even in view of these facts, it is a big advantage for any contractor to have in his organization a highway engineer who will study the different traffic, climatic and other conditions under which the pavements or road will be subjected, and then be able to judge those materials which are most likely to prove suitable for the work. He will also be able to advise regarding the proper handling of these different materials, or at least to look for and properly receive expert advice regarding them.

There are few bituminous materials on the market to-day that require the same treatment at the plant in order to get the best results at the lowest possible cost; in fact, numerous failures can be cited where the cause was due to the handling of different materials at the paving plant in the same manner.

While the highway engineer in the contractors' organization will likely find his work for some time confined to estimating and to the actual construction, he will in time prove a valuable asset in the promotion work

There will be many obstacles to overcome by the highway engineer entering such a field. He will have to proceed with his new ideas and methods in a slow but sure way and use his technical knowledge in a practical and efficient manner, but if he has received a proper academic training he cannot help but be of value to the contractor, and will find each year an increased demand for his services. It would be well if universities and engineering colleges consider the advisability of incorporating a three-hour-year course devoted to highway engineering in their undergraduate courses in civil engineering in order that engineering graduates may have a broad general knowledge of that important field.

A LARGE POWER STATION.

Work has been started on the hydro-electric power station of the Cedar Rapids Manufacturing and Power Company, Montreal, Que., which, when completed, will be the largest in the Dominion of Canada. Its initial rating will be about 100,000 horse-power, and later on this will be increased to 160,000 horse-power. The site is at Cedar Rapids, in the St. Lawrence River, about 30 miles above Montreal.

The plant will be 663 ft. long and 130 ft. wide, and will be built as a part of the dam. The intakes will be of the scroll or involute type. Orders have been placed by the Cedar Rapids Company for the generating equipment. This includes twelve 10,800 horse-power waterwheels, which are to operate at 56 r.p.m. under a head of 30 ft., and will be the largest ever built. There will also be three 1,500 horse-power exciter units, which will operate under the same head as 150 r.p.m. Twelve generators are to be connected to the waterwheels.

The design of the turbines possess an interesting feature in the arrangment for carrying the weight of the generator rotor and the moving parts of the turbine on a thrust bearing above the generator instead of below, as is often done. The waterwheel contract includes the turbine complete, the shaft running through the turbine and generator, the thrust-bearing support or truss to be located above the generator, also the thrust bearing complete. The weight of the generator will be taken through cast-iron supporting harrels through the turbine to the foundation below. The main units will be of the single-runner, vertical-shaft type, and will be installed in wheel chambers of spiral shape formed in the concrete foundations of the power house. The exciters will be of the same type, but smaller in size. The runners for these wheels will be an enlargement of a model runner, which, under test at Holyoke, gave an efficiency of 90 per cent.

About 100,000 yds. of concrete work and 2,000,000 yds. of rock and earth excavating will be necessary. It is expected that the plant will be finished in October, 1914.

INTERNATIONAL CONGRESS OF MINING.

One of the largest of the great scientific and industrial congresses is to be held in London in the early part of June, 1915. This is the sixth international congress of mining, metallurgy, applied mechanics, and practical geology. These congresses take place at intervals of five years, and the last, which was brilliantly successful, was held at Düsseldorf in 1910, previous congresses having been held in Paris and Liége. The attendance at the Düsseldorf congress was more than 2,000, and it is anticipated that the attendance in London in 1915 will be equally large.

FUEL FOR HEAVY-OIL ENGINES.

A BULLETIN recently issued by the U.S. Bureau of Mines consists of a paper dealing with heavy oil as a fuel for internal-combustion engines. The writer, Mr. Irving C. Allen, enlarges upon the varieties of liquid fuels, viz., gas oil, coal tar and tar oils, lignite tars, wood tars, seep oils and animal oils, and also upon the use of alcohols. The heavy-oil engine, its advantages over the steam and explosion engine for marine use, its maintenance cost and fuel consumption are fully described, and the various uses to which this type of engine may be satisfactorily consigned are enumerated. An important part of the subject, specifications for fuels and lubricants, is also exhaustively dealt with.

Concerning the desirable properties of fuel for the heavy-oil engine the writer has this to say:—

In selecting a fuel for this engine its composition as affecting combustion is most important. For proper combustion the fuel should be mobile and volatile, clean, and free from water, solid particles, and grit. In general the specific gravity of an oil rises directly as the vapor density. The boiling point and the amount of air necessary for combustion vary inversely with the volatility, and the greater the volatility of the fuel the better the ignition and combustion. The benzene-ring bodies, or benzol, seem to be more difficult to break up than the paraffin-chain bodies, and the latter have a better diffusibility than the former. They are, therefore, more active and seem to give better results in combustion, though for this same reason they are more dangerous. The calorific value of biuminous tars in general is lower than that of lignite tars or petroleum products. Petroleum benzines require approximately 40 volumes of air, whereas the heavy petroleum products require approximately 100 volumes of air for complete combustion.

Petroleum, gas oils, and lignite tar oils readily lend themselves to gasification and they leave practically no residue, giving them peculiar value in an oil engine. Anthracene and creosote oils gasify fairly well. Paraffin-chain bodies, in general, gasify very readily and are suitable for heavy-oil engines. Benzene-ring bodies, however, volatilize more difficultly. They volatilize regularly and do not have the explosive tendency to be noted in the several kinds of petroleum products, which gives the latter the value peculiar to oil engines. An oil, to give best results in a heavy-oil engine, should on heating show a tendency to volatilize suddenly at some given temperature and not to give off vapors regularly and uniformly, that is, distil with the rise in temperature. To this tendency to sudden volatilization or explosion, in contradistinction to regular volatilization or uniform distillation, is due the value as a fuel in the heavy-oil engine (unlike the explosion engine fitted with carburetor and igniter where the time of combustion is so short).

Lignite tar oils and bituminous tar oils mixed with 25 per cent. anthracene give good results in a heavy-oil engine. In general, in a good paraffin oil, the ratio of hydrogen to carbon, as shown by analysis, should be 10 to 15, and in bituminous tar oils the ratio should be about 10 to 12.5.

If an oil be heavy, with a very low content of "flashy" constituents, it should be enlivened by having mixed with it before admission into the cylinder about 2 per cent. of gaseous oil, such as the "gas oil" previously mentioned.

One gram of gasoline of specific gravity 0.71 to 0.73 requires approximately 15 grams of air for theoretically complete combustion, and under working conditions from 19 to 23 grams, whereas 1 gram of denatured ethyl alcohol, 90 per cent., requires theoretically 8 grams, and under working conditions from 9.5 grams to 11.5 grams. That is, under normal working conditions denatured alcohol requires about half the weight of air that gasoline requires; 25 to 50 per cent. excess of air, however, is necessary in both cases for best results; or, stated in heat units, denatured alcohol, 94 per cent. by volume, develops 5,833 calories per gram, whereas gasoline of specific gravity 0.71 to 0.73 develops 10,611 calories. Therefore the power developed by denatured alcohol and by gasoline is approximately 10 to 18 in favor of the gasoline. The difference in ignition temperature, a matter of prime importance in the Diesel engine, is also greatly in favor of the gasoline, because an explosive mixture of alcohol vapor and air can be compressed to over twice as high a pressure (180 pounds per square inch) as can an explosive mixture of gasoline vapor and air (70 pounds per square inch) before self-ignition takes place. Although explosion engines are hard to start with alcohol and are uncertain with variable loads, an explosion engine properly designed and regulated will run as well with alcohol as with gasoline; but less cooling water is required for the engine cylinders with alcohol than with gasoline.

Use of Water in the Cylinder.—It is believed that an auxiliary nozzle could be advantageously used to inject a small quantity of water into the combustion cylinder simultaneously with the fuel. The nozzle must be removed as far as practicable from the fuel nozzle, however, so as not to dampen the ignition of the oil by the steam thereby generated. During ordinary running the cylinders are continuously superheated and must be cooled by water circulating externally. This circulating water cools the cylinder; carries away considerable heat, and thereby causes a direct loss of fuel value. The water injected will generate steam or power by absorbing a portion of the surcharge of heat and converting it into power, and will at the same time reduce, at least in part the necessity for externally cooling the cylinders and thereby losing some heat. This principle has been practically developed by James Hargreaves in his internal-combustion engines, and might be applied, so far as practicable, to eliminating the explosion pound of internal-combustion engines in general. That an engine so fed with water will run more quietly and smoothly has been demonstrated by Strong in his gasoline-alcohol tests. Even as low as 50 per cent. alcohol and water has been burned by him in an explosion engine.

Relative Calorific Values of Some Fuels.—The calorific values of the chemically pure fundamental bodies found in liquid fuels is given below for the purposes of comparison:—

Heat of Combustion of Pure Liquids.

Substance	Specific gravity	Average Calories per gram
	0°.C	
Methyl (wood) alcohol, CH_3OH....liquid....	0.810	5,314
Ethyl (wine) alcohol, C_2H_5OH.....liquid....	.791	7,107
Hexane (paraffin), C_6H_{14}..... ..liquid....	.677	11,603
Benzene, C_6H_6 .....liquid....	.899	10,001
	15°.C	
Commercial gasoline	.710-.730	11,368
Commercial kerosene	790-.800	11,050
Crude California asphaltic petroleums:		
Coalinga (average of 53 samples)	.9462	10,501
Coalinga (average of 62 samples)	.9498	10,404
McKittrick (average of 26 samples)	.9566	10,282
Midway (average of 29 samples).....	.9570	10,341
Kern (average of 40 samples)	.9645	10,307
Sunset (average of 25 samples)	.9701	10,266
Average of asphaltic petroleums	.9574	10,350

MUNICIPAL CONTROL OF WATERFRONT.

By J. A. Oliver,
Mayor, City of Port Arthur, Ont.

MAYOR Oliver's address to the Union of Canadian Municipalities, in convention at Saskatoon, Sask., recently, strongly endorsed citizen control of waterfront. The gist of his paper is aptly summed up in his closing recommendations, in which he is quoted as advising thus:—

"Let no individual or corporation get between you and the water privileges if you can avoid it. Hold fast to every inch of waterfront you have. Acquire the balance by any reasonable means in your power. Control your waterfront and, if necessary, operate it, tolerating nothing that is a restraint on your trade and advancement; your sanitary requirements, and your pure air and water needs, and by all means endeavor to place something on the statutes to prevent towns to be established in the future from having to make the same up-hill fights that the majority of our cities on the waterfront are now facing."

From his paper the following potent remarks and suggestions are extracted:—

Possibly no other problem has confronted municipal representatives with as many difficult and serious problems involved, or no question is more vital to a city's interest and at the same time more hemmed in with almost unsurmountable difficulties as that concerning ownership or control of its waterlots. All agree that from every standpoint it is beneficial to every city to have complete and untrammelled control of its waterfront. Considered in the light of aesthetic, industrial and sanitary conditions, there should be no opposition to civic control. Instead of this, however, we find the waterfront of almost every city and town in a totally unpresentable condition, the derelicts of commerce stranded on the beach, and sewers drained into the water. Docks, elevators, warehouses and boathouses are placed in positions beneficial only to the owners, while railways own the whole or the greater portion of the waterfront, which ultimately becomes a network of tracks and spurs. To aggravate the trouble, many streets are closed, and traffic is thus thrown on a few, conditions then becoming dangerous. This all goes to show that in the strenuous rush for individual and corporation gain, natural beauty, scenic grandeur, landscape planning, sanitation, pure air and breathing spots have all been ruthlessly swept aside. At the same time, opportunities for civic commerce are restricted, municipal authority ignored, and the public, whose birthright has become the possession of the transportation corporations, struggle very ineffectively to win back the vital right of free entry.

It seems a wrong principle that as soon as a town site is laid out and plans adopted, the owner of land facing the shore can apply to government and receive deeds for the water lots in front thereof. The writer would suggest, therefore, that legislation be enacted to govern all new town sites, villages, etc., hereafter established making it imperative that the government grant the municipality the said water lots under a condition that the title can never be transferred by the city to any individual or corporation. The legislation should also allow cities to expropriate and hold water lots already deeded subject to similar conditions. By doing so, the city can advance trade and assist industries leasing sites carefully selected so as not to interfere with any civic plan, at a good rental with a reasonable increase from time to time.

It should be further suggested that a stated case should be taken to the Dominion Railway Board and a ruling obtained to the effect that no individual or corporation can prevent any person from gaining access to the waterfront or withhold trackage or spurs where asked for when the petitioners are willing to pay for any land necessary; because a persistent refusal is a restraint on trade and injurious to the general welfare of Canada.

Further, where conditions have already become acute, it would be advisable to take all ways and means to have the railroads themselves operate their railways and trackage within your city limits as a terminal railway, thus avoiding the necessity of duplicate and triplicate spurs and tracks, or the running of more than one company's cars and engines on one spur; the latter procedure being almost tabooed by railways to-day. Still better, however, would it be for the city to own and operate her own terminal railway as a municipal franchise. In the young city this would, of course, be difficult and expensive, but the municipality would be better saddled with a debt for a few years than to be cursed with the present load of trouble forever.

A municipal terminal would have to be managed by a commission, and the said commission could have, in addition, all the authority of a harbor commission. A harbor commission, such as now exists in Montreal, cannot be too strongly commended, uniting as it does assistance to trade and commerce, with sanitary cleanliness and the retaining of natural scenic and landscape beauties.

EXPERIMENTS WITH ROAD BINDERS.

Asphalt and asphaltic oils as binders are being extensively experimented with in the United States, while the use of tar has been adopted as standard practice in England and Scotland. It is essential to success with tar that it should be of uniform quality, and should be refined by heating to drive off volatile oils. Creosote and pitch are often added. The Ottawa Improvement Commission report that the use of a grade of refined tar has been attended with success. Other special materials which may be mentioned are glutrin, which is a bye-product in the manufacture of wood-pulp, and is used for spraying. An emulsified asphaltic oil is used, and another, a liquid compound, when mixed with powdered limestone, produces silicate of lime on exposure to the atmosphere. All these materials are as yet in the experimental stage, but up-to-date and progressive road authorities will not be averse to experimenting with promising materials, for only by practical tests can they discover the kind of road which is specially suited to their local requirements.

FRENCH ROADS.

An appropriation of $6,800,000 is being allowed this year for the upkeep of the 38,337 kilometres of national highway existing in France. This will represent an increase of $400,000 compared with a year ago, and will be an allowance of $243.6 per mile per annum for maintenance only. For 1914 it is proposed to grant the sum of $7,200,000 for the national highways, this being at the rate of $302.25 per mile per annum. These figures deal only with the national highways of France, which have a total length of 23,831 miles, and are entirely under the control of the central government. The three other classes of roads, which are more or less under local control, have a mileage of 339,867, giving a total for all classes of made roads in France of 363,698 miles.

THE CANADIAN PACIFIC RAILWAY BRIDGE OVER THE ST. LAWRENCE RIVER AT LACHINE.

By W. P. Murray, B.A.Sc.,
With Dominion Bridge Company, Erection Department.

THE erection of the 408-foot through channel spans of the Canadian Pacific Railway St. Lawrence River Bridge at Lachine gave rise to many interesting problems. The excessive height of approximately 70 feet clear of the water, a river depth of about 30 feet and a current of approximately 8 miles per hour were factors that had specially to be provided for in launching the spans.

The arrangement of the through and adjoining deck spans of the bridge was well suited to the end launching scheme. (See Fig. 1.) The 408-foot through span was assembled on camber blocking on the deck of the 269-foot adjacent span, so that three panels of the through span overhung the river. The camber blocking was placed over the panel points of the lower deck span, the chord of the through span being much deeper and stronger against bending than that of the deck span.

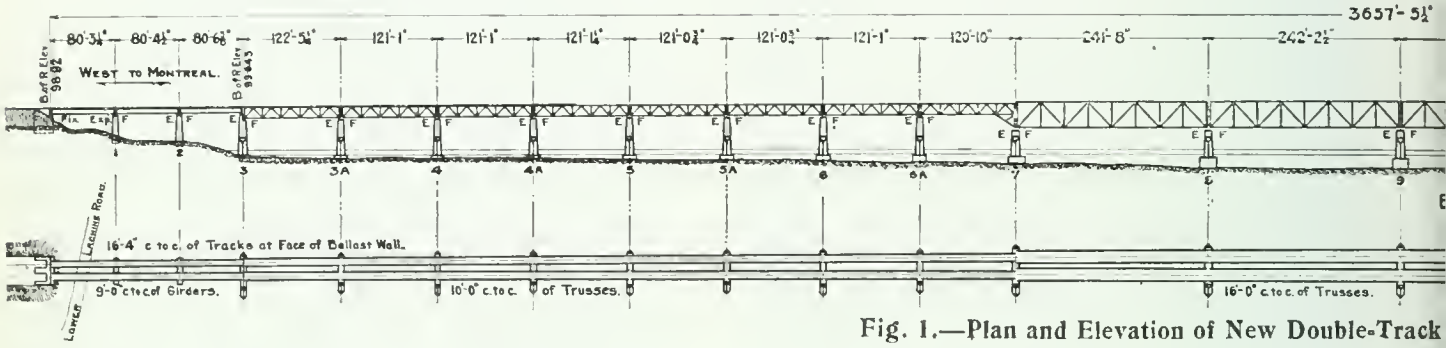


Fig. 1.—Plan and Elevation of New Double-Track

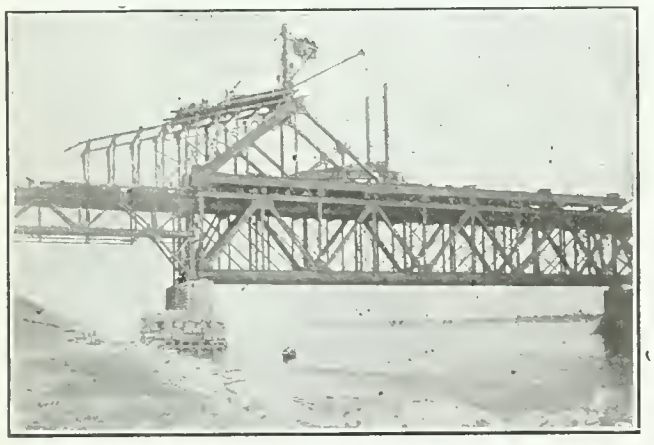


Fig. 2.—Showing Traveller on Falsework, and Camber Blocking.

The bottom chords and floor system, out as far as the end of the deck span, were placed by two derrick cars from the old track. The top chord type of traveller was used for assembling the remainder of the span, as Figs. 2, 3 and 4 show. This traveller was erected on an inclined track on timber falsework and pulled up to position for placing the members of the end panel, and then moved from panel to panel, adjustment being provided to keep the mast vertical at all times. A long and a short boom were convenient in handling the heavy chord sections. Steam was supplied to the engines from a boiler below the floor of the old span, through a flexible pipe connected to the engine on the traveller.

In assembling the overhanging panels, temporary bars were used to support the lower chord and post until the top chord was connected.

Specially dressed 10 by 10-inch hard pine blocking was provided at the end of the deck span to carry the excessive load due to the overhang of the longer span above.

The total weight of the span as launched was 1,300 tons, 900 tons being carried on the barge and 400 tons on the deck span during launching.

The floor system of the deck span being inadequate, to carry a concentrated load of 400 tons, necessitated the construction of a special carriage distributing the load over three points on a 40-foot base. The carriage had three pairs of shoes with a planed and polished plate on the bottom, which slid on a greased track of eight 100-lb. standard rails, placed directly over the stringers of the deck span. This arrangement is illustrated in Fig. 4. The centre pair of shoes were constructed to take the full load of 400 tons, which resulted when the forward pair of shoes slipped over the end of the deck span, throwing three-point distribution of the carriage out of commission. The end panel of the deck span was designed specially heavy to carry the concentrated load.

The barge was 200 ft. long by 37 ft. 6 in. wide, built of longitudinal steel trusses, steel brace frames and timber covering. Two 100-foot plate girder spans, borrowed from another contract, were used as a base to distribute the load on the barge. On top of the girders a tower of timber was constructed, composed of twenty-four 14-inch by 14-inch timbers for verticals strongly braced with steel cross frames and timber.

Water was admitted to the barge through four valves in the sides of the barge near the bottom until the top was clear of the span and placed in position beneath the span with 1-inch wire guys. Then sufficient water was pumped out to bring approximately one-half the load on the barge, the span being supported in this manner until ready for the actual floating operation.

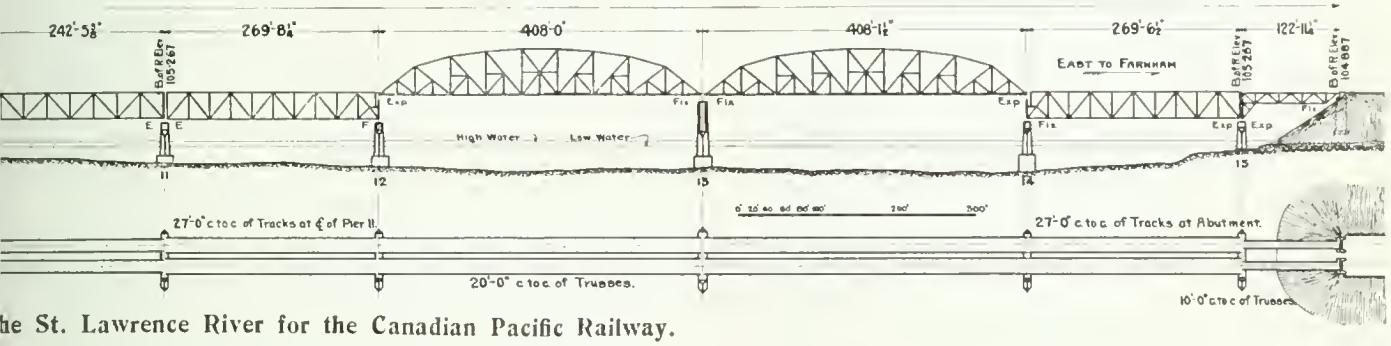
Two anchors were used to hold the launching barge in the swift current of the river, one, 1,400 feet upstream from pier 13, consisted of fifteen 5-ton concrete blocks threaded on a 1½-inch wire cable; the second consisted

of a 12-inch beam grouted in the rock on shore upstream from pier 14. From each of these anchors 1,000 feet of 1½-inch wire cable passed on to a light barge, which in

Fig. 3.—Span During Launching, Showing Hauling Apparatus.

turn was connected to the main barge by a 400-foot line of 1½-inch cable, operated by a steam hoisting engine.

The hauling apparatus for the actual launching of the span consisted of a 60-ton Lidgerwood ballast unloader,



he St. Lawrence River for the Canadian Pacific Railway.

anchored securely at the end of the skidding track, pulling on a two-part purchase of 1½-inch Samson brand wire cable. Fig. 3 illustrates the method. Steam was supplied by a C.P.R. locomotive.

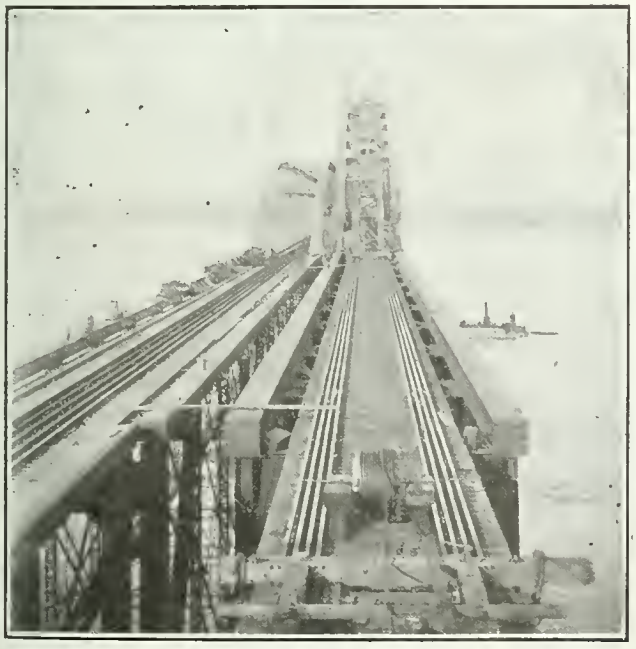


Fig. 4.—End View, Showing Old and New Spans. Also Skidding Track After Launching.

Although all parts of the anchorage and falsework had been designed for a 10 pds. per sq. ft. wind, acting on the total surface of the span, it was thought advisable to choose a day with little or no wind on which to perform the actual launching operation.

November 4th, 1912, being favorable, at 7 a.m. the pumps were put in operation. By 8.30 the south span on the downstream track was afloat and all blocking cleared away. The actual time of moving was about 30 minutes, but owing to stops, about three hours were occupied in launching the span on blocking on pier 13. On November 24th a similarly successful operation was performed in launching the second span, the north channel span of the downstream track, this operation completing the erection of the steelwork for the downstream track of the new bridge. The two 408-foot through spans and adjoining deck spans for the upstream track will be erected during the present year.

The steelwork was fabricated and erected by the Dominion Bridge Company, Limited, for the Canadian Pacific Railway, of which Mr. P. B. Motley is engineer of bridges. The details of the erection were planned and executed under the direction of Mr. Jas. Finley, general superintendent, and Mr. F. P. Shearwood, assistant chief engineer, for the Dominion Bridge Company.

Some interesting experiments have been carried out in Glasgow with the Ostermann system of "metalizing" all kinds of materials. The plant was installed in the works of Messrs. Stewarts and Lloyds, and during the experiments a considerable number and variety of articles in metal, glass, paper, wood, and stone were coated with metal so that when the articles were bent or hammered the coating showed no signs of bursting or peeling. Zinc, lead, tin, aluminum, copper, bronze, nickel, or alloys of any of them are forced in an atomized condition from the nozzle of the machine employed upon the surface under treatment. It is claimed for the system that it can be applied to many purposes for which galvanizing is unsuitable, especially to the coating of ships' bottoms and other large steel structures, that it can be used also for coating very light materials, such as the woven fabrics of aeroplanes or airships, and that it affords a guarantee against corrosion. Although new in this country, the system, it is said, has found considerable favor in Germany, where a large number of installations have been ordered by the Government for use in warship work.

The League of American Municipalities will hold an annual Convention in Winnipeg on August 7th, 8th and 9th. Among Canadians who will present addresses are T. R. Deacon, mayor of Winnipeg; H. H. Ruttan, city engineer; R. D. Willson, assistant city engineer, and Sanford Evans, ex-mayor.

REINFORCED CONCRETE IN MINES.

By F. M. Dixon, M.E.

CONCRETE is eminently suited for structural work in mines, according to a paper read by Professor F. M. Dixon before a meeting of the Institute of Mining Engineers of Great Britain, in June last, and the discussion which followed its presentation. Many points arose which indicate that its uninflammability, indestructibility through rot, oxidization, etc., make it material which seemed to be especially designed for mining purposes, and vastly superior to wood construction.

Four totally different classes of structural work are within the scope of the mining engineer. The writer dwelt upon the suitability of concrete, its advantages and its limitations respecting each as follows:

Surface Works.—It is now admitted that reinforced concrete will always be an admirable material of construction in these cases, though, of course, economical considerations may often decide that other materials have to be used instead. If settlement is likely to require providing for, reinforced concrete is the only satisfactory material. A few years ago a building erected at Tunis tilted over, owing to the failure of the foundations, till it was inclined at 25 deg. to the vertical. By excavating under the higher side and loading the building it was brought to a level bearing, and though now it is several feet lower than originally designed it remains an example of the bad treatment reinforced concrete may receive without failing. Its capability for resisting shock is also shown in its use for sleepers, piles, and various railway structures.

Shafts.—While plain concrete would in some cases be a very suitable material for use in lining shafts owing to its great crushing strength and to the ease with which it may be put in position, it is often quite impossible to use it in a satisfactory way. A considerable time is required for concrete to develop a reasonable strength, and therefore it is necessary that the expensive timbering or steel centres which support the green concrete should remain in place till this strength is attained. But it is quite feasible to use reinforced concrete in a way exactly similar to that in which a cast-iron curb is used. Reinforced concrete seems a suitable material for making a shaft lining by building it in cylindrical sections keyed and grouted together, the cylindrical sections being formed either by keying together several curved plates of reinforced concrete or by being cast in complete rings. Cylindrical tubes 7 ft. in diameter have recently been successfully made in this material and then lowered into trenches to form a main sewer.

Permanent Roads.—For these works reinforced concrete is the best material. Its great strength, resistence to shock and the effects of settlement and fire, and its durability, combine to make it superior to any other. When properly designed it will be found economical. Already it is used in several important mines in the country. In some cases it has been described as too expensive. Some engineers, however, use reinforced concrete like plain concrete; that is, the steel work is put in merely to ornament the drawings and make them appear up-to-date, there being ample concrete in place to carry all the load, and so naturally the method of construction appears costly.

Professor Dixon exhibited an experimental arch reinforced on the Monic system. This method of reinforcement, he explained, consists of embedding in the concrete a net of steel wires about 3 in. centre to centre, the diameter of the wires in the arch in question being about 0.34 in. The dimensions of the arch shown were 32.8 ft. span, the width being 13 ft., and the depth at crown 6 in. The following test loads were applied: First a locomotive weighing 40 tons was run across the arch. Then a locomotive weighing 53 tons was placed on the half span. Having stood these loads satisfactorily, a dead load of 110 tons was piled on the half-span. The deflection under this load was only 0.12 in. When the load was increased to about double this figure the arch failed owing to the abutments giving way.

Recently, at the University of Birmingham, some experiments have been carried out on the strength of arches on a reasonable though smaller scale than that of the above experiment. Arches 10 ft. span and 1 ft. rise are constructed, the width being 3 ft. A uniform load is applied by means of a pump and hydraulic jacks. Several arches in brick concrete and reinforced concrete have already been tested, showing failure at crown. The great strength of concrete and reinforced concrete arches was fully demonstrated. The depth at the crown of the concrete arches was 6 in., and the reinforced-concrete arch tapered from 6 in. at the springing to 3 in. at the crown. The total uniformly distributed loads supported by these arches when tested three months after making were 53 tons and 42 tons for the concrete and reinforced-concrete arches respectively, this giving crushing loads of 4,000 lbs. and 3,200 lbs. per sq. ft. of arch. It is hoped to carry out exactly similar tests on timber beams, but if a maximum fibre stress for a round 10-in. diameter beam of larch be assumed to be 4,000 lbs. for average conditions, then the breaking load of a solid floor of these 10-in. bars on a 10-ft. span would be about 2,500 lbs. per sq. ft.

It is evident from these experiments that there should be no difficulty in designing a light section in reinforced concrete with side walls and invert which might be depended on to support a main road in any ground. This has been done at several mines in England.

Temporary Roads.—It is in temporary roads, however, and as a substitute for ordinary timbering that an extended use of reinforced concrete in mines is suggested. In a paper before the Concrete Institute this year, the writer gave results of a number of experiments on reinforced-concrete beams and posts 8 ft. long. Such work is coming into use in the United States and Canada. In this method posts and beams suitably reinforced are made and stored ready for use. In many metal mines the broken stone, which makes admirable material for the greater bulk of the concrete, is being constantly mined, and so the sand and cement only needs to be brought into the mines, the beams and props being made and stored below ground. For use in mines the beams should be reinforced on the upper side as well as the lower to save accidents in transport. For posts the reinforcement should be of the simplest kind, the object aimed at being chiefly to render the posts portable and secure against shock. It would be easy to suggest other shapes than round or square as being probably more economical in mines. For example, it may be shown that a triangular shape might be best for both beams and props, and a series of experiments carried out on a simple triangular section gave excellent results. Also the ends of posts and beams might be modified for the sake of getting better bearings and also for increasing their strength. The successful economical manufacture of the structures will

depend to a very large extent on the design of the forms and moulds, and there is no doubt that in a short time it will be possible to order these small structures for delivery just like timber or steel.

The advantages of these posts and beams when used will be obvious. Besides their considerable strength, the following points may be noticed: They will be durable. It has been proved conclusively that a steel prop, if embedded in concrete, is not deteriorated by time under the most severe conditions. The strength increases with age to a maximum and then does not decrease. The strength is not to any great extent affected by moisture, the material in this respect differing much from timber. It may be roughly stated that timber when wet has only 50 or 60 per cent. of the strength which it would have when dry, and, as is well-known, in a dry heading the timber rots quickly. All tests (outside mines it is true) show that of all materials of construction properly constructed reinforced concrete is the best for resisting destruction by fire.

A further advantage that the use of these posts and beams presents is that the method of erection, while being as rapid as the ordinary method of timbering, could be at slight expense converted to permanent construction. This would be done by fitting reinforced slabs between the settings or by ramming plain concrete between them. Modifications of design would always allow this to be done.

AIR AND WATER PURIFICATION BY OZONE.

THE commercial and hygienic value of the powerful oxidizing activities of ozone in the matter of attacking and destroying organic impurities was recognized in Europe at a somewhat earlier period than in this country. There it was first applied on a large scale to the sterilization of water supplies, and later to the purification of air. These applications have produced such satisfactory results that the question of the practicability and effectiveness of sterilization, by means of ozone, has passed beyond the stage of discussion. In fact, the many advantages of the method are so obvious, particularly its low cost, certainty of operation, simplicity, uniformity of results, and above all, absence of poisonous residue or taste, that it is likely to be universally employed where the sterilizing of water on a large scale is a necessity.

The principal existing installations of this class are the large municipal plants at St. Petersburg, Paris, Chemnitz, Nice, Madrid, Milan, and Paberhorn. Extensive plants are also in operation in many other places. Several of these installations were described in an article appearing in July 10th issue of *The Canadian Engineer*. That the method is entirely satisfactory is demonstrated by the decision of the Duma of the city of St. Petersburg to greatly increase the capacity of the existing plant at a cost of $5,250,000.

It is noteworthy, however, that although Europe is ahead of us in the application of ozone for sterilizing water, this continent leads in the development of small ozonator devices for purifying the air. This is due to the fact that in general the attitude of European engineers tends to limit the use of small apparatus, it being their usual practice to recommend highly developed systems, where the application of the method is either necessary or desirable. The practice here commenced with portable machines, and consequently considerable ingenuity has been displayed by the Canadian General Electric Co. in the design of small household types of apparatus which serve greatly to extend the field of application.

Of the European systems designed for the specific purpose of purifying the air, the general application of ozone to the subways of London is most extensive. In this case 8,000,000 cubic feet of air per day are ozonized, and conditions which previous to the installation were subjected to much adverse criticism, are now most favorably commented upon by the patrons of the underground service. Another notable installation is that of the Central Refrigerating plant, at Hamburg, affording storage for upwards of 14,000,000 barrels of salted herring. This is an example of the application of ozone for the purpose of destroying all odors, the operation of the installation being highly effective in rendering entirely inoffensive odors emanating from the stored herring. Another interesting installation is that on board the German trans-Atlantic steamship "Imperator." This vessel, the largest afloat, is equipped with a complete system of ozone-producing apparatus for the purpose of aiding ventilation, destroying odors, preserving food stuffs, purifying water, etc.

In Europe, many of the abattoirs are provided with ozonizing apparatus which completely destroy the odor common to such establishments, thus rendering them entirely unobjectionable to neighboring residents. This is particularly noticeable in Germany, where the application of highly developed methods of employing ozone, for purifying and deodorizing the air within and around industrial plants located in urban districts, is becoming very common.

The production of ozone for such purposes can be undertaken with a high degree of efficiency and on a basis of economy which permits and warrants its application in many fields already developed and in speculative fields which are almost limitless.

STONE OR CLAY HANDLING.

Cars which are to be used in quarry service for carrying the stone from the quarry to the crusher should meet the following requirments:—

First—Height from ground to top of bed should be as low as possible, paricularly if cars are to be loaded by hand.

Second—Cars should be able to be dumped instantaneously and automatically when they arrive at crusher, both to save time in unloading and to save the cost of unloading by hand.

A large number of different designs have been made up for such service, but it is not possible to make a car, the body of which will dump without also making it so high that it cannot be loaded by hand, if the capacity of the car is to be large enough to make it economical. This, of course, does not apply to cars which are loaded by a steam shovel, as the height of these cars can be several times as high as the car which is to be loaded by hand, but a low car is also an advantage for steam shovel service, as it makes it possible for the steam shovel to load the cars for a longer time without shifting the tracks. There have been several designs of cars made which had a separate body hinged on one side to the underframe, in connection with which an air or electric hoist engaged a side of the car opposite crusher, lifting the body up so that the load would slide into the crusher. A car constructed in this manner, however, is very expensive, as it requires practically two underframes, and if a large number of cars are used, the cost of the equipment is increased excessively.

ASPHALTIC CONCRETE AS A PAVING MATERIAL

CONSIDERED SPECIALLY WITH RESPECT TO RESIDENCE STREETS, SUBURBAN DISTRICTS AND BOULEVARDS—VARIETIES OF ASPHALTS USED—THEIR QUALITIES AND SIMILARITIES.

By LINN WHITE,
Chief Engineer, South Park Commissioners, Chicago.

IN his paper to the Civil Engineers' Society of St. Paul, and appearing recently in the Journal of the Association of Engineering Societies for June, Mr. Linn White refers to the most suitable pavement as one requiring the study of such influences as the kind of traffic which it is to bear, character of district served, probable future growth, limitations as to cost, nature of soil and climatic conditions, provision for maintenance, etc. The streets of a heavily travelled business district require, first of all, a permanent surface on an unyielding foundation, and the question of cost properly receives but secondary consideration. It is regrettably true, too, that the important considerations of cleanliness and noise generally receive only secondary or later consideration.

On light traffic streets, or those of mixed service, permanency is hardly so imperative, and the consideration of cost becomes more important. Here, also, the future growth or probable change from a district partly occupied by residences to one devoted entirely to business should receive careful consideration.

A third general class of streets, comprising residence streets, boulevards and those serving suburban districts, is the class it is proposed to discuss in this paper. The general character of the districts served may be considered fairly well established, so no great changes in *kind* of traffic may be anticipated. The traffic on such streets is seldom what is probably termed "heavy," but may be "intense," that is, there may be a great many rapidly moving, comparatively light vehicles. Automobiles will predominate, with a lesser number of horse-drawn passenger vehicles. At times, heavy teaming of building material, produce, coal, etc., must be provided for, and the general delivery and express service for the district.

To satisfy the requirements of such cases, a pavement must have many high qualities, and the standard is all the time growing higher, the public exacting and expecting better service. It must be reasonably permanent, moderate and flexible in cost, serviceable on all kinds of foundations, sanitary, smooth, dustless, noiseless, non-slippery, resilient, and agreeable to the eye in strong sunlight. Quite a formidable list of virtues difficult to attain.

Examining the different generally known kinds of pavements we will at once pass up many of them as possessing in an eminent degree only a few of the qualities named. Brick, concrete, stone block and wood block all possess some of these qualities but are lacking in others. Macadam cannot be classed as a permanent pavement, and we are thus reduced to some form of bituminous paving surface.

Sheet asphalt (sand asphalt) pavement is the best known and most widely used form of bituminous pavement—at least, it has been so for years past, though now other forms are becoming extensively known. Sheet asphalt must, however, be made comparatively thick, say, three inches, to conform to accepted standards; its cost is comparatively high, dependent on its thickness, though not in direct ratio thereto; it is suitable for use only on a concrete base; has a smooth, sheet-like surface more or less slippery; and last but not least has fallen somewhat into disrepute because of the skill and care required to produce a successful paving mixture and the constant effort during recent years to reduce its cost.

Asphalt block is a pavement that has been in existence for many years, but has not come into general use because of its high cost and difficulty of manufacture and transportation.

Macadam surfaces bonded by the application of bitumen in a liquid form have come largely into use during recent years, but have not established themselves as a standard type of pavement because lacking in the very essential quality of permanency under considerable traffic. Their place is on the country highway and roads of occasional traffic.

Having thus briefly reviewed the principal varieties of street pavement known and used in this country, we come to the one remaining general variety, designated as "bituminous concrete." Under this general name is included all paving mixtures consisting of broken stone combined with sand or other fine mineral matter, cemented together by a bituminous binder, which may be either tar or asphalt, making either "tar concrete" or "asphaltic concrete."

While both tar and asphalt are hydrocarbon compounds, their qualities are quite different. Tar, for practical use in a pavement, cannot have a melting point much higher than 130 degrees Fahr., as it would become very hard and brittle in cold weather. In this climate it is not unusual to find temperatures of 115 or even 120 degrees Fahr. on the street surface, under which conditions a tar binder melting at less than 130 degrees would be almost liquid and have but little cementing or bonding value. In other words, tar, while quite adhesive and ductile, is very susceptible to changes of temperature. For these reasons it will not be considered further in this discussion.

The various asphalts that may be used in an asphaltic concrete have very different qualities and require different treatment, which will be briefly alluded to later.

For a paving mixture to merit the name of asphaltic concrete, the broken stone, according to a definition adopted by the American Society of Municipal Engineers, must be in sufficient quantity to form an important part of the mixture; also the ingredients must be combined and mixed before being laid. Neither the size of the stone nor the proportion of the various sizes in the mixture can be limited by the name "asphaltic concrete," any more than the size and proportions in a hydraulic concrete can be limited by the name. This can be done only by the specification of the particular mixture it is desired to produce.

Several varieties of asphaltic concrete are offered on the market under trade names, copyrighted or patented,

that presumably conceal or but half reveal their somewhat mysterious qualities, such as Bitulithic, Amiesite, Filbertine, Warrenite, Westrumite, etc. They are all asphaltic concretes founded on the old concrete idea of a broken stone aggregate supported and held together by a mortar matrix.

The first one named, Bitulithic, is supported by letters patent in which the principle of filling the voids in the aggregate by the use of successively smaller sizes down to impalpable powder is exploited. It is claimed by this method of grading the sizes of the mineral that an "inherent stability" is produced in the pavement independent of the asphaltic binder, which then may be very soft and serve only to waterproof the mixture and to fill the remaining small percentage of voids. Several patents have been issued to the originators of this pavement, the claims of which to the lay mind seem very similar, all of which rely upon this main idea of carefully grading the aggregate, and some of which describe carefully the process of separating the mineral into a number of sizes and recombining them according to a definite formula. This brings out the idea of "predetermining the sizes" of the mineral aggregate, which is a phrase met with in Bitulithic literature.

There is another claim in the Bitulithic patents that is an excellent one if carried out to its logical conclusion, that is, that by reason of filling voids so completely by grading the mineral the quantity of asphaltic binder may be reduced and the pavement "produced at a smaller cost." This is a quotation from the claims of the patent, and if *produced* at a smaller cost it naturally should be sold at a smaller cost, thus justifying protection under the patent laws and earning the gratitude of the nation.

These references are made to the claims of the Bitulithic pavement disregarding the other special asphaltic concrete pavements named above because the Bitulithic is the only one that endeavors so to broaden its claims as to monopolize the field of asphaltic concrete paving. If we sum up the claims of the Bitulithic patents, we find they hinge upon, and in fact are reiterations of, the principle of reducing voids by carefully graded sizes so that an "inherent stability" is produced and less bitumen used, thus reducing cost and increasing usefulness.

If it is true that Bitulithic methods are the best and cheapest, it becomes the duty of every engineer and city official to support them and use them. Let us examine the situation a little further and see what conclusions can be drawn on this point.

It cannot be contended that good Bitulithic pavements are not produced, for many excellent examples may be found throughout the country. At the same time, many excellent examples may be found of sheet asphalt pavements, and it cannot be contended there is any "inherent stability" in the sand of which they are composed. All the stability must be supplied by the asphaltic cement.

In 1907 a contract was let to the Bitulithic Company for about three miles of pavement on Michigan Avenue and South Park Avenue in Chicago, which was laid during 1907 and 1908. On these avenues there is but little heavy teaming, as they are boulevards and under usual boulevard restrictions as to traffic. In 1908 a traffic census showed from 3,000 to 5,000 vehicles per twenty-four hours on the three miles of pavement in question, which by 1912 had increased to from 5,000 to 12,000 per twenty-four hours—practically doubling the average number.

During the summer of 1909 some small portions of the surface began to show a tendency to form waves and ruts, but was scarcely noticed, being considered only local or accidental defects. It was not thought there could be anything very serious the matter; the spell of "inherent stability" was too strong. By the summer of 1910 conditions were much worse, and the contractors put heavy rollers on to smooth out the waves and ruts, also attempting to roll into the surface, first, limestone screenings, then granite chips, and, finally, crushed granite about three-quarters of an inch in size. These expedients one by one failed. The screenings, chips and crushed granite could not be forced very deeply into the surface and most of the particles were easily loosened and torn out again by the traffic. It was found that while the rollers smoothed out the surface it wouldn't stay smooth, but quickly formed ruts again as long as warm weather continued. By keeping the rollers going more or less all the time until cooler weather arrived, the streets were kept in fair condition for the winter, but early in the summer of 1911 the campaign had to be begun again.

This season it was prosecuted more vigorously. The crushed granite was coated with bitumen to make it bond more effectually into the body of the pavement.

The surface of the street was punctured full of small holes into which the coated stone was swept and then rolled. These efforts were all of doubtful and temporary value. Conditions all the time grew worse, and it is safe to estimate fully $20,000, or from 25 to 30 cents per square yard, was expended by the contractors during the three seasons named without materially improving the condition of the pavement.

In the summer of 1912, under strong pressure from the Park Board, they abandoned their efforts to stiffen up the pavement and resurfaced the whole area with a layer of new asphaltic concrete about 1½ in. thick. The method followed was to go over it with surface heaters, softening up the surface until about an inch in thickness could be removed with rakes. Then the new 1½-in. layer of asphaltic concrete was spread and rolled, thus making it about ½ in. thicker than formerly. After this resurfacing the pavement was left in excellent condition at the end of the season of 1912 and so remains up to the present time.

It is to be noted the original pavement was specified to be at least 2 in. thick and actually averaged 2½ in. throughout a large portion of it; also that the original binder was tar. Thus the pavement is now composed of 1 to 1½ in. of tar concrete, overlaid with 1½ in. of asphaltic concrete.

In extenuation of the troubles on this particular pavement it may be pointed out that there are many excellent examples of Bitulithic pavement to be found. This is true. There is one other piece of Bitulithic pavement in Chicago, about one-half mile long, on Sheridan Road, which is as fine a piece of pavement as can be found, and it is older than the Michigan Avenue pavement. But it is from one failure like this that we can learn more than from numerous successes that teach nothing.

It may also be argued that the traffic on Michigan Avenue was extremely severe, or that if the original binder had been asphalt instead of tar the result would have been better.

This may be true, but it is not to the point. The main point is the very important "inherent stability" was not in the pavement to resist displacement independent of

the support of the binder; and if it was there at all it was not sufficiently "inherent" to resist the severe traffic.

The traffic, while severe, was not prohibitive—was not sufficient to strain a good asphaltic concrete pavement beyond a safe limit. It was merely a severe test and developed a weakness that might have developed to a lesser degree or more slowly under lighter traffic.

In 1909 an asphaltic concrete pavement was laid on Michigan Avenue, between Twelfth Street and Jackson Street, which in 1911 was carrying a traffic of 17,000 vehicles during twenty-four hours. This was not laid by the Bitulithic Company nor under their specifications, and was the subject of a suit between the Bitulithic Company and the South Park Commissioners, of which more will be said later. No trouble has occurred with this pavement up to date except a comparatively small number of cracks which have in every case been traced to the concrete base. In explanation it should be said the street between these points is 75 and 85 ft. wide between curbs, having been widened 35 feet to the eastward when paved in 1909. Thus a portion of the sub-foundation is new filled ground and a portion the old street, and the support is uneven. Also the construction of a number of large buildings on the west side of the street has caused settlement in places and consequent cracks in the pavement.

This pavement is between the Bitulithic pavement and the centre of the city and carries a larger traffic.

There were also asphaltic concrete pavements laid adjoining the Bitulithic on Michigan Avenue at 39th Street, and on South Park Avenue at 35th Street. They are on both avenues extensions of the bitulithic to the southward and carry the same traffic in slightly decreasing numbers. No trouble has occurred with these pavements and they have cost nothing for repairs up to date except on two intersections where the cross traffic was quite severe and has occasioned minor repairs.

As stated above, neither Bitulithic methods nor formulas were followed. No special care was taken to grade the aggregate except to be sure there was plenty of mortar to fill voids and the fine material in the mortar was in proper proportions to give a well-filled mixture. Beyond this the success of the pavement depended on the proper preparation of the base and the use of a suitable asphaltic binder. Dependence was had on only common-sense methods to resist lateral displacement, and the paving mixture was intended to be waterproof for obvious reasons. The heating and mixing was done in portable plants working on the street; the proportioning of the mineral ingredients was by wheelbarrow loads; and the prepared material was delivered quickly and directly on the street surface. Much of the success and moderate cost were doubtless due to the methods and machinery used. There was no overheating or chilling of material due to long hauls, no separation of ingredients from the same cause, and no bad work on account of delays either at the plant or on the street. The concentration of all operations in one place, under one superintendent, undoubtedly tended to better results in many ways.

The comparison of cost between the three sections of pavement referred to above is as follows:

The bitulithic by contract cost $1.90 per sq. yd., exclusive of cost of base. Asphaltic concrete by contract on Michigan Avenue, between 12th and Jackson Streets, $1.73 per sq. yd., including concrete base, which would make it exclusive of base about $1.10 per sq. yd. Asphaltic concrete laid by day labor on Michigan Avenue, south of 39th Street, and on South Park Avenue, south of 35th Street, less than 75 cents per sq. yd., exclusive of base.

Following are the analyses of the mortar constituent (that is, 10-mesh material or less) of several samples of asphaltic concrete which have been under traffic for long enough periods of time to demonstrate their good or bad qualities. The first four proved to be very good, and the latter two indifferent in quality.

	No. 1 Jackson and La Salle	No. 2 Jackson and Main	No. 3 Michigan and Park	No. 4 Grand and Okwd	No. 5 Jackson and Franklin	No. 6 Jackson and Market
	%	%	%	%	%	%
Bitumen	18.8	18.9	16.1	21.0	18.9	16.3
200-mesh	10.8	11.6	11.7	10.9	4.3	3.5
80- "	10.6	11.5	7.0	26.2	5.9	5.7
40- "	36.8	35.3	22.7	19.3	50.3	54.1
10- "	23.0	22.7	42.5	22.6	20.6	20.4
	100.0	100.0	100.0	100.0	100.0	100.0

As far as the coarse aggregate is concerned, that is, all material coarser than 10-mesh, there were considerable variations in the different samples, but the total quantity was approximately the same, and the variations seemed to have nothing to do with the success or failure of the sample. Samples 1 to 4 were successful, and they were rich in dust and reasonably well proportioned in other sizes up to 10-mesh. Samples 5 and 6 were practically failures, and they are seen to be lean in dust with an excess of 40-mesh material not well filled by the smaller sizes.

Here is where stability is found, or such "inherent stability" as belongs to the mineral aggregate of asphaltic concrete, not in the careful grading of the larger sizes. It would not matter if there was 25 or 50 per cent. of mineral larger than that passing a 10-mesh screen added to the mortars of samples 1 to 5; the result would have been the same. Nor would it matter if this 25 or 50 per cent. of coarse mineral was all of one exact size or of several carefully graded sizes; the pavement would have been good. Therefore, in the making of good asphaltic concrete, it is an axiom that we must have a good mortar, well proportioned as to mineral, with a good asphaltic cement to bond it properly together. Having this, the coarse aggregate may be added with considerable freedom. There are, of course, certain precautions that must be taken and certain useful refinements that may be attained, as in the making of other bituminous pavements. For instance, too much dust in a mixture will require more asphalt, etc. All such points could not be covered in such a discussion as this, but the principles stated above may be taken as fundamental.

There are on the market two general classes of asphalt binders, or asphaltic cements, as they are more properly called when of a character suitable for use in paving mixtures, distinguished generally from each other by the presence or absence of any considerable degree of ductility. Ductility is the quality that enables a substance to be drawn out like chewing gum without breaking. It is of no direct value in the paving industry, but is supposed to indicate other qualities of value such as cohesion and adhesion. At the same time it indicates other objectionable qualities, such as susceptibility to changes of temperature. A considerable degree of ductility is required in most sheet asphalt specifications, but engineers conversant with the most successful practice in asphaltic concrete work agree ductility is not an essential quality.

It may be conservatively said that good work can be done with either ductile or non-ductile asphalt, with simplicity of manipulation somewhat in favor of the non-ductile material.

These statements, however, are not intended to dispose of the question of which is the most durable under heavy traffic or to suggest that one class be chosen in all cases to the exclusion of the other.

Successful foundations may be made of either concrete or macadam. Where traffic is comparatively heavy, unquestionably the concrete base has the advantage of greater rigidity, more "inherent stability." On the other hand, macadam in some cases may be the more advantageous to use. It does not have to stand so long to set up before you can apply the wearing surface, consequently the street is not out of service so long, and if you are working over an old street, where there is some old macadam in a more or less worn-out condition, frequently considerable economy can be effected by using a macadam base. This is a question for the engineer to work out in each case.

One principle may be laid down to apply to either concrete or macadam base. Don't finish it up smooth, but leave the surface rough and grainy, so the paving material may be forced into the interstices.

The specifications promulgated by the Association for standardizing Paving Specifications go into the question of preparing the base pretty well.

Some litigation was had in Chicago with the Bitulithic Company, of which the following is a brief statement:—

In 1909, when the South Park Commissioners let a contract for paving Michigan Avenue from 12th to Jackson Streets with asphaltic concrete, the Bitulithic Company sought an injunction in the federal circuit court. The injunction was denied by one judge, but under some legal technicality the case was reopened before another federal judge in the same circuit. Injunction was again denied, and as this left the case before the court in such a shape that any further action would have to be a trial on its merits, the complainants dismissed the complaint and no attempt has been made since to renew it. To reach this partial conclusion in the courts required over a year, and of course before then the contract over which the litigation started was completed and the pavement in use. The South Park Commissioners, however, had proceeded to lay other considerable quantities of similar pavement and if good grounds for an injunction had been shown the result would have been to force them to come to terms with the Bitulithic Company, and account for royalties on both past and future work.

Up to date, considerably over one million yards of asphaltic concrete pavement has been laid in Chicago and the royalties would amount to a considerable sum.

It is unfortunate the Chicago case could not have been fought to a conclusion on its merits, as this might have made it possible to secure a Supreme Court decision on the Bitulithic patents and determine just what of their claims are valid. Several other decisions have been rendered in litigation of this patent, which are more or less conflicting, some in their favor and others contrary. It has been the policy of the patentees not to push any case to a conclusion where the preliminary rounds have been against them. For this reason it has been impossible to get an appeal into the Supreme Court.

IMPULSE TURBINES OF NOTE.

The two largest impulse turbines built to date, each capable of producing 20,000 h.p., have recently been installed in the Pirahy plant of the Rio de Janeiro Light and Power Company in Brazil. The wheels operate at a speed of 300 revolutions per minute under a head of 900 feet. These two units are an addition to the Pirahy plant, where six 9,000 h.p. units have already been in operation, and will bring up its total capacity to 94,000 h.p.

A close second to this record is found in the White River plant of the Pacific Coast Power Company of Seattle. In this case, each turbine was designed to develop 18,000 h.p. at 360 revolutions per minute under a 440-foot head. However, in consideration of the lower head and the fact that these turbines can totally carry 20,800 h.p. they must undoubtedly be of greater bulk than the new units of the Rio de Janeiro Company's plant.

INCREASED DRAINAGE OF ONTARIO FARMS.

In the report of the Minister of Agriculture for the Province of Ontario, mention is made of the campaign which the Ontario Agricultural College is carrying on for the assistance and encouragement of farmers in the matter of drainage work. It is in charge of the Physics Department of the college, and is carried on in co-operation with district representatives, and the enterprise is very successful, as is shown by the accompanying table:—

Year.	Surveys.	Acres surveyed.	Miles of drain.
1906	15	500	45
1907	70	3,500	350
1908	100	5,000	510
1909	179	5,157	613
1910	383	14,672	1,800
1911	327	15,211	1,864
1912	293	17,212	2,278
Totals	1,367	61,252	7,460

GRAPHITE IN CEYLON.

The graphite of Ceylon being about half exported to the United States, a chapter is devoted to it in the last report on the mineral resources of the United States. The mineral is found over a fifth of the island, in the mountains of the south-west and west, but, instead of being disseminated through the gneisses and associated rocks, it occurs chiefly as veins along fracture planes, being, therefore, of later origin than the rocks. The veins are from an eighth of an inch to several feet wide, some not more than two or three inches being worked. The masses of graphite, usually pure, but sometimes mixed with pyrite and milky quartz, are aggregates of needle crystals; but in one mine a remarkable cavity or "rug," of oval section and about 15 feet high and a yard wide, was lined with flaky graphite, which completely filled the bottom of the cavity. The mines, usually less than 100 feet deep, sometimes go down 400 or 500 feet. Steam pumps and hoists are sometimes used, but very primitive methods are mostly employed. Directly or indirectly, 50,000 men, women and children are given work by the mines. The deposits are clearly not metamorphosed coal or asphalt, and the theories suggest that they came from some solution of metallic carbides, hydrocarbons, or other carbon compounds.

THE PRESERVATION OF IRON.

In a Carnegie memoir submitted to the Iron and Steel Institute by Dr. J. Newton Friend, some useful information is given as to the value of paint as a preservative for iron and steel.

His results reveal a number of interesting facts of considerable technical importance which may be enumerated as follows:—

(1) The surface of a paint film does not always give a correct idea of the extent of corrosion taking place beneath.

(2) The addition of small quantities of paraffin wax to paint destined for the protection of iron and steel exposed to the air reduces the corrosion very appreciably. If the paint is required to set at the normal rate, not more than 1 lb. of wax should be used for every 1,000 lbs. of oil present in the paint. If, however, the rate of setting is less important, the amount of paraffin wax may with advantage be increased to 3 lbs. per 1,000 lbs. of oil. This latter is, roughly speaking, equivalent to 2 lbs. of of wax per ton of ready mixed paint—an estimate that is sufficiently near for the purpose.

(3) In the case of plates immersed in water the addition of the paraffin wax seems rather to assist corrosion than to diminish it.

(4) A fine pigment is superior to a coarse one in the preparation of protective paints, a fact which is now generally recognized.

(5) It is generally believed that two coats of paint preserve an iron surface from corrosion considerably more efficiently than one coat. Liebreich and Spitzer have recently called attention to the fact that in their experiments, by increasing the number of coats of paint not only was the corrosion not reduced, but it actually increased, as if the extra coats stimulated corrosion. Dr. Friend's results lend support to the work of Liebreich and Spitzer.

(6) It is always found that a rusty surface when painted yields unsatisfactory results, and the careful painter removes the rust prior to the application of paint. Undoubtedly this is necessary in damp weather, and it is also necessary to scrape off any scale and thick coats of rust.

It occurred to the author, however, that a slight coating of rust, absolutely free from caking and lumps, might be an advantage rather than otherwise, if perfectly dry, for two reasons: (1) Fine rust is practically a pure ochre, very free, in the case of wrought iron and steel, from silica. Hence the surface is very absorbent, and if painted with a good coating of thin paint a similar result may be expected as by first laboriously cleaning the metal and then painting with a thicker paint—that is, one containing more pigment in proportion to oil than the former. (2) If the iron surface is sandpapered down it is made much smoother, and its area is reduced to a minimum. If, however, the rust is left on as a thin coating, the underlying surface of metal in contact with the rust is slightly pitted and uneven. Hence when the paint is applied it has a larger surface to grip, and its tenacity will therefore be increased in proportion.

It was found that plates suffered far less from corrosion when painted in a rusty condition than when first polished bright before painting. This is a remarkable result. It would seem, therefore, that when the painter is called upon to protect by painting thin sheets of iron, such as galvanized iron, which has already rusted somewhat, any lumps of scale should be removed, and a coat of paint applied in warm, dry weather to the rusty surface. The danger of the sheets rusting through will thus be considerably less than if the rust is first carefully scraped off and the metallic surface polished with sandpaper before the application of paint, as is the more usual custom.

UNITED STATES RAILWAY BUSINESS FOR MAY.

During May the railways of the United States received for their services to the public an average of $8,230,000 a day; it cost to run their trains and for other expenses of operation $5,920,000 a day; their taxes were $341,500 a day; their operating income $1,972,322 a day for the 220,897 miles of line reporting, or at the rate of $8.93 for each mile of line for each day. Thus for every six dollars of their earnings which remained available for rentals, interest on bonds, appropriations for betterments, improvements and new construction, and for dividends, the railways had to pay more than one dollar in taxes.

All of these amounts are substantially greater than the similar returns for May, 1912. They are from the summary of the earnings and expenses compiled by the Bureau of Railway Economics from the monthly reports of the steam railways of the United States to the Interstate Commerce Commission. They include over 95 per cent. of the mileage and earnings of all of the railways of the country.

PAVING BLOCK PRODUCTION.

The total production of paving brick and paving blocks in Canada in 1911, according to statistics contained in the annual report on mineral production in Canada by John McLeish, B.A., was reported as 5,220,400, valued at $79,444, as compared with a production of 4,215,000, valued at $78,980 in 1910.

This paving brick is made at West Toronto, Ont., from shale obtained from the banks of the Humber River. The annual production has for a number of years varied from 3,000,000 to over 5,000,000 per season, and the output finds a market chiefly in Toronto. Statistics of production are available since 1897; the average price per thousand has varied from $8 to $20.

The imports of paving brick have during the past three years exceeded the domestic production. During the calendar year 1911 the imports were 11,450 thousand, valued at $164,292, or $14.34 per thousand, and included 4,988 thousand, valued at $78,201, or $15.68 per thousand, from the United States, and 6,462 thousand, valued at $86,091, or $13.32 per thousand, from Great Britain. The imports during the calendar year 1910 were 10,503 thousand, valued at $124,994.

In the following table, compiled by *The Canadian Engineer*, are given the Canadian imports of iron, steel, etc., from Great Britain for June of this year and last, and for the first six months of each year:—

Item.	Tons in June. 1912.	1913.	Tons in first six months. 1912.	1913.
Pig iron	5,339	3,363	26,161	11,963
Wrought iron bars	484	1,074	2,928	4,724
Railway rails, etc. (iron and steel)	....	10	274	297
Steel bars, etc.	833	3,044	4,104	18,011
Tinned plates and sheets	249	452	3,778	4,320
Galvanized sheets (flat and corrugated)	2,367	2,519	10,711	18,475

The Canadian Engineer

ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

Editorial:	PAGE
Lake of the Woods Water Level	277
The Pollution of the Niagara and Detroit Rivers	277
Provincial Roads in Ontario	277
Patents and the Engineer	278
The International Geological Congress	278
Leading Articles:	
Notes on Tunnelling for Sewers	261
Opportunities for Highway Engineering in Contractors' Organizations	264
Fuel for Heavy-Oil Engines	266
Municipal Control of Waterfront	267
The C.P.R. Bridge at Lachine	268
Reinforced Concrete in Mines	270
Asphaltic Concrete as a Paving Material	272
High-Pressure Spray Treatment of Road Surfaces	280
The Ottawa River Storage System	284
The Third International Road Congress, London, 1913	287
Coast to Coast	290
Personals	292
Coming Meetings	292
Railway Orders	75
Construction News	76
Market Conditions	92-94
Technical and Municipal Societies	94

LAKE OF THE WOODS WATER LEVEL.

A report is to be expected about October 1st from the International Joint Commission respecting water levels in Lake of the Woods. Different municipalities and companies have different opinions as to what these levels should be, based, undoubtedly, upon the bearing any changes will have upon their own interests. The dissension is common to both sides of the boundary, and it was, therefore, consigned to the Commission for decision.

Although not itself on the boundary, the town of Kenora, Ont., recognizes how vitally important the boundary water level is to its water power development. The Commission of Conservation places the available horse-power at a minimum of 4,100 for the east branch and 18,000 for the west branch of the Winnipeg River, based upon an 18-foot head; and of this amount some 6,300 horse-power is already developed. Naturally, the corporation's electric plant desires any change of water level to be a raise. The navigation interests also feel that the levels cannot be too high to suit them.

On the other hand, high water conditions interfere with fishing, and followers of this industry have protested lustily against any change, but one of lowering, in which contention they are upheld by the landowners, whose property, bordering the lakes and streams in the vicinity, is in danger from overflow. The interests at International Falls, near Fort Frances, where a dam has been installed, and where there is 14,000 horse-power available, inclines to side with the low-water adherents.

The Commission has been at work since early spring, and a Government decision establishing the water levels for the future will follow the presentation of its report.

THE POLLUTION OF THE NIAGARA AND DETROIT RIVERS.

Another important boundary matter receiving attention this summer is the degree of pollution of the Detroit and Niagara Rivers from the sewage emptied therein from the cities of Detroit and Buffalo, respectively. Being of mutual interest to Canada and the United States, the problem fell to the International Joint Commission, whose parties for both countries have been engaged for the past several months in investigation. The report, which will likely be completed within two months, will be a deciding factor concerning the various allegations of pollution. It may require considerable alterations to the present sewer systems of both cities. At any rate, the outcome of the investigation will be a valuable record of data that will be a fine addition to Canada's statistics concerning her international boundary waters.

PROVINCIAL ROADS IN ONTARIO.

The appointment of a commission to investigate fully the public highway situation in the older counties of Ontario, and to study all matters relating to construction, improvement and maintenance, is a second step in this important Government project. Although quite independent of the development work, of which Mr. J. F. Whitson is in charge in Northern Ontario, the two form a strong, progressive movement in the welfare of the province and its highways.

The plan to which the recently-formed Commission will devote its attention has long been under consideration. Six months ago it was announced in Legislature

that an appropriation was being considered for establishing a system of provincial roads, and the new Commission will define and regulate the amount of this expenditure. The Government is prepared to devote $10,000,000 to the enterprise.

The work in New Ontario has progressed satisfactorily, although handicapped by late snow and ice at the setting-in of the season. Many good pieces of road are in evidence for the small portion of the total expenditure of $5,000,000, some $250,000 of which will have been consumed by the time work ceases in the fall.

PATENTS AND THE ENGINEER.

Just how close a relationship exists between the engineering profession and the patent office is exemplified in a comparison of the terms in which both functions are defined. It is the common object of both to further civilization by the advancement of science and art. By its existence the patent stimulates creative and inventive ability, while the engineer exists to adapt the inventor's achievements to the use of mankind. The relationship, therefore, implies that the engineer, of necessity, must be familiar with the practical workings of the patent office.

This relationship is certainly not new, as the improved methods, machines and appliances of the age are, or have been, the subject of patents. Further, almost all engineering contracts and specifications include clauses contingent upon patent infringements and legal difficulties ensuing from such. Since these agreements constitute a phase of the engineering office production, the obviousness of a thorough knowledge of all exclusive rights associated with the work or the equipment used in construction is apparent. This knowledge consists chiefly in a clear understanding of what the inventor's rights really are, or, in other words, the scope of his patent; and of being able to distinguish the line of demarcation between the features of the work effected.

Patent law has come to be a profession in itself. It is a summation of specialties only contiguous to engineering in the above respect. But it is decidedly in the interests of the engineer to be clear in his ideas of the *modus operandi* and nature of patent office practice and patent litigation.

THE INTERNATIONAL GEOLOGICAL CONGRESS.

The Toronto session of the International Geological Congress opens to-day in Convocation Hall, University of Toronto, and continues for one week. The first series of excursions (12) is at an end, and all roads lead to Toronto.

At the meeting the chief topics for discussion have been selected as follows:—

(1) Coal Resources of the World.

(2) Differentiation in Igneous Magmas.

(3) The Influence of Depth on the Character of Metalliferous Deposits.

(4) The Origin and Extent of the Pre-Cambrian Sedimentaries.

(5) The Sub-divisions, Correlation and Terminology of the Pre-Cambrian.

(6) To What Extent was the Ice Age Broken by Interglacial Periods?

(7) The Physical and Faunal Characteristics of the Palaeozoic Seas, with Reference to the Value of the Recurrence of Seas in Establishing Geological Systems.

The session will be further enhanced by reports of committees of previous congresses, and by ten excursions to points of geologic interest in older Ontario.

The congress does not terminate with the close of the Toronto session on August 14th, but continues, in the form of lengthy excursions, the longest of which, extending into the Yukon, ends at Vancouver on September 22nd.

EDITORIAL COMMENT.

Attention is called to a change of name in one of our prominent technical societies. The Board of Directors of the National Association of Cement Users announces an amendment of the organization's charter, changing the name to American Concrete Institute. The association was founded in 1905, and since that time has done a great deal in the interests of cement and concrete. The nine conventions which were held during this period furnished much of the advanced and authoritative knowledge of the various applications to which cement has lent itself. The new name, American Concrete Institute, applies infinitely better to the activities of the organization than the old.

* * * *

It may be that one of the greatest discoveries in chemistry, possibly leading to the solution of the fundamental problem of the science, the nature and relationship of the elements is the production of Helium and Neon by electrical discharges in an atmosphere of hydrogen. Under suitable conditions, these and other elements, of a heretofore unknown character, have repeatedly been obtained, these results indicating a transmution of elements or a synthesis or a combination of both. They are the results of a series of investigations by Professors Collie and Patterson, University College, London, Eng.

SOME WANTS OF MUNICIPALITIES.

In an address given by Mr. J. N. Bayne, Deputy Minister of Municipal Affairs for the Province of Saskatchewan, at the thirteenth annual Convention of the Union of Canadian Municipalities, held in Saskatoon two weeks ago, reference was made to the absolute need of technical men in rural municipalities.

Among the appointed officials there is always need of the technical man, be that officer a road foreman, inspector, engineer, secretary, assessor or treasurer. Very often a rural municipality cannot, or may be under the impression that it cannot, afford to hire a skilled man as engineer for the laying out of proposed improvements. In a new country professional men of the kind are often scarce and their fees apparently high, so that as a result much experimenting with municipal public works is the result, costly in the extreme, and demonstrating the fact that proper preparation by way of securing competent advice at the start is highly advisable. Technical services are a want, therefore, in many rural municipalities, but fortunately this is being speedily overcome. Its absence is often simply the temporary lack of funds with which to meet the expense.

Another want which Mr. Bayne mentioned is the lack of continuity in the policy of the organization con-

cerned. This is due in the majority of cases to the constantly changing council boards. Too often a ward of division is represented for five years by as many different councillors.

Still another want which should not be overlooked is the knowledge on the part of every ratepayer, whether resident or non-resident, that he is an integral part of the municipal institution. That the business of the organization is his business, that he is a partner in a mutual co-operative benefit establishment. In speaking of the municipality and its officials he should learn to use the term "we" instead of "they." Mr. Bayne in closing gave a general statement or two regarding municipal development in Saskatchewan, now the third largest province in confederation.

On September 1st, 1905, the day on which Saskatchewan first came into being, there were only two rural municipalities, whereas to-day we have two hundred and ninety. Sixty-three villages have increased their number to two hundred and fifty-five. There were sixteen towns on the first mentioned date, now there are seventy-two; three cities were in existence on September 1st, 1905, and to this number was added Saskatoon in May, 1906, and in the same month in 1913 North Battleford became a city, and thus reached the highest possible municipal status for any organization to attain.

THE ECONOMIC POSSIBILITIES OF THE OVERSHOT WATER WHEEL.

The turbine in some form has so completely replaced all other motors in water power development that no other type of water wheel comes to mind ordinarily when water power is being considered. The overshot water wheel, for example, in the thought of most engineers, we presume, ranks as an obsolete device. This would be particularly so in America. Yet we are told of frequent use by German and French engineers of overshot water wheels for small water power plants, and the presumption is that their use has been found satisfactory and economical. This presumption is sustained by tests conducted at the University of Wisconsin and described by Mr. G. R. Weidner in a bulletin recently published by the university. Much of the discussion and the refinements of data contained in this bulletin are for the engineer versed in hydraulic motor engineering, but the main facts brought out are facts for the civil engineer to keep in mind, and are concisely given by "Engineering and Contracting" in a recent issue.

The results of the experiments show the overshot wheel to be a very efficient type of hydraulic motor, which, within certain limits is capable of rendering an efficiency quite equal to that of the turbine or even greater. It is the opinion of the author that, with a properly designed overshot wheel, operating under favorable conditions, the efficiency, computed on the basis of the output delivered at the wheel shaft, may be as high as 90 per cent., or even more. The conclusion has been reached from the fact that 89 per cent. was actually obtained in the experiments on a 10-ft. wheel, and that the Franklin Institute experiments showed an increase in the efficiency, although small, with the diameter of the wheel. Under the ordinary conditions of operation, this efficiency would be reduced somewhat to allow for the clearance between the wheel and tail water, so that 85 per cent. may be considered as a conservative estimate of the efficiency of the overshot wheel, when properly designed and installed.

The economical field of the overshot wheel lies in developments which range approximately between 2 and 30 sec.-ft. discharge, with heads varying from 10 to 40 ft., corresponding to a maximum development of about 75 horse-power. Within this field, the question whether to install a water wheel or turbine must be decided on the basis of the particular conditions of the power to be developed, the class of machinery to be operated, and the cost of installation. Only a rough approximation can be made as to the cost of the two types of motors, from the figures furnished by the manufacturers. In general, it may be said, that the overshot wheel, up to a diameter of 16 ft., will cost about double the amount a turbine of equal horse-power would cost, and above that diameter it will cost little more than double.

The peripheral velocity of the overshot wheel, when operating efficiently, varies approximately between 3 and 7 ft. per second, depending on the diameter, discharge, and velocity of the entering water. It is, therefore, particularly adapted for the operation of slow-speed machinery, and should find a field of usefulness, for the operation of small factories, the machinery on farms or country homes, and especially for pumping plants, where the pumps may be connected directly to the wheel-shaft.

For the operation of high-speed machinery, a loss of energy of from 3 to 10 per cent. may be estimated to occur through the necessary gearing or belting. The principal application or use of water power at present is the development of electrical energy. In general, the opinion is held, that only turbines on account of their high speed are applicable for this purpose. A number of electrical plants, operated with water wheels, have been built, which are giving satisfactory service. The inertia of the heavy wheel and gearing provides a very uniform motion, and high efficiency at part load is a very desirable feature in electrical plants. It is a matter for the designing engineer to decide, which type of motor will give the highest total efficiency, for a plant of this kind.

The overshot wheel is not adapted to conditions, where there is a considerable variation in the level of the tail water, unless the discharge can be increased sufficiently to compensate for the loss of power due to submergence. The efficiency of the wheel is reduced materially with a submergence of only a few inches.

In view of its high efficiency, reliability, adaptability to varying discharge, and simplicity in construction, setting and operation, the overshot wheel is still a useful type of hydraulic motor, worthy of receiving the attention of, and consideration by, engineers who may have occasion to develop small water powers.

An interesting test was made recently in Massachusetts to compare the relative efficiency of stump-removing by dynamite and by a $135 stump-puller. One man did the blasting, while two with a pair of horses operated the stump-puller. The contest was started in the morning. By four in the afternoon thirty-three stumps had been removed by the former method. These ranged in size from 9 to 33 inches; all were clean of dirt and split so as to be easily handled. Meanwhile the stump-puller had extracted twenty-one stumps. These were not clean, nor were they split, in fact, it was estimated that an additional day would be required to put them in shape. Fifty-six pounds of 40 per cent. dynamite and sixty-one electric fuses were used. The cost, including time and materials, was $26.07.

The National Municipal League will hold its annual convention in the city of Toronto, commencing the 12th of November next.

HIGH-PRESSURE SPRAY TREATMENT OF ROAD SURFACES.

BASING his paper upon experiments with tars for road purposes, started as early as 1892, and the use of experimental spraying machines, the first of which he had devised in 1895, Mr. Thos. Aitken, county surveyor, Cupar Fife, Scotland, has published his observations in a recent issue of *The Surveyor, London*. His paper was not completed in time for inclusion in the International Road Congress communications, unfortunately. It sets forth a wide range of experiences with high-pressure spraying machines in surfacing, treating macadamized roads and in bituminous macadam construction. The following is abstracted from it:

The system of tar-spraying roads by machines has greatly facilitated the work and reduced the cost. It lessens wear and tear, prevents suction by pneumatic tires of vehicles travelling at a high speed, reduces dust in dry, and mud in wet weather to a minimum, and at the same time lengthens the life of a road. It is usual with one of these tar-spraying machines, working under favorable conditions, to spray from 2,400 to 3,200 gals. of tar per day. This represents on an 18-ft. road a length of 1.37 miles at the former figure and 1.66 miles at the latter.

A tar-spraying machine to be of really good service should be economical in operation, constructed to withstand the hard usage naturally expected from the nature of the work it undertakes, and be capable of traversing the roads at a fairly high speed in order that full advantage may be taken of the limited time available for these operations.

There is absolutely no penetration by the hand or gravitation machine methods on an ordinary macadam road unless the tar used is of a very poor quality, applied exceedingly hot, and the metalling is in a practically loose state, certainly not the best combination to attain success. Overheating of refined tar, and even of some tar-compos when applied to the cold road surface, brings about results which are disastrous sooner or later. The idea of raising tar to a high temperature repeatedly, as has often to be done, is brought about by the necessity of making it sufficiently liquid so that it can be manipulated by the gravitation machines or used in carrying out other methods of application without due attention being given to the fact that the quality of the tar is thereby impaired. A good quality of refined tar has in many instances been condemned through being badly handled by inexperienced persons.

Refined tar and "bituminous tar" heated, if necessary, by steam coils and sprayed by a high-pressure tar-sprayer effects beneficial penetration, providing the road surface is properly cleaned. The amount of penetration varies according to the description of binding used when the road was recoated last and its general condition at the time of treating with tar.

The writer has found it 1½ ins. to 1¾ ins. in depth in many cases, and in this connection it is not oil that is meant, but tar of the same binding quality as that on top of the road. Effective penetration, along with a good film of tar on the wearing surface, is just what is required, and, the whole being keyed, gives a waterproof crust. As surface spraying on important and medium-trafficked roads is of an annual or recurring nature, it is of great importance that, in the first instance, the penetration should be effective, even although a greater amount of tar per square yard be applied than that found necessary subsequently.

It is a significant fact, borne out by experience, that when recoating roads by the ordinary or waterbound method, and employing a binding material of a loamy-sand description, penetration is easy and effective compared with roads which have been repaired with road scrapings or other promiscuous matter as a binding material.

Surface spraying over many of the principal counties in Scotland has occupied the writer's attention for some years past, and more especially in East Fife, where he holds an official position. Certain roads under the writer's jurisdiction have been treated with a variety of tars, oils and other dust preventives.

Refined tar has unquestionably given the most effective and economical results for surface spraying existing roads from the dust point of view, and, in addition, has greatly reduced the cost of maintenance on these roads by reason of the penetration effected, which practically waterproofs the surface and, to a great extent, prevents internal friction and consequent wear of the road stones.

A section of the Dundee, Stirling and Glasgow road west of Cupar was recoated for 4 miles, and a portion of this road for a distance of ¾ mile was treated later on with refined tar in 1908, and again in 1909, and has not been sprayed since. The section beyond the tar-treated portion, or westwards, had to be repaired with a centre coating in 1911-12 to bring the surface into good repair in view of the numerous potholes then existing. The tar-treated section has not required any further attention or expenditure so far as repairs are concerned during the period in question. The cost of recoating and rolling the whole section was 7.55d. (15.1 cts.) per square yard, and surface spraying on the section mentioned was 1.85d. (3.70 cts.) for each application, which together equals 11.25d. (22.5 cts.) per square yard during the period up to December, 1912, or five years. This section beyond, or westwards, has cost, first in 1908, 7.77d. (15.54 cts.) and then, in 1911-12, 7.77d. (15.54 cts.) per square yard, or 15.54d. (31.08 cts.) per square yard, so that, assuming the tar-treated section wears out about the same time before renewal, compared with the other section, which to all appearance is most likely, the comparative cost for ordinary macadam and macadam treated with tar per square yard per annum is 3.11d. (6.22 cts.) and 2.25d. (4.5 cts.), or nearly 28 per cent. in favor of tar treatment.

On another road, the Dundee, Edinburgh and Glasgow road, 1 mile east of Cupar, the surface had similar spraying treatment, which was carried out in the spring of 1907 and early in the following year.

This section, or rather one side of it, was again sprayed with tar in October, 1908. On the latter occasion the tar-spraying was carried out to demonstrate the practical working of the tar-spraying machine to some road engineers from abroad, although the road did not actually require this application.

As it turned out, however, the second and third application had, combined with the previous treatment, very beneficial effects in so far that when the other portions of the road were recoated in May, 1912, the portion referred to did not require any repairs, it being then in excellent condition. Although the portion was at the footpath side of the road, embracing the water table, a considerable volume of traffic passes over it, as the road, being only 21 ft. in width, is made use of practically from side to side by overtaking and passing vehicular traffic. The cost of the three applications of tar and chippings amounted to 5.55d. (11.10 cts.) per square yard, while the cost of re-

newing the adjacent portion by ordinary macadam was 7.11d. (14.22 cts.) per square yard. This would mean a considerable saving when long stretches of road are taken into account, and in this case represents £77 per mile over six years, or £12.83 per mile per annum. The condition of the portion of the tar-treated road referred to is excellent, and may reasonably be expected to last as long as the newly coated sections, or a period of from five to six years. The traffic on this road is principally that of motor cars.

It is necessary, however, to state that, had the surface spraying mentioned been carried out at present-day prices, the cost of the three applications, in these successive periods, would have been 6.19d. (12.38 cts.) per square yard, which represents approximately a saving of £44, or £7.33d. per annum per mile of road at the width stated, and which would show a considerable saving on an extensive mileage.

These costs per square yard for surface spraying mentioned in the preceding page include haulage of the tar to the place of operation, heating, repairs to and depreciation on the machines, and the cost of the tar and application of same.,

In regard to fairly deep penetration, a road in the burgh of Newport, Fife, may be cited. The burgh engineer being desirous of thoroughly testing this point, and at the same time have a satisfactory surface, repeatedly washed the road to rid it of extraneous mud which had been incorporated in the crust at some previous time when the road was repaired and rolled. After the road dried out it was swept clean and the tar-spraying carried out in dry weather. The penetration was such that the tar practically disappeared, which appears remarkable, considering the fact that 1 gal. of tar only covered 4 sq. yds. The road was duly spread with chippings, but did not present a surface which was likely to satisfy the burgh engineer. On the advent of warmer weather, however, the tar was gradually drawn to the surface. The penetration in this case was fully 2 in., which could not possibly have been done with any other machine than a high-pressure one.

Similar cases could be described from data in the writer's possession of work carried out in and around Cupar Fife, but it may be more conclusive to describe some of the surface spraying carried out by Aitken's patent gold medal tar-spraying machine in another centre, the figures as to cost of maintenance and other details being given by the official in charge.

The road in question is an important one, leading from the city of Edinburgh to Queensferry, over which, especially during the summer months, a very heavy continuous traffic passes, including motor buses. The road for the most part is 40 ft. wide, and extends to about 1½ miles, and the whole surface has been sprayed annually in the beginning of May for the last three years, and certain portions for the past five years.

The annual cost of maintenance previous to the tar treatment, including all items except establishment charges, was, on an average, for three years previously, £440 per mile, or 4.19d. (8.38 cts.) per square yard per annum.

Since this thoroughfare has been tar-sprayed the annual expenditure for materials and labor has been reduced to £399 per mile, or 3.84d. (7.68 cts.) per square yard, which figure includes surface spraying. These figures represent a difference which is equal to .35d. (0.7 ct.) per square yard, or an annual saving on previous expenditure of 9¼ per cent., in addition to a considerable reduction in the cost of watering and cleansing. The cost of surface spraying on an average for three years was, for tar and application, sweeping and chippings, 1.92d. (3.84 cts.) per square yard.

It is necessary, however, to mention that this road was put in good repair previous to the first surface spraying, and the work was carried out in what the writer considers, and has always recommended, ideal methods of using 2-in. gauge metal with a binder of chippings—and it may be mentioned the latter material was produced from rock having stable constituent minerals—rolled and the surplus binding swept off. When the tar-spraying operations were commenced the road had been thoroughly swept, and was in a dry condition. The quantity of tar applied under these favorable conditions figures out at the somewhat excessive amount of 4.5 gals. per square yard, and it was remarkable how small a film of tar was apparent on the surface of the road immediately after the operations were carried out. On the advent of warmer weather, however, the actinic force of the sun's rays caused the tar to reappear, and, combined with the clean whin chippings applied, made an excellent surface, which was absolutely free from dust. This, the writer considers, is the proper condition in which a road should be for effectively waterproofing the surface, and which lays the groundwork for future spraying operations.

The writer considers the excellent condition of this road previous to being tar-sprayed, combined with the deep penetration effected, has been instrumental in securing the results obtained, and the surface spraying, which has been carried out annually, has maintained these economical results.

In carrying out surface spraying the thorough cleansing of the surface of the road cannot be too strongly emphasized as an important factor in obtaining successful results. The surface of the road for treatment must be cleansed of all foreign matter by repeated applications of a rotary brush, or otherwise, so that the surface be left as open as possible to permit of penetration, and so allow the tar to act partly as a binder, and not merely forming a "blanket coat," which has already been referred to.

In the course of the writer's experience he has many times seen a good quality of tar, properly applied, give but poor results, entirely due to inefficient preparation of the road for the application.

Spreading clean, uniform-sized chippings on the newly sprayed road surface is also a factor which assists in the attainment of satisfactory work, and should always be adopted. This important point has, however, apparently not been so well understood in some counties, as it is noticed from time to time in the technical journals, that road scrapings have been used considerably for this purpose. This is remarkable, and certainly cannot lead to success, and it is a matter of surprise to the writer that any road engineer permits such material being used.

These remarks, so far as possible in a paper so limited, practically conclude the writer's experience of surface spraying macadam roads from the point of dust prevention through the road crust being waterproofed by effective penetration of the tar. Unquestionably tar spraying, when properly carried out, is a very effective remedy against the formation of dust, and also lessens the excessive wear of the roads by vehicular traffic.

This has been abundantly proved by the cases cited in the preceding pages, which roads have been treated with high-pressure tar-spraying machines.

In addition it may be stated that the cleansing of roads properly treated by high-pressure tar-spraying machines is considerably reduced, and, in fact, in many cases

the cost of tarring is met by the reduced cleansing account, and in addition there are the economical results attained in the cost of maintenance.

Bituminous Macadam Construction.—In using high-pressure spraying machines for making tar macadam *in situ* the following operations are usually adopted: The road, previous to coating with metal in the usual way, is repaid in a superficial manner to make the surface fairly uniform, and approaching the contour which the new surface is intended to have when finished. All extraneous soft binding matter should be removed so as to present a clean, hard surface. When the moisture is dried out the surface, after sweeping, is sprayed with bituminous tar or other tar-compo, and ½ in. to ¾ in. whin or similar chippings applied so as to waterproof the old surface, and form a key on which the new crust is to be formed.

The metalling, preferably 1½-in. to 2-in. gauge, free from extraneous matter, is then spread to the desired depth—3 in. to 4 in. generally—and when a stretch of 30 yds. to 50 yds. has been carried out, and without being rolled, the "tar-spraying machine," with the atomized nozzles placed at an angle, commences at outside and works in 6-ft. to 7-ft. breadths until the surface is all sprayed. The machine is then reversed, and the spraying is carried out in an opposite direction. This effectually covers all the road stone surfaces, especially in the lower parts, as, being left in a loose state, the great pressure used in forcing the binder into the body of the metal coating covers all with a film of tar. When this has been carried out ½-in. to ¾-in. chippings are sprinkled over the surface and lightly rolled. The chippings work gradually down into the metal coating, practically filling, along with the binder, all the voids. Should any depressions appear these are made good before the spraying machine again travels over the portion first treated and gives two other applications of binder. Chippings are applied, and further rolling finishes the work, and, if necessary, more chippings are sprinkled over the surface. This generally completes the operation, but if a very smooth asphalt-like surface is desired an extra coating of binder may be applied. In all 1-25 to 1-50 gal. per square yard are sprayed, depending on the depth of the metal coating, and description of the road stone used.

In carrying out this class of work, especially in the earlier stages, some curious results have been experienced, insofar that even when using the same road material and binder on a stretch of road of an apparently uniform nature certain small portions or patches became very unsatisfactory at varying periods after construction. These defects evidently pointed to bad subsoil drainage, but, as it turned out, it was invariably due to this combined with the presence of clay which apparently had not been specially treated when the road was originally made.

It has been the writer's practice when making new roads to separate any portion or even pockets or patches of clay from the road proper by laying a bed of hard engine ashes or clinkers, and in some cases gritty sand.

It is well known what bad effects a clay subsoil improperly drained and not specially treated has in the maintenance of an ordinary macadam road. It is doubly so with tar-macadam, as when the surface breaks up, even in isolated spots, the advent of rain permits of percolation, and the moisture spreading on top of clay with no possible means of escape except upwards by evaporation increases the area of the patches originally affected, and spreading practically ruins the whole surface.

The few exceptions mentioned previously were brought about by this cause. Roads which are to be made of tar-macadam, no matter by what process, should be carefully examined by making trial pits, and the nature of the subsoil recorded as a guide in carrying out the subsequent operations, so that uniform and satisfactory results may be obtained. The most satisfactory work is obtainable when the formation is of sand or gravel, as the subsoil drainage under such conditions is practically perfect and cannot be improved upon.

The character of the road stone is a factor in making tar-macadam. The writer, after many years' experience in using most kinds of igneous rocks, considers that the material which has a rough or coarse grain when broken into road metal gives the best results. This roughness gives a keying power and holds, along with the binder, the whole coating firmly together. It is a significant fact that less binder may be used and that less rolling is necessary, or, in other words, more work can be accomplished in the same time by using such materials.

Basalts, dolerites and gabbro generally, if the constituent minerals are in a fresh condition, prove satisfactory materials for tar macadam, and along with these certain granites. Andesites, on the other hand, having a dense, fine-grained texture, and with other similar descriptions of stone, are not so good and generally require a greater amount of binder to obtain good results. Further, should rolling operations be commenced immediately after the spraying is finished, the individual stones slide one upon another, and it is difficult to keep the road in proper section. Under these circumstances it is better to leave the tarred section for some time to permit of the binder partially setting before rolling is commenced. The writer has observed roads apparently left in good order become somewhat uneven during very hot weather, and this undoubtedly has been brought about by using too much binder. In some cases this has, along with the use of road stones of the andesite family, prevented sufficient frictional resistance to maintain the road in a stable condition.

The proportion of aggregate and matrix forms an interesting factor in construction, initial cost and future maintenance entering largely into the matter. The voids in a coating of 1½-in. to 2-in. metal spread loose amount to practically 46 per cent., and when consolidated the total volume will be reduced, including, say, 10 per cent. of chippings and the binder itself, to a density or solidity of from 86 to 90 per cent., the difference being taken up by air spaces.

It is the writer's opinion that if the proportions of aggregate and matrix are properly adjusted, according to location and traffic conditions the tar-macadam crust should, providing all other circumstances are favorable, form a roadway capable of being looked upon as a foundation, and the actual wearing surface may be renewed from time to time by the application of a bituminous material of recognized quality, such as Trinidad asphalt. Therefore, according to traffic conditions, the road crust never need be renewed. It is understood this is possible, providing the foundations do not give way, and that the subsoil drainage is kept in perfect working order—a matter, however, which requires constant examination and careful supervision.

In comparing the cost of tar-macadam in different centres the fact that the specific gravity of the stone is seldom mentioned when the amount of binder is stated at so much per ton of material applied is very misleading. This point should be very carefully kept in view when figuring out detailed particulars, as the following instances will show. In the county under the writer's juris-

diction the specific gravity of road stones varies from 2.49 to 2.99, the former being a felsite and the latter an ophitic dolerite. The respective covering power per ton of these two materials varies considerably, as in the former 1 cu. yd. = 20-61 cwt.; therefore, 1 long ton will only cover 7-37 sq. yd. As the covering power of 1 cu. yd. of metalling at any given depth is the same under any circumstances, it follows that in the case of a stone having a lighter specific gravity, the amount of binder per square yard would be, for a coating 4 in. in depth, 1.26 gals., and in the case of the heavier stone 1.50 gals. per square yard—quite a significant difference when large areas are under consideration. In addition to the specific gravity being given, it is also desirable to state the amount of binder used per square yard for a given depth of metalling when spread loose, or if consolidated the gauge of the material used in the coating, as consolidation varies to an appreciable extent in coatings composed of different gauges of stones. Statements as to cost would then have some comparative value, and this would save considerable trouble in investigating work carried out in various centres throughout the country.

Tar-macadam carried out with ordinary bituminous tar and such like compositions requires that the wearing surface be renewed every two to four years, according to the amount of traffic and the nature of the metalling employed when carrying out the work. In such operations coarse-grained stones will proportionately require to be treated every two to four years compared to one and two years when fine-grained stones are used.

The method of renewing such surface is very easily accomplished. First of all, should there be any serious depressions, these must be repaired by applying a suitable oil and filling in the pothole with a small quantity of bituminous tar, and level up with ¾-in. chippings. When these patches have set properly the whole surface must be thoroughly swept and then sprayed with a good coat of suitable binder, ½-in. to ¾-in. clean chippings being spread over the whole area and treated and then rolled. A more effective method of performing this operation, especially if the weather is not very hot, is to spray a small quantity of oil on the surface and allow it time to soften or revivify the old binder material, and then apply a good coating of the bituminous or other suitable composition, apply the chippings and roll solid. These operations, as already mentioned, require to be carried out periodically, and by so doing the original tar-macadam road is effectively renewed for traffic at a comparatively cheap rate compared with reconstructing the whole road crust should it be allowed to get so far out of condition that such measures become necessary. Tar-macadam carried out as described in the preceding pages presents a smooth, uniform surface, which is waterproof and slightly resilient, very important factors in modern road construction.

A German inventor, Carl Canzler, has a process of welding copper with oxy-acetylene flame whereby his torches, according to the "Scientific American," are larger than the ones used for the welding of iron. He also employs a liquid welding paste to prevent the formation of an oxide. It is claimed that copper plates up to one inch in thickness have been welded. The joint formed will withstand acid, it is said, and is as strong as a continuous copper sheet of solid metal. This new process is being used with success in the principal copper works in Germany.

FORCEFUL APPLICATION OF CEMENT.

Owing to the menace of teredos and liminoria to wooden piles, untreated piles having been eaten through in three years and creosoted piles having fared but little better, great ingenuity has been exercised to devise some permanent and satisfactory way to protect wooden piles from the ravages of these pests.

Inventions along this line have included sheet copper coverings, plaster coatings, covering with concrete, wrapping with burlap and compounds, and innumerable other devices, all of which have proven too costly or ineffective for one reason or another.

The most promising line of endeavor, and along which most attempts have been made, has been concrete coatings, and the best results, so far, have been obtained by applying this coating of cement-mortar to the pile for a portion of its length, extending from below the mud line to high water, with the aid of a cement gun.

Mr. Rudolph Hering suggested another important use of this apparatus in a report he made concerning the repair of a Nashville, Tenn., reservoir. He recommended its use as a means of applying a coating to prevent leakage through the walls of the structure. A portion of his report dealing with this is as follows:—

"In order to secure watertightness of the present walls they should receive a lining of cement mortar over the entire inside surface of the reservoir, applied by what is known as the cement gun. Wet cement mortar of a proper mixture is shot against the surface of the wall, after this has been thoroughly cleaned, first by thorough washing and scraping, then by sand blasting, which will make the adhesion of the cement complete. The density of this gun cement is very great, and it penetrates into all open crevices and covers every fine crack. An average thickness of about an inch is more than enough to make a wall entirely watertight."

Micrometer measurements in thousandths of an inch are no longer rare, and even the ten-thousandth is quite determinable. Far beyond this is the sensitiveness of the new electrical machine described by Dr. P. E. Shaw to the British Institution of Mechanical Engineers. It depends upon the principle of electrical touch, has the quarter-millionth of an inch as its unit, and is adapted for a variety of measurements of cylindrical, spherical or parallel-faced bodies. In engineering gauges of great precision it has shown errors of something like the one-hundredth-thousandth of an inch.

When excavation and construction work is carried on at night the results obtained are in many cases vitally affected by the character of the illumination provided. So well understood is this factor of night work efficiency that even among contractors who do not utilize electric drive, electric lighting is being very generally adopted when the working area is located in or near a zone of electric current distribution. For this class of service the use of long life flame arc lamp insures a maximum illuminating effect for a given current consumption, while the simplicity and strength of the mechanism will minimize outages and the cost of cleaning and trimming. This lamp can be supplied for operation on either alternating or direct current circuits, and is especially designed for outdoor service and the illumination of large areas. On the Panama and New York State barge canals electric searchlights have been advantageously used for directing night operations and for concentrating illumination at distant points where the use of ordinary lighting units would be impracticable.

THE OTTAWA RIVER STORAGE SYSTEMS

A SCHEME TO STEADY THE FLOW FOR THE PRODUCTION OF POWER—TO INCREASE THE DEPTH FOR PURPOSES OF NAVIGATION AND TO IMPROVE THE POTABILITY OF THE WATER.

By J. A. MACDONALD

HYGIENIC experts agree that the extreme low level of the Ottawa River at certain times in the year is a big contributing force, not only to the diminution of the capacity of the scores of water-powers on the river, but also, and probably to a more serious extent, to the health of the people living contiguous to the river. It is conceivable that with the subsidence of the full flow of the steam, deposits of deleterious matter are scoured by the shallow currents, and carried into the intake pipes of the various waterworks systems drawing their supply from the Ottawa. At all events, the sedimentary pollution would be delivered in a more concentrated form under such conditions than if a normal level had been maintained. And it is an observed fact that, the occurrence of sickness due to impure drinking water synchronizes with the periods of extreme low water in the river. This is particularly true of the city of Ottawa.

It is now over four years since work was begun on a scheme of conservation of the waters of the Ottawa by means of reservoirs created by the construction of dams at the outlets of several of the large lake expansions on the upper reaches of the river. The first, upon which considerable progress has been made, is situated at the foot of Lake Timiskaming. To store the waters of the Kipawa, a tributary of the Ottawa flowing into Lake Timiskaming, another dam is being built, and about fifteen miles above the head of the Timiskaming on the reach of the Ottawa, known as the Quinze, a third dam is in course of construction. This dam will store the waters of the Quinze and Expanse Lakes. The execution of these important works has been placed by the late Minister of Public Works in charge of Mr. C. R. Coutlee, C.E., a leading authority in hydraulics, who has made an exhaustive survey of the drainage areas of the Ottawa and its tributaries, and who has been given direction of the entire storage scheme.

Fig. 1.

Measurement of the flow at the Chaudiere Falls shows that at extreme spring flood 150,000 cubic feet per second goes to waste over the falls. At extreme low water the flow declines to 10,000 cubic feet per second. To prevent the waste in spring and utilize it to augment the diminished flow in the low water period is the object of the storage system.

filled up with a reserve supply. This can be fed out during November, December, January, February and March, thereby doubling the present insufficient low-water flow."

A stream 100 feet wide and 3 feet deep, running at the rate of 1 foot per second, or ⅔ mile per hour, would practically fill one square mile a foot deep in 24 hours;

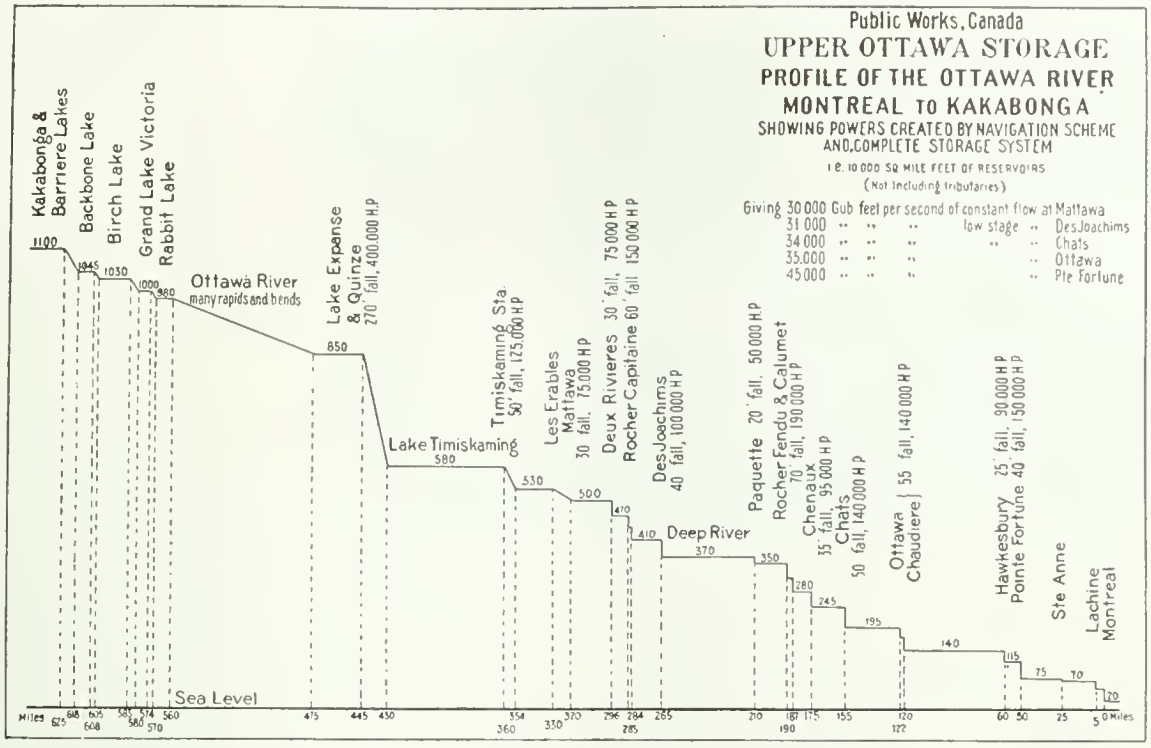

Public Works, Canada
UPPER OTTAWA STORAGE
PROFILE OF THE OTTAWA RIVER
MONTREAL TO KAKABONGA
SHOWING POWERS CREATED BY NAVIGATION SCHEME AND COMPLETE STORAGE SYSTEM
I.E. 10 000 SQ MILE FEET OF RESERVOIRS
(Not including tributaries)
Giving 30 000 Cub feet per second of constant flow at Mattawa
31 000 " " " low stage " Des Joachims
34 000 " " " " " Chats
35 000 " " " " Ottawa
45 000 " " " " Pte Fortune
Kakabonga & Barriere Lakes
Backbone Lake
Birch Lake
Grand Lake Victoria
Rabbit Lake
Ottawa River many rapids and bends
Lake Expanse & Quinze 270' fall, 400,000 H.P
Lake Timiskaming
Timiskaming Sta. 50' fall, 175,000 H.P
Les Erables Mattawa 30' fall, 75,000 H.P
Deux Rivieres 30' fall, 75000 H.P
Rocher Capitaine 60' fall 150 000 H.P
Des Joachims 40' fall, 100 000 H.P
Paquette 20' fall, 50 000 H.P
Rocher Fendu & Calumet 70' fall, 190 000 H.P
Chenaux 35' fall, 95 000 H.P
Chats 50' fall, 140 000 H.P
Ottawa Chaudiere 55' fall, 140 000 H.P
Hawkesbury 25' fall, 90 000 H.P
Pointe Fortune 40' fall, 150 000 H.P
Ste Anne
Lachine
Montreal
Deep River
Sea Level
Miles

Fig. 2.

In a progress report upon the Ottawa River Storage System, Mr. Coutlee says: "The capacity of each of the three lakes, Timiskaming, Kipawa and Quinze-Expanse, is about 100 square miles in extent and a layer 20 feet in depth stored in them would be 2,000 square mile feet of storage. Altogether, then, their storage would amount to a depth of one foot over 6,000 square miles. It would

or, more exactly, 322 c.f.s. will fill or empty a square mile one foot deep in one day.

It is further estimated that perfect control would require a constant flow of 31,000 cubic feet per second, and that this can be obtained by a further system of dams which will remain and regulate the waters of the numerous lakes and tributaries of the Ottawa between the

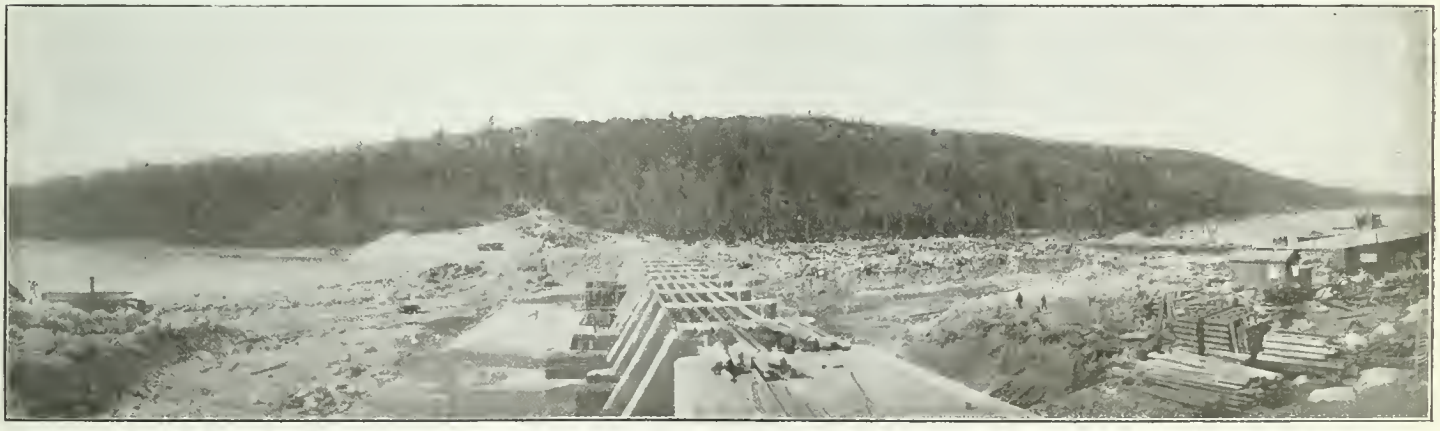


Fig. 3.—Timiskaming Dam, Ontario Side.

take a flow of 18,000 c.f.s. to empty the three reservoirs in 100 days, or a flow of 12,000 c.f.s. to empty them in 150 days—the average low-water period of the river. If we encroach upon the spring flood and allow only a normal flow to pass, these three great reservoirs will be

Quinze-Expanse basin and the source of the river. These include Lakes Opasaica, Grand Lake, Victoria, Barriere, Kakabonga, etc., which would give an additional 5,000 square mile-feet of storage. Although, measuring across country from the head of Lake Timiskaming, the Ottawa

and Gatineau are over 200 miles apart, they take their rise within a mile or so of each other about 150 miles north of Ottawa city, and at Kakabonge Lake they are so close together than an arrangement can be made there to divert a considerable part of their contents towards Hudson Bay in case of need.

Fig. 4.—General View Timiskaming Storage Dam, Ontario Channel, Looking West.

"Investigation shows," says Mr. Coutlee's report, "that several lakes can be economically converted into reservoirs by dams at the outlets. The flood water, then, instead of rushing to waste, would be pent up in these reservoirs, and gradually let out later in the season. These reservoirs will exert a three-fold effect upon the discharge of the drainage basin, as follows: 1, Improve the potability of the water; 2, increase the depth for navigation; 3, steady the flow for power production."

While in the foregoing summary of advantages to be derived from the proposed storage system probably the most important is the beneficial effect upon the quality of the water, it was evidently not the intention of the engineers in charge to intimate that regulation of the flow would convert the Ottawa River into a safe and dependable source of water supply for the various towns and cities situated along its banks.

The St. Lawrence is a vastly larger stream than the Ottawa, with immense settling basins, and flowing over a limestone bed which tends to clarify its water. Yet, it is well to mention in this connection that Toronto is obliged to filter the St. Lawrence water, although taken outside the Island.

The supply of the Ottawa is too large to heat, but not large enough to prevent contamination. The increased and uniform flow to be secured by the construction of the conservation works, now well under way on the Upper Ottawa, will bring about the only improvement in the water supply that can be counted upon for some time to come.

The Main Object of the Work.—It was chiefly with a view to improving the navigation and steadying the flow for power production that the conservation works were originally planned. While only the source of supply and storage which are available from Lake Timiskaming upward are yet being dealt with, it is the intention of the government to have surveys made of the drainage areas of all the tributaries of the main river, so that eventually their entire capacity may be rendered available for purposes of power generation and transportation. The magnitude of these latent resources may be grasped when it is considered that the Ottawa basin is 56,000 square miles in area, and contains the grandest aggregation of lakes and streams of any similar area in the known world. Ten thousand square miles of this lies south of the river and is drained by the Petawawa, Bonnechere, Madawaska, Mississippi, Rideau and South Nation Rivers. Five thousand square miles drain into the main stream through small tributaries. Forty thousand square miles lie north of the river. The Dumoine, Black, Coulonge, Gatineau, Lievre and Rouge Rivers drain 20,000 square miles, which includes the drainage area above Mattawa, forms the upper basin.

The scheme is, briefly, to dress the river up in convenient reaches by large rock-fill dams provided with sluice openings to pass the flow from basin to basin, locks being provided at each dam. It would be possible to build the dams required at any point as soon as the reservoirs are completed, and offer, in advance of a navigation

Fig. 5.—Timiskaming Storage Dam, Showing Method of Drilling Boulders Under Water; Dynamite is Loaded into the Drill Hole Through a Gas Pipe, and Exploded by Electric Battery.

project, sites for power development with a guaranteed steadiness of flow, and a constant head without ice difficulties. The river being thus arranged by dams, power can be developed on a general scheme, which could be enlarged to utilize the whole flow at each point in years to come, when transmission may convey to unheard-of distances, and when large blocks of power will be required for heating, for nitrogen fixation from the atmospheric air (now an engineering commercial enterprise except for the expense), for smelting, and for electro-chemical processes.

THE THIRD INTERNATIONAL ROAD CONGRESS, LONDON, 1913.*

By Arthur H. Blanchard, M. Am. Soc. C.E., Professor of Highway Engineering in Columbia University, and Consulting Highway Engineer, New York City.

"STOP, Look and Listen," the characteristic sign which attracts the attention of the traveller at crossings of highways and railways throughout the United States, contains advice of inestimable value to those interested in the development of highways. As a pertinent citation of its application, the work of the third International Road Congress is worthy of careful study in order that the mass of information collated through the medium of reports, discussions, conclusions and exhibitions may be drawn upon to furnish ideas which may be used in the development of highway engineering in this country.

To-day, the world appreciates the admirable work instituted by the French Government in 1908, through the medium of its famous Department of Roads and Bridges in calling to Paris highway engineers and officials from all over the globe for the purpose of mutual exchange of opinions pertaining to the administration, construction, and maintenance of highways. At this convention the First International Road Congress, steps were taken to form the Permanent International Association of Road Congresses.

The Association includes in its membership national governments, state governments, municipalities, associations and societies, companies manufacturing materials and machinery, and individual members. According to the 1913 report of the Executive Committee of the Association, the membership on May 31st included 32 national governments, 256 corporate bodies and 944 private members. The dues of these members for the year ending May 31st, 1913, were $21,520, of which $14,980 was subscribed by national governments.

Of particular interest to the citizens of the United States are the regulations relative to the affiliation of national governments. The pertinent portions of the regulations pertaining to the two controlling bodies of the Association, the Permanent International Commission and the Permanent Council, are as follows:—

"The Permanent International Commission is composed of members belonging to the various countries represented in the Association. Each country has the right to one representative for each $200 of its total annual subsidy. Provided, however, that the number of representatives from any one country shall not exceed fifteen, and that any country which pays not less than $50 shall have the right to appoint one delegate.

"The Permanent Council is composed of representatives chosen from among the members of the Permanent Commission: one for each country whose annual subsidy does not exceed $100; two for each country whose annual subsidy exceeds this amount, and is less than $2,000; three for each country whose annual subsidy exceeds $2,000."

It is unfortunate that our national government stands alone among the great governments of the world in not having affiliated with the Permanent International Association. Our neighbors, Cuba and Mexico, are among those who have led us in officially expressing the interest of their national governments in the improvement of highways.

Since 1908 the subject of affiliation has been under consideration in the United States, and since the Second International Road Congress, held in Brussels in 1910, an active campaign has been waged to secure the adherence of the United States. In order that the United States may take its proper and dignified place in the world-progressive movement conducted under the Association, it appears the duty of every Association interested in good roads to pass resolutions memoralizing the Congress of the United States to take the necessary steps to become a member of the Permanent International Association of Road Congresses.

During the sessions of the Third International Road Congress held in London in June, 1913, it was decided to accept the invitation extended by the German Government to hold the 1916 Congress in Munich. Since the Brussels Congress there has been a tacit understanding that the Fifth International Congress should be held in the United States in 1919. It is, of course, obvious that unless the United States becomes a member prior to 1916, it will be practically impossible to carry out this very desirable programme, desirable not only from the standpoint of the citizens of the United States, but also from the standpoint of highway engineers and officials in all the countries of the world.

A brief outline of the scheme upon which is founded the work of an International Road Congress will give some idea of the large amount of available information relative to every phase of highway engineering which is disseminated among highway engineers and officials throughout every land. The Permanent International Commission, about two years in advance of a Congress meeting, decides upon a series of topics which it considers of vital importance, and upon which a large amount of investigative work is in progress. Another series of topics is selected pertaining to subjects upon which thought has not crystallized as definitely as in the case of the first set of subjects, but information in regard to which will serve as the basis for future concentrated and co-operative work. The first set of topics is defined as Questions, the second set as Communications. The Executive Committee of the Association then notifies the national representatives in various countries of the list of Questions and Communications, and requests that in each country a reporter, or a group of reporters, be designated to prepare a comprehensive review on each Question and upon each Communication, the viewpoint in each case being national. The reports are delivered to the Executive Committee some six to nine months prior to the meeting of a Congress, are printed in the three official languages of the Association—English, French and German—and distributed before the opening of the Congress to all members of the Association. In the country in which a given Congress is held general

* Paper presented before the Convention of the North Carolina Good Roads Association at Morehead City, N.C., August 1st, 1913.

reporters on each question are appointed to review all reports submitted, to summarize the practice indicated, and to draft a set of conclusions which represent the majority opinion relative to various essential phases of each subject. These general reports are supposed to be distributed prior to the meeting of a Congress. The business sessions of the various sections of a Congress are devoted to a consideration of the conclusions submitted by the general reporters. Naturally, many amendments are proposed before the conclusions are finally adopted by the section particularly interested in a given subject. The conclusions as reported by the various sections are submitted at the final general meeting of a Congress, where they are considered for final adoption. The discussions, conclusions, general work of the Congress, and a description of the excursions, entertainments and the exhibition are published as the Proceedings of the Congress.

At the Third Internation Congress a total of 140 reports was presented by reporters from nineteen national governments, nine Questions and ten Communications composing the programme. Nine general reports by British engineers were prepared relative to the Questions. The meetings of the Third Congress were well attended, the total attendance being between 2,500 and 3,000. The Congress was so conducted that the proceedings of the various sessions, although carried on in the three official languages of the Congress—English, French and German —were interesting and instructive. By having present expert interpreters, those in attendance were made acquainted with the remarks of members from all countries without any material delay in the progress of the meetings.

The exhibition was divided into four divisions: road materials and machinery; traffic; models, maps, drawings and publications; and historical data. The first division comprised 42 exhibits of the principal types of materials and machinery employed in Great Britain and on the Continent.

The practical influence of the Congress on the development of administration and organization of highway departments and the improvement of roads and pavements will depend to a marked degree upon the extent of the adoption of the principles and recommendations contained in the conclusions of the Congress. The conclusions, although expressing in many instances the fundamentals of modern highway engineering practice, nevertheless will repay careful digestion by every American interested in good roads. Unfortunately, American engineers and highway officials have not universally adopted many of the fundamental principles laid down at the International Road Congresses. Among the 83 conclusions adopted at the Third Congress, which are of especial interest to those having charge of highway work in the United States and Canada, are the following:—

First Question—Planning of New Streets and Roads.

"As a general principle, it is better that new main roads be constructed to pass outside rather than through towns, and that, where an existing main road passing through a town is unsatisfactory for through traffic, it is often better in preference to widening an existing narrow main road through the centre of a town, new roads should be planned according to the principles of the science of town planning.

Second Question—Types of Surfacing to be Adopted on Bridges, Viaducts, etc.

"On short bridges in town or country it is desirable that the surfacing should be the same as that on the adjoining streets or roads.

Third Question—Construction of Macadamized Roads bound with Bituminous (including Tarry and Asphaltic) Materials.

"Confirming the conclusions adopted in 1910 by the Second Congress (Brussels, second question), which called attention to the advantages of a dry foundation and a sound subsoil, the Congress especially insists upon the great importance of efficient foundations in the case of road crusts bound with bituminous (including tarry or asphaltic) binders for the following reasons:—

"The road crust being expensive, it is important to give it a base which will increase its life.

"As the weight, speed and intensity of the traffic continually tend to increase on roads considered worthy of such a crust, it is best to provide a foundation which has been so constructed as to secure for the crust the best possible conditions of resistance to wear.

"It is agreed that it is absolutely necessary to carry out repairs, in the case of all bituminous (including tarry and asphaltic) road crusts, immediately the necessity for them arises.

"The complete renewal rendered necessary by wear must be carried out immediately the depth of the road crust is below a given limit of safety, or when its waterproofing qualities have become so poor that the road will unduly suffer from climatic conditions.

"In the mixing method the stone must always be dry, and if necessary it must be heated.

"One must never employ road rollers which are too heavy.

"Sufficient information is now available to enable engineers to select and specify bituminous binders which will have no prejudicial effect upon public health, fish life, or vegetation; but which, on the contrary, will conduce to conditions of considerable hygienic advantage.

Fourth Question—Wood Paving.

"Hard woods give varying results, according to local circumstances, and it does not appear desirable to recommend them for roads with intense traffic in large cities, unless some means are devised to effectively prevent the rapid destruction of the joints and the resulting destructive effect on the concrete below.

Fifth Question—Methods of Lighting.

"Every vehicle, whether standing or moving, should carry or show a light of sufficient power at night which can, except when specially authorized, be seen from the rear as well as from the front of the vehicle.

"Every motor car must carry after nightfall two lighted lamps in front and one at the back; if it is able to move at a high speed it must be fitted in front with a headlight of sufficient illuminating power to light up the road or path for at least 50 yards to the front. In inhabited places, where the ordinary lighting is sufficient to allow motorists to see their way and to be easily seen, the light of the headlights must be limited to that of the ordinary lamp.

"One and the same color should be universally adopted as the color for danger signals.

"It is desirable that each Government should do away as soon as possible with colored lights on automobiles.

Seventh Question—Regulations for Fast and Slow Traffic on Roads.

"That all regulations for the control of road traffic should be based on the principle of allowing the speed practicable for each different kind of vehicle consistent with public safety, general convenience, and the normal wear of the road.

Eighth Question—Authorities in Charge of the Construction and Maintenance of Roads—Functions of Central Authorities and Local Authorities.

"A principle that can be laid down as of universal application is, that the unit of highway administration shall be sufficiently large and command sufficient resources to employ and adequately remunerate a competent staff.

Ninth Question—Finance of the Construction and Upkeep of Roads—Provision of Revenues.

"The expenditure on the maintenance and improvement of roads which are used mainly by long-distance traffic, unless such expenditure is borne wholly out of the national revenues under a system of State administration of roads (which system is practicable and suitable in the case of some roads in some countries) should be mainly paid for out of national revenues, whether or not such roads are locally administered and maintained, subject, where local administration prevails, to the supervision of a central government authority, both as to efficiency and expenditure.

"It is desirable to abolish, so far as possible, all tolls on public roads, but it is equitable that vehicles which, on account of their weight or weight combined with speed, or any other exceptional circumstances connected with either the vehicle or use of the road, cause special damage to roads beyond the wear and tear of the ordinary traffic of any district, should be subject to special taxation the proceeds of which should be earmarked for expenditure on roads.

"Borrowing money for new road construction and for the periodic renewal of the surface coating of a road is consistent with sound financial principles provided that the loan period in the case of loans for renewals, is kept well within the life of the surface coating."

Even a brief summary of the work of the Third International Road Congress should not be closed without reference to the hospitality and elaborate series of entertainments and excursions provided by our British cousins and the officials of the Permanent International Association of Road Congresses.

A new generating station will be opened shortly at West Hartlepool, England, which claims to be the first municipal authority to produce electricity by means of waste heat, says a Consular report. The two turbo-generators, each of 1,500 kw., will be driven by exhaust steam from the furnace-blowing engines of the Seaton Carew Iron Co., adjacent to whose works the station is built. In return for their exhaust steam, which has hitherto been blowing to waste in the air, the Seaton Carew Iron Co. will receive current free from the corporation. Expenditure on coal will practically be eliminated. The coal bill for the present electricity station is about $20,000 a year, and, as it is anticipated that the consumption of current will largely increase under the cheaper rate now possible, the ultimate saving by the use of waste heat will be very considerable. Should the supply of exhaust steam not be available, either through a breakdown of the blowing engines or through the iron works being idle, a supply of high-pressure steam will be obtainable from the Seaton Carew Iron Co. The total expenditure involved in connection with the new scheme is $188,500, the plant alone having cost $150,000. The old generating station will be maintained as a stand-by and as a town substation. There the current from the new station will be transformed to the voltage required for distribution to the town.

SPECIFICATIONS FOR FUEL FOR HEAVY-OIL ENGINES.

THE United States Bureau of Mines has carried on a careful investigation to ascertain some means of more effectively burning heavy asphaltum oils as fuels for steam raising and for internal-combustion engines. The result of the extended search appears in pamphlet form as a bulletin recently issued, and entitled "Heavy-Oil as Fuel for Internal-Combustion Engines," by Irving C. Allen. From this investigation the consensus of opinion seems to be that an oil, to be burned with success in these engines, should possess the following characteristics:—

Solidifying Point.—The oil should be mobile at 0° C. If it be heavy or viscous or contain a considerable proportion of asphaltum or paraffin, it will become sluggish and stiff at low temperatures, and considerable heat will have to be used to warm it before it can be run into the engine.

Fluidity.—Sluggish oils should first be heated before being introduced into the engine. If it be necessary to use very heavy oils, the engine should first be warmed by running on a more fluid fuel and the heavy oil introduced only after the engine is hot and running well. This process should be reversed when shutting down, and the heavy oils should be washed out of the engine valves and pipes with a lighter oil, the engine being run a short time on one of these lighter oils before it is allowed to become cold.

Tar Content.—An oil should contain not more than 0.4 per cent. of material insoluble in xylene, as a larger proportion of insoluble material will tend to form coke in the cylinders. (Ten grams of the sample mixed with 10 cubic centimeters of xylene shaken and filtered should show not more than 0.04 gram increase on the filter.)

Coke Residue.—The residue on coking should be not greater than 3 per cent. A high content of asphaltum or free-carbon will give considerable trouble by coking in the cylinders.

Free-Carbon Content.—There should be not more than a trace of free carbon in the oil, as free carbon tends to clog the valves and to deposit on the surfaces of the cylinders.

Volatility.—At least 80 per cent. of the oil should distil over at 350° C., for oil leaving more than 20 per cent. residue at this temperature will show a large carbon content by coking.

Distillation.—Heavy oils and residues, though they may be successfully burned in a heavy-oil engine, should properly be distilled (not refined) before using, as it is cheaper to prepare the oil before introducing into the engine than it is to dismantle the engine, or a part of it, for cleaning.

Flash Point.—The flash point should be between 60 and 100° C. (closed tester). A small proportion of oil of a low flash point is required to insure ignition.

Ignition Oil.—In general a heavy oil containing no material having a low flash point should be enlivened by the addition of about 2 per cent. of a "gas oil," flash point 60 to 100° C. or less, before being fed into the cylinders.

Specific Gravity.—The specific gravity in itself, although of little significance, should be not greater than 0.920, because when greater the large proportion of heavy

residual material would give trouble in the engine. In general the boiling point or distilling proportion is of more importance.

Calorific Value.—The heating value should be not less than 9,000 calories, and the hydrogen content not less than 10 per cent., as lower values are approaching the value of pure carbon and will give poor combustion.

Sulphur Content.—The sulphur content should be not more than 0.75 per cent., as a greater proportion may attack the cylinder walls and will tend to pit them, making them rough. Brass, zinc, and copper are to be avoided in the surfaces exposed to combustion. Nickel steel seems to be the most resistant material.

Acid and Alkaline Content.—The oil should contain no free ammonia, alkalis, or mineral acids, because of their pitting effect on the surfaces exposed to combustion.

Ash Content.—The oil should contain not more than 0.05 per cent. of non-combustible mineral matter, because such matter tends to hasten carbonization within the cylinders and to prevent proper combustion.

Water Content.—The water content should be not greater than 1 per cent. One per cent. of water reduces the calorific value by 1 per cent. Moreover, to raise the temperature of 1 gram of water from room temperature, say 30°, to 100° C. requires 70 calories, and to evaporate 1 gram of water at 100° C. into steam at 100° C. requires 536 calories. Hence 1 gram of water causes a total reduction of 536 + 70, or 606 calories, and to raise the temperature of the steam to that of the cylinder requires still more heat. The absorption of heat in raising the temperature of the steam is partly compensated by the action of the steam in expanding and performing work on the piston, there being an abundance of heat in the cylinders. In short, 1 per cent. of water in the fuel itself will cause a loss of approximately 1.06 per cent. in the calorific value of the fuel. It must also be remembered that a drop of water suddenly generated into steam within the fuel spray at the instant of ignition may lower its temperature and thereby prevent ignition, and a number of such drops in succession might stop the engine.

Resin Content.—The resin content should be low, as resins have a tendency to carbonize readily and will tend to coke in the cylinders.

Creosote Content.—Oils containing creosotes up to 12 per cent., though causing smoke to some extent, can be burned; a higher percentage of creosote gives trouble by coking.

Paraffin Content.—A paraffin content of 15 per cent. will give some trouble. An oil containing a still higher percentage of paraffin, because of the large quantity of oxygen necessary for complete combustion, will burn with more difficulty.

Asphaltum Content.—The heavy-oil engine, at least so far as the use of asphaltum oils is concerned, is still in its experimental stage, but the assumption can fairly be made that when the mechanical difficulties are surmounted it will be practicable to burn any fuel oil containing asphaltum that is sufficiently fluid to flow, providing the oil be free from solid matter and water. An oil containing 21 per cent. asphaltum has been successfully burned.

Atomization.—Fine atomization is essential, for if the fuel enters the cylinder in drops of appreciable size, which can burn only from their surfaces, it will not have time for complete combustion. The fuel will consequently strike the sides of the cylinders and the piston head and there carbonize.

COAST TO COAST.

Ottawa, Ont.—The report of the Conservation Commission on the Long Sault power development scheme will shortly be ready for submission to the Government. It will declare emphatically against such an undertaking being turned over to any company, and that if the power is harnessed it should be done by the Government. The engineers have found the scheme quite feasible from their standpoint, but there would be danger to navigation as well as risk of flooding adjacent territory. The immense value of the power as a natural resource will be emphasized, together with a declaration that its export from the country should not be permitted. The report is now being revised by Hon. Clifford Sifton, chairman of the Commission.

Ottawa, Ont.—If Canada becomes a base of supply for oil fuel for the British Admiralty in furtherance of its scheme for operating warships by that method, the sands of the Athabaska River will be the principal source, is the opinion of Mr. James Whyte, deputy head of the Conservation Commission. "If the tar sands of the Athabaska mean anything," said Mr. Whyte recently, "it is that below them are quantities of petroleum. On three occasions wells have been sunk, but this was always done on a wrong principle. The boring was not of sufficient size. It is wholly probable that if the examinations were made under proper conditions the supply would be forthcoming in paying quantities. We are endeavoring to interest capitalists in the proper development of these deposits. The oil in the eastern wells is too valuable as an illuminant to be used for fuel."

Montreal, Que.—After careful consideration, the Harbor Commissioners have decided that the projected extensions to the Alexandra, King Edward and Jacques Cartier piers cannot be commenced this season. When the programme of works for this year was given out, it was announced that the Commissioners were desirous of extending each of these piers, but that they would await certain alterations which the Dominion Government intended to make at the entrance of the Lachine Canal before putting the work in hand. After the collision between the lake steamer "Calgary" and the "Levenpool," while the latter was lying at her berth at Shed 15, the Harbor Board reconsidered the question, as the danger to navigation in the harbor of the sterns of ships projecting beyond the piers at which they were berthed was obvious. Finally, the decision has been arrived at that the work cannot be undertaken, pending the alterations referred to above, as the congestion of traffic that would inevitably result would be too great.

Victoria, B.C.—Dr. G. A. B. Hall, medical health officer, and Mr. Birch, the city analyst, discussing Dr. Newnham-Davis, advocacy of the oxychloride process of treating sewerage, remarked that the use of salt water by its electric decomposition had been tried in the East with success. The isolation of chlorine by electrolysis results in the typical disagreeable odor, which would have to be cared for by rendering the gas soluble in water and using it over again. As a disinfectant the results in hospitals and surgeries are well known, and there is no reason why it should not succeed in sewerage treatment. At the present time in the north-west sewer scheme experiments are being made to determine the course of currents so as to ascertain whether the tide would bring back sewerage from McLoughlin Point to the Inner Harbor. If it is necessary to treat the sewerage, as is done in the oxychlorine process, two tanks would be necessary, and it is the intention of the health department to secure some more information on the subject.

Hull, Que.—At a special meeting of the Hull city council, held recently, a motion was passed approving of the Federal

Government project for the embellishment of Hull and Ottawa, and expressing the willingness of the city to pay their share towards paying for the cost of the preparation of the plans, as contained in the report of the special committee appointed by the city council, which interviewed Hon. George Perley. Mayor Dupuis had no written report of the work accomplished by the committee, but submitted a verbal one. He stated that he with Alderman Doucet and Alderman Thibault interviewed Hon. George Perley, and were advised that plans of the Federal Government's project had been prepared and would be submitted to the cities of Ottawa and Hull, who would be asked to pay half the cost of their preparation pro rata according to the population That the said plans might cost in the neighborhood of $50,000, of which sum the Government would pay half, Ottawa would pay $20,000 and Hull $5,000

Vancouver, B.C.—"The engineers of the Provincial Forestry Department who are to cruise the timber in the watersheds of the various creeks on the north shore of Burrard Inlet, will commence their work immediately," stated Alderman Black, chairman of the waterworks committee of the city council. Asked when he expected the reports of the two parties would be available to the waterworks committee, Alderman Black said that he thought it would take the engineers and cruisers about two months to complete their work and prepare their reports. It is expected that when all the information and data that the reports will contain are received and digested the scheme of Alderman Black's for the conservation of the waters of the streams from which Vancouver derives its water supply will be proceeded with. This scheme, which has already been made public, involves the purchasing by the city of timber limits in the watershed of Seymour Creek for a number of miles from the present intake towards its source and the construction of a dam which will create a reservoir lake with sufficient water to meet all demands made upon the source of supply for future years during the dry season.

Ottawa, Ont.—Simultaneous with the appointment of the three highway commissioners by the Ontario Government come various opinions and recommendations regarding the good roads movement throughout the province. In the hope of getting suggestions which might be passed on to the new commissioners, the secretary of Ontario good roads has communicated with the reeves of various townships scattered about the province, and the result is a decided tendency to ask more money from the government. The most common recommendation is that the government pay one-half the cost of good roads construction, instead of one-third, as provided under the Highways Act.

A second common demand is that motorists be compelled to pay more towards the roads they help to destroy. Complaints are made that motors wear roads out faster than the townships can afford to keep them repaired, and that it is the motor and not the horse vehicle, which does the bulk of the damage. This seems to be particularly the case in townships lying close to the larger cities. Force motors to pay a high tax, proportionate to weight of the car, is the suggestion.

From one county comes the recommendation that the roads leading from large centers of population, bear the full cost, and hold this out as an incentive to the more remote districts. Some districts are not inclined to favor the movement entirely, stating that more progress will have to be made at less cost, or the system will rapidly become unpopular among the people who are now paying the bills. The government, however, might absorb a good share of that cost.

The suggestion of a frontage tax comes from another country. It is a recognized thing that improved roads increase the value of adjoining farms and the recommendation is that these farmers help pay for the roads in larger percentage than those whose farms are benefitted less.

Quebec, Que.—The Quebec Board of Trade has forwarded a memorial to the Minister of Public Works advocating the establishment of a modern steel shipbuilding plant at Levis in connection with the new drydock that is to be built by Messrs. M. P. and J. T. Davis. The memorial points out that in order to ensure the proper working of the dock it will be necessary to maintain a staff of competent shipbuilders and ship repairers and that these men must have constant work.

Winnipeg, Man.—Practical assurance has been given to the Winnipeg and St. Boniface Harbor Commission that the Dominion Parliament will appropriate the sum of $100,000 in the next estimates to be brought down for the purpose of improving the harbor facilities on the Red River. Assurances to this effect have been given to the commissioners by Hon. Robert Rogers, Minister of Public Works in the Dominion Government, who has taken a deep interest in the work of the Commission ever since it was formed.

Ottawa, Ont.—Plans are well advanced, and tenders will be called for shortly for the new interior terminal elevators to be erected by the Government at Moose Jaw and Saskatoon. The designs are being made by the Barnet-McQueen Company, under direction of the Grain Commission. The works will go on this autumn, but final steps to build similar elevators in Alberta have not yet been taken. The interior elevators are designed to facilitate the farmers in marketing their wheat and getting their cash, and their establishment has long been urged by the grain grower societies. The Grain Commission intends to add a chemist to its staff for examination and analysis of wheat.

Vancouver, B.C.—Either water consumers of the city must show a less wasteful disposition in the use of water, or the Water Commissioner will be forced to resort to the Elk Lake supply to augment the supply being received from the Esquimalt Waterworks Company's system. With the advent of hot weather the demand for water has jumped by leaps and bounds, until now the supply being daily taken from the mains of the private company is 4,750,000 gallons, and the limit which the city can take under its agreement, and which can be delivered through the temporary main at the pressure given by the company is 5,000,000 gallons. The great superiority of the Goldstream supply, both as to temperature, taste and quality, induced the Water Commissioner to shut down the Elk Lake supply altogther, with a view of improving that source of supply while the water there is at its lowest point. But of late the demand has shown such an increase that this policy had to be discontinued. Water Commissioner Rust stated recently that Elk Lake water at this time of year, from its odor and color, is not desirable, and his idea had been to cut it off altogether, as he did not desire to mix the supply from the two sources. But the useless waste of water during the night has made it imperative to turn Elk Lake water into the main supplying the northwestern section, and in consequence many complaints have been received from that section. He believes that, with the assistance of the consumers, the great waste can be obviated. The 5,000,000 gallon supply, he states, should be more than ample to meet all legitimate demands, but with hundreds of thousands of gallons going to waste every night, the problem of keeping up the supply is a dicult one, especially in the warm weather. If the consumers will assist, the supply will be ample during the day, and the reservoir steadily increased during the night.

Victoria, B.C.—To approve a satisfactory system of dividing the cost of construction and maintenance of the new Johnson Street bridge the city council sat in special session recently. The two draft agreements between the city

and the Esquimalt and Nanaimo Railway on one hand, and the city and the British Columbia Electric Railway on the other were the subjects of discussion, and several changes were suggested to protect the city's interests. For the first time it developed from a remark that the share of the provincial government will be $150,000. This will be given as a lump sum to aid construction, and will involve no obligation to contribute anything towards maintenance, as the government does not regard itself as bound in any sense to assist in the future payments for the bridge. The British Columbia Electric Company's share is to be $50,000. The share of the Canadian Pacific is to be such a sum as would put a new bridge on the present site, which, the engineer said had been set at $80,000. The balance, some $120,000, is to be found by the city. Maintenance is to be met jointly by the three last-named parties to the scheme.

PERSONAL.

CHARLES A. MAGRATH, W. A. McLEAN and A. M. RANKIN have been appointed by the Ontario Government as a commission on Ontario roads.

WM. STORRIE, A.M.I.C.E., until recently waterworks engineeer for the city of Ottawa, has joined the staff of the John M. Ver Mehr Machinery Company, the builders of the Ransome municipal filters.

W. A. CASEY has been appointed municipal engineer at Esquimalt, B.C. Mr. Casey was previously a member of C. H. Topp's staff, Mr. Topp carrying on a consulting engineering practice in Esquimalt.

GEORGE A. JOHNSON, of Johnson & Fuller, consulting engineers and sanitary experts, of New York city, was a visitor at the offices of *The Canadian Engineer* while passing through Toronto last week.

SIR ALEXANDER H. BINNIE, of London, Eng., has been obliged to relinquish his appointment with the city of Ottawa to report on water supply, owing to ill-health. Messrs. William Binnie and R. S. Tickell have been appointed to do the work.

E. P. A. PHILLIPS, B.A.Sc., O.L.S., has been appointed corporation surveyor for the city of Port Arthur. Mr. Phillips is a graduate in civil engineering of the University of Toronto, and has for some time been engaged in surveying with the firm of J. G. Mackay, of Hamilton, previous to which he was a member of the firm of Pierce & Phillips, Porcupine, Ont.

J. B. CHALLIS, B.A.Sc., superintendent of the Dominion water powers branch, and S. J. ROBINS, assistant private secretary to the Minister of the Interior, have left for the coast for the purpose of consulting with the British Columbia Government with regard to water powers in the railway belt there.

M. J. PATON, M.A., has resigned his position as assistant secretary and editor for the Conservation Commission to accept the position of treasurer of the Publishers' Association of Canada, with head offices in Toronto. He is an honor graduate of Queen's University, having obtained his M.A. in 1909 and winning the gold medal in economic science.

LAWFORD GRANT, who recently resigned the managing-directorship of the Canadian British Insulated Company, Limited, Montreal, will assume his new position with the Eugene Phillips Electrical Works, Montreal, in about a week. Mr. Grant retains the presidency of the Canadian British Insulated Company. He is succeeded in the managing-directorship by his brother, A. E. Grant, formerly manager of the Cardiff office of British Insulated and Helsby Cables, Limited.

OBITUARY.

DAVID BURNS, lecturer on higher mathematics and structural drawing at the Carnegie Institute of Technology, Pittsburg, died at his home in that city on July 27th. Deceased was born and educated in Toronto, being one of the early graduates of the School of Practical Science, receiving the degrees of civil engineer and Ontario and Dominion land surveyor. He had considerable railway and bridge construction experience, holding positions with the Pennsylvania Railroad, the Keystone Bridge Works and the American Bridge Company. He has been connected with the Carnegie Institute since 1904.

COMING MEETINGS.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelfth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ONTARIO MUNICIPAL ASSOCIATION.—Annual Meeting to be held in Toronto, August 28th and 29th. Secretary-treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Annual Meeting in Regina, September 16th, 17th and 18th. General Secretary, Major Drum, Ottawa; Local Secretary, Dr. Murray, Regina.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington,

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, Lo21 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

AMERICAN CONCRETE INSTITUTE.—First Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

Concrete work in the Panama Canal locks is nearly completed, the aggregate amount in place at the close of work on June 21st, being 4,471,463 cubic yards.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for smal fee.

19798—July 16—Authorizing Government of Saskatchewan to construct Third Street East across C.N.R., at Service Townsite, in S.W. ¼ Sec. 26-8-1, W. 2 M., Sask.

19799—July 11—Approving British America Express Co.'s Standard Tariff, C.R.C. No. 12, filed in compliance with General Order No. 104.

19800—July 17—Amending Order No. 16998, dated July 13, 1912, to provide that Charlemagne St., Maisonneuve, be left open; and that application with respect to streets to the east be refused.

19801—July 17—Authorizing C.N.O.R. to construct across public road between Lots 13 and 14, Con. 1, Tp. Pembroke, by means of a structure carrying railway over highway: Provided a proper road be left for John A. Gourlay, owner of part of Lot 14, Con. 1, between road shown on plan, being at right angles to road to be crossed, and Muskrat River.

19802—July 17—Approving revised location C.N.O.R., through unsurveyed territory, Dist. Algoma, Ont., mileages 198.26 to 201.66.

19803—July 17—Authorizing Mun. Tp. South Hull, Que., at its own expense, to construct crossing over C.P.R., mileage 9.7, from Aylmer, on Waltham Subdivision, of said railway, where it intersects road now being built to join present Eardly Road.

19804—July 17—Authorizing C.P.R. to construct, by means of grade crossings, additional track across fifteen (15) highways, mileages 1.00 to 15.38, Moose Jaw Subdivisioo, Saskatchewan Division, Sask., mileage o being at Broadview.

19805—July 17—Approving revised location C.P.R. main line, as constructed, from mileage 74.46, a point in Sec. 20-28-25, W. 5 M., thence to a point in Sec. 34-26-26, W. 5 M., mileage 88.56, Mountain Subdivision, B.C.

19806—July 11—Authorizing G.T.P. Ry. to construct spur across C.N.R. between Edmonton Portland Cement Co.'s spur and Can. Nor. Alta. Ry. in N.E. ¼ Sec. 6-53-19, W. 5 M., Dist. North Alta., Alta.: Crossing be protected by a diamond inserted in track of C.N.R., and by watchmen; such crossing to be temporary until such time as C.N.R. commence to operate its line at point in question, when this Order shall be rescinded. Cost of inserting and maintaining diamond and cost of watchmen at said crossing to be borne and paid by G.T.P. Ry.

19807—July 17—Authorizing G.T.P. Ry. to construct spur for the Edmonton-Portland Cement Co., Limited, in Sec. 1-53-19, W. 5 M., Alta.; spur to be completed within three months from date of Order.

19808—July 15—Approving G.T.R. plan showing proposed automatic block installation on Victoria Jubilee Bridge, Montreal, carrying automatic block district from east end of Point St. Charles across bridge to St. Lambert and connecting it with the interlocking plant at St. Lambert Junction.

19809—July 17—Authorizing C.P.R. to construct spur for Messrs. Watson and Todd, Limited, Ottawa, Ontario.

19810—July 18—Extending until September 15th, 1913, time within which G.T.P. Ry. install interlocking plant at crossing of C.N.R. by G.T.P. stock yards spur, St. Boniface, Man., as required by Order No. 16930, dated June 29th, 1912.

19811—July 18—Extending until September 15th, 1913, time within which interlocking plant be installed at crossing of Fort William and Port Arthur St. Railway, by G.T.P. Ry. Lake Superior Branch at Syndicate Avenue, Fort William, Ontario, as required by Order No. 17657, dated September 24th, 1912.

19812—July 18—Authorizing C.P.R. to reconstruct bridge No. 18.1, near Inglewood Station, Tp. Chinguacousy, Ont., Div. Orangeville Subdivision.

19813—July 17—Authorizing C.N.R. to extend existing spur for Twin City Coal Company, Limited, across Sixth Street East, Edmonton, Alta.

19814—July 17—Approving location C.P.R. Port Moody and North Shore Branch, from a point at end of Port Moody Branch, Station 182.70, to ferry dock, east side of North Arm; and from Roche Point, where car ferry is shown on plan, to Hendrie Avenue, Province of British Columbia.

19815—July 17—Authorizing city of Regina, Sask., to construct its Municipal Street Railway, across Arcola Branch of C.P.R., and the Commercial Spur of said company, where said tracks cross Winnipeg Street, between Ninth and Tenth Avenues, at rail level, city of Regina, subject to and upon certain conditions.

19816—July 18—Authorizing Hamilton Street Railway to construct across spur belonging to Oliver Chilled Plow Works of Canada, Limited, (operated by G.T.R. and T.H. & B. Railway Companies) on Gilkison St., opposite McKinstry Street, city of Hamilton, Ont., subject to and upon certain conditions.

19817—July 17—Approving location G.T.P. Branch Lines Company's stations, namely:—Erith, 23-51-19, W. 5 M., mileage 10.7; Weald, 7-51-19, W. 5 M. 16.4; McLetod River, 7-52-18, W. 5 M., M. 5.5; Embarras, 8-50-20, W. 5 M. M. 25.2 and Minchead 10-49-21, W. 5 M. mileage 34.0 Province of Alberta.

19818—July 18—Approving station site and station of G.T.P. Branch Lines Company at Charlton, Bear's Head and The Lean Man Indian Reserves, Nos. 110 and 11, Battleford Branch, Saskatchewan.

19819—July 18—Approving locatioo Algoma Eastern Railway Company, station at town of Little Current, Dist. Manitoulin, Ontario.

19820—July 17—Approving location G.T.P. Ry. stations in Ontario, namely:—Petry, mileage 114, Dist. Thunder Bay; Empire Ave., Lot 8, Con. 2, Neebing Tp. Fort William, mileage 0.7; Kelly, mileage 75.12, Dist. Thunder Bay; Yonde, mileage 170.16, Dist. Kenora and Alcona, mileage 184.8, Dist. Kenora.

19821—July 17—Approving location C.P.R. stations on Weyburn Westerly Branch, Sask., namely:— Verwood, S.E. ¼, 31-6-27, W. 2 M.; Mayroone, L.S. 13, 24-8-7, W. 3 M.; Aneroid, S.E. ¼, 9-9-10, W. 3 M.; Kincaid, N. ½ N.E. ¼, 22-8-8, W. 3 M.; Landscape, N.E. ¼, 13-6-27, W. 2 M. and Hazenmore, S.E. ¼, 34-8-9, W. 3 M.

19822—July 18—Directing G.T.R. to construct at its own expense, a crossing over its railway between Lots 5 and 6, Con. 7, Tp. Fitzroy, mileage 160, near Carp, Ont., easterly line of proposed road over Ry. Co.'s property to be 60 ft. clear of westerly end of culvert.

19823—July 17—Authorizing N. St. C. and T. Ry. subject to terms and conditions contained in resolution of town of Niagara, dated March 19th, 1913, to construct spur along King and John Streets, town of Niagara-on-the-Lake, from points "A" to "B", to connect lines and tracks of said spur with Michigan Central R.R. siding from points "C" to "D" and "E" to "F"; and cross Regent Street said town, spur to be completed within three months from date of this Order.

19824—July 11—Granting leave to city of Medicine Hat, Alta., to construct subway on Esplanade Street, city of Medicine Hat, work to be completed within six months from date of this Order, etc.

19825—July 11—Approving revised location portions of C.P.R. main line as constructed from mileage 18.27, a point on West Boundary, N.W. ¼, Sec. 12-10-22, W. P M., in westerly direction to a point on easterly limit of S.E. ¼, Sec. 30-9-24, W. P M., mileage 35.69 and from M. 115, N.W. ¼, 4-16-2, W. 2 M. to N.W. ¼, 19-16-3, W. 2 M., mileage 124, (zero of mileage being at Brandon, Man.); 2, authorizing construction of additional track across 26 highways, mileage 19.45 to 122.92; 3, divert road in Sec. 27-9-23, W. P M. and 4, after diversion Co. close portion of road allowance between Secs. 22 and 27-9-23, W. P M., within its right of way.

19826—July 18—Authorizing C.P.R. to operate bridge No. 109.7, over Pitt River, Cascade Subdivision, B.C., provided operation of trains over bridge be limited to a speed not exceeding six miles an hour.

19827—July 11—Authorizing C.P.R. to construct road diversion in Sec. 33-14-9, W. 4 M., at Suffield, on Suffield-Blackie Branch, after diversion Co. may close portion of preseot road allowance between Secs. 32 and 33-14-9, W. 4 M within its, right of way.

19828—July 11—Authorizing C.P.R. to construct branch line for S. E. Stewart, Saskatoon, Sask.

19829—July 18—Authorizing C.P.R. to construct proposed double track of main line as already constructed, across Municipal Roads D.G.S. 66 and 67, D.G.S. 86 and 87 and D.G.S. 93, Parish Kildonan, Manitoba.

19830—July 14—Directing that all switching movements on the two sidings (G.T.R.) which parallel the main line, be flagged over crossing of Barrett Street, town of Port Hope, Ontario.

19831—July 14—Amending Order No. 19239, dated May 9th, 1913, by adding words, 'between the hours of 8 a.m. an d8 p.m., and that all movements over the crossing between 8 p.m. and 8 a.m. be flagged over by one of the train crew,' after word 'Flagman,' in second line of operative part of Order.

19832—July 18—Authorizing Department of Public Works, Alta., at its own expense, to construct highway crossings over G.T.P.R. Calgary Branch, in N.E. ¼, Sec. 27-45-21, W. 4 M. and S.E. ¼, 34-45-21, W. 4 M., at Duhamel, Alta., applicant, at own expense and cost, do all grading required for approaches to said crossings and thereafter maintain same; Ry. Co at sole cost of applicant, provide all material, including crossing planks, suitable and proper cattle guards, crossing signboards and turned in fences and all work to conform with Railway Act. All questions as to protection of said crossings is reserved for further consideration.

19833—July 14—Authorizing city of Saskatoon, Sask., to construct highway across C.N.R. at Hilliard Street, Saskatoon.

19834—July 11—Substituting C.N.O.R. plan "A." dated Toronto, June 20th, 1913, showing proposed crossing over Conklin River, for plan approved under Order No. 18598, dated Jan. 29th, 1913.

19835—July 17—Authorizing C.N.R. to construct "Wye" through southeast ¼ sec. 28-55-25, W. 4 M., Alberta; to be completed within three months from date of this Order.

19836—July 18—Directing C.P.R. to install improved type of automatic electric bell at crossing known as "Muler Crossing," about ¾ of a mile west of Kingsbury, P.Q., and thereafter maintain bell at its own expense; 20 per cent. of cost of installing bell to be paid out of the Railway Grade-Crossing Fund, and remainder by railway company.

19837—July 18—Directing (1) that C.P.R. cut down 4 or 5 feet of earth on west side of crossing of river road about three miles east of Kingsbury, between Melbourne and Windsor Mills, on top of the rock, and raise west approach, so that approaching trains may be seen 900 feet away at a distance of 100 feet from the crossing; (2) within 60 days from date of this Order railway company install improved type of automatic electric bell at said crossing, and thereafter maintain bell at its own expense; 20 per cent. of cost of installing bell be paid out of the Railway Grade-Crossing Fund, and remainder by railway company.

19838—July 10—Directing that C.P.R. repair retaining wall, raise it at least one foot higher, and erect standard railing along same; widen road on south shore of St. Francois River, running parallel to C.P.R. (Orford Sub.-Div.) at mileage 55, to width of at least 18 ft. throughout, without disturbing too much of permanent slope of hillside, and put in retaining wall to hold up toe of slope.

(Continued on page 84.)

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Bassano, Alta., sewage disposal works	Aug. 15.	July 17.	86
Cheverie, N.S., construction of wharf	Aug. 14.	July 31.	78
Cobalt, Ont., municipal building	Aug. 15.	July 24.	86
Dorchester, N.B., construction of wharf	Aug. 18.	July 31	78
Kenora, Ont., construction of wharf	Aug. 14.	July 31.	80
Kerrisdale, B.C., incinerator	Aug. 18.	July 24.	80
Little Current, Ont., dredging	Aug. 12.	July 31.	80
New Westminster, B.C., public building	Aug. 12.	July 31.	80
North Vancouver, B.C., drill hall	Aug. 11.	July 31.	80
Ottawa, Ont., cables and induction regulators	Aug. 14.	July 24.	78
Ottawa, Ont., steel steamer	Aug. 28.	July 24.	80
Prince Albert, Sask., drill hall	Aug. 11.	July 31.	80
Rainy River, Ont., dredging	Aug. 12.	July 31.	80
Toronto, Ont., cutting pulpwood	Aug. 15.	July 19.	78
Toronto, Ont., Toronto harbor works	Aug. 25.	July 17.	84
Toronto, Ont., construction of a sewer	Aug. 19.	July 31.	84
Toronto, Ont., breakwater	Aug. 11.	July 31.	86
Vancouver, B.C., wharf	Aug. 21.	July 17.	80
Winnipeg, Man., motor generator	Aug 9.	July 10.	76

RAILWAYS—STEAM AND ELECTRIC

Montreal, Que.—Word comes from London that the $4,000,000 4½ terminal debenture stock of the Canadian Northern Pacific has been fully subscribed before the advertised time of its closing. The scrip was quoted at a quarter premium.

+—Ottawa, Ont.—The Dominion Government has awarded the ROGER-MILLER COMPANY, Toronto, the contract for the Prince Edward Island terminal at Carleton Point, of the Intercolonial Car Ferry. The contract price is $950,000 which is the lowest.

Ottawa, Ont.—Tenders will be received up till the 14th of August, 1913, for supplying 41,000 track ties. Plans and specifications may be obtained from the Department of Railways and Canals. L. K. Jones, Secretary.

Toronto, Ont.—An army of twenty-five thousand men are now at work on the steel which will bind British Columbia and the western provinces with the Atlantic outlets on the east when the Canadian Northern Transcontinental line is completed next spring. Of this number nine thousand are working on the line east of Port Arthur and sixteen thousand on the line in Western Canada. Reports up to the beginning of the month on the construction of the connecting line in Eastern Canada show 117 miles of steel from Port Arthur east, 34 miles west from Oba, 12 miles east from Oba, 82 miles west from Ruel now completed. Work on the portion of the Transcontinental between Yellowhead Pass and Port Mann, B.C., is now more than 80 per cent. accomplished, and unless some of the bridges take longer to build than is anticipated, the whole line to the Pacific coast should see completion this coming winter.

Victoria, B.C.—Although the oil-burning locomotives have been in use on the E. & N. Railroad for a comparatively short period, they already are providing a distinct improvement over the coal burners. While the change has involved a considerable initial expenditure, the chief item of which is in connection with the construction of oil tanks, it is apparent that the innovation effects a saving in several respects, the importance of which will be more strikingly evident at a later date. For one thing, the necessity of patrolling the right-of-way, has, to a large extent, been obviated. Besides the forest fires, which in previous summers have caused serious destruction along the line, have not been experienced thus far. This is directly attributable to the use of oil.

BRIDGES, ROADS AND PAVEMENTS.

+—Bassano, Alta.—The Government has awarded Capt. McKINNERY the contract for the erection of the new bridge across the Bow River.

+—Burlington, Ia.—The DOLARWAY PAVING COMPANY have been awarded the contract for the construction of 7,700 square yards of pavement. The contract price is $1.45 per square yard.

Calgary, Alta.—The City Council have decided to cancel a large number of contracts for sidewalks, on the ground that they were projected out into the suburbs so far that there are no people to use them. It has been decided that in future sidewalks will not be built until they are needed. Approximately $30,000 worth of contracts have been cancelled in Sunnyside subdivision alone. As well, many contracts have been cancelled in other parts of the city.

▲—Cayuga, Ont.—Tenders will be received up till the 16th of September, 1913, for the construction of 26½ miles of stone macadam road. Plans and specifications may be obtained from Messrs. Jackson and Kyd, county engineers, and T. A. Snider, county clerk.

+—Fort George, B.C.—The G.T.P. has awarded the BATES-ROGERS CONSTRUCTION COMPANY, Chicago, the contract for the construction of a bridge across the Fraser here.

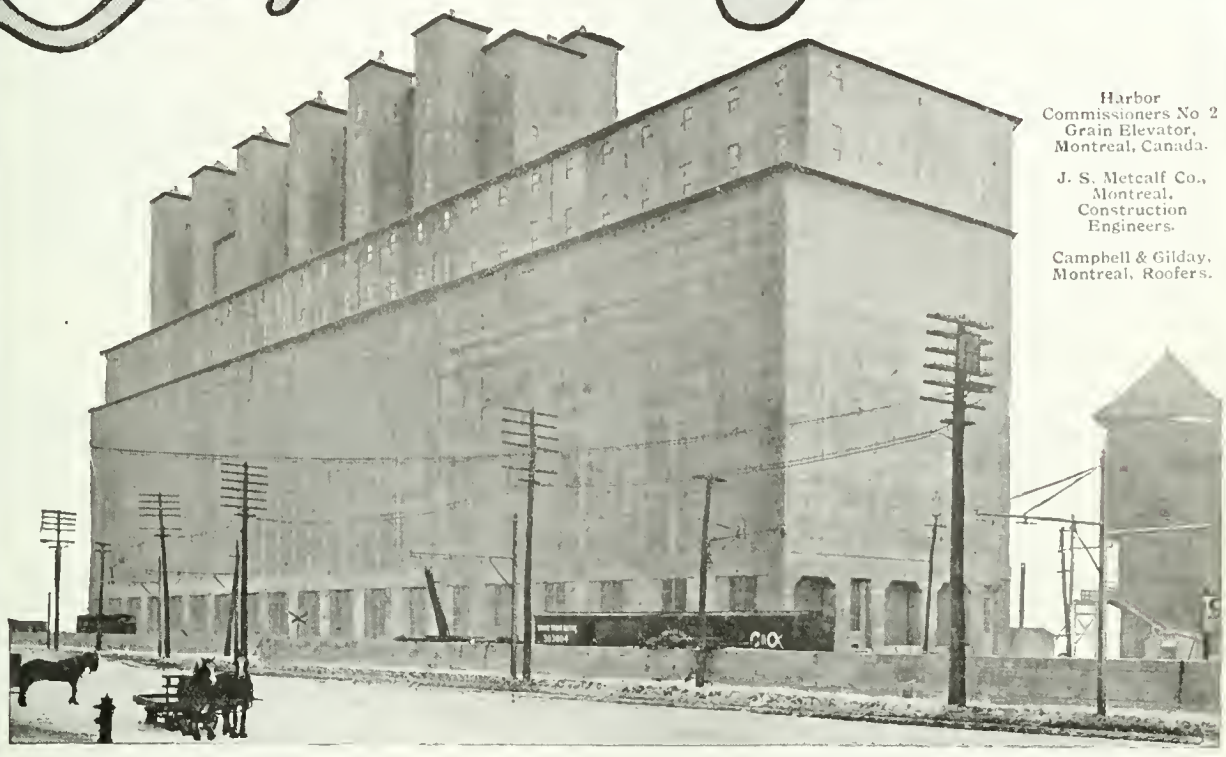
Halifax, N.S.—Tenders will be received up till the 11th of August, 1913, for the erection of bridges and culverts in Inverness County. Plans and specifications may be obtained from the Department of Public Works and Mines, Halifax. E. H. Armstrong, Commissioner.

London, Ont.—The Board of Works has awarded the contract for the abutments and approaches of the West London bridge to Messrs. BAIN & ROSS, of Embro, for the sum of $6,441. Two other tenders were received, one from Freeman Talbot for a solid concrete foundation, instead of reinforced concrete, as the accepted tender demanded, for the sum of $9,900, and from Frank Barber for the sum of $8,845. The superstructure will be tendered for later.

Montreal, Que.—City Engineer Janin in a report to the Board of Control announced that no tenders had been received for the construction of cement sidewalks on nearly one hundred street sections.

+—Natrona, Pa.—The DOLARWAY PAVING COMPANY have been awarded the contract for the construction of 5,900 square yards of pavement. The contract price is $1.38 per square yard.

Barrett Specification Roofs



Harbor Commissioners No 2 Grain Elevator, Montreal, Canada.

J. S. Metcalf Co., Montreal, Construction Engineers.

Campbell & Gilday, Montreal, Roofers.

On the World's Largest Concrete Grain Elevator

As we have frequently pointed out, most of the large commercial buildings of the day are covered with a Barrett Specification type of roof.

For example, here is the great new grain elevator at Montreal. It is said to be the largest in the world, with a capacity of 2,600,000 bushels. It carries a Barrett Specification Roof 55,000 square feet in area.

The engineers chose this type of roof because it is the lowest-priced and most reliable roofing known.

Barrett Specification Roofs require no repairs or attention of any kind, they invariably last twenty years or more, and are fire-retardant.

Architects, engineers and owners of permanent buildings of all kinds should have a copy of the Barrett Specification on file.

A request will bring it by return mail.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification revised August 15th, 1911, using the materials specified and subject to the inspection requirement.

THE PATERSON MANUFACTURING COMPANY, LIMITED

Montreal Toronto Winnipeg Vancouver St. John, N.B. Halifax, N.S. Sydney, N.S.

+—**North Vancouver, B.C.**—The District Council recommended that Messrs. WAUGH, WISNER & BAILEY be given the contract for filling in McCartney Creek. The contract price is $24,320. The next lowest tender was that of Mr. T. R. Nickson for $25,515.

Peterborough, Ont.—City Engineer Parsons will call for tenders for the construction of pavements on several streets, shortly.

+—**Regina, Sask.**—The city council has awarded the CANADIAN WESTRUMITE COMPANY the contract for the construction of 500 square yards of pavement. Their tender was $33 higher than that of the National Pavers, who were recommended by the city engineer, but as the former had all the materials on hand and could go ahead with the work at once the commissioners recommended that the pavement be laid by the Westrumite people. Their tender price for the whole work, including pavement, curb and gutter work, is $1,749.

+—**Rossland, B.C.**—The West Kootenay Power and Light Company has awarded the CANADIAN GENERAL ELECTRIC COMPANY the contract for supplying a 75,00 K.V. water-wheel driven generator. The CANADIAN ALLIS-CHALMERS, LIMITED, will supply the water-wheel. It will have a capacity of 9,000 horse-power at 180 r.p.m. under a head of 70 feet.

+—**Saskatoon, Sask.**—The city has awarded Messrs. McKENZIE & THAYER the contract for supplying 20,000 tons of coal for power production. The contract price is $168,000.

+—**Saskatoon, Sask.**—The Provincial Government has awarded R. J. LECKY AND COMPANY, Regina, the contract for the construction of a new traffic bridge across the river. The contract price is $398,000 which is $98,000 above the amount agreed by the city and the government and in all probability another by-law will have to be submitted to the people to take care of the thirty-three thousand odd which was not reckoned in the amount first submitted to the p
next lowest tender was that of T. J. Robertson, amounting to $604,000 and the third tender showed the largest range of all, being for $837,000 from Parson Bros., also of Regina.

+—**South Vancouver, B.C.**—The Council has awarded the DOMINION CREOSOTING COMPANY the contract for creosoted wood blocks on Main and Fraser Streets. The cost is $750,000.

Toronto, Ont.—Owing to the opposition of a large number of ratepayers, the proposed construction of a three-year temporary pavement on Yonge Street at a cost of $127,000 has been abandoned and the present road will be temporarily repaired at a cost of $30,000 as originally intended at the expense of the ratepayer at large.

+—**Vancouver, B.C.**—The Board of Works have recommended that the following pavement contracts amounting to $220,000 be awarded:—Main Street, Eighteenth to Twenty-fifth Avenues, M. P. COTTON COMPANY, LIMITED, $23,-100; South Cambie Street, from Dufferin to Broadway, COLUMBIA BITULITHIC COMPANY, $29,643; Heather Street, from Broadway to Twelfth Avenue, B. C. GRANITOID COMPANY, LIMITED, $12,061; Heather Street, Twelfth to sixteenth Avenues, COLUMBIA BITULITHIC COMPANY, $14,139; Vernon Street, from Harris to Venables Streets, M. P. COTTON COMPANY, $6,700; Water Street, from Cambie to Carrall Streets, COLUMBIA BITULITHIC COMPANY, $23,500 and Hastings Street from Victoria Drive to Nanaimo Street. Messrs. LEDINGHAM & COOPER, $44,000 and from Nanaimo to Renfrew Streets, Messrs. T. R. NICKSON & COMPANY, $68,500, the two latter on the understanding that the track allowance only would be done this year.

Vancouver, B.C.—The City Council have passed local improvement by-laws in connection with pavements amounting to $1,151,560.

Vancouver, B.C.—The city council have accepted an offer from a London firm for an issue of $2,500,000. This means that one-half of the by-law amount passed in January will be disposed of and many delayed projects will be carried on, chief in importance being the construction of pavements. This work will cost $350,000.

Victoria, B.C.—Tenders will be received up till the 12th of August, 1913, for the construction of bitulithic pavement on a concrete base on the roads of Saanich. Plans and specifications may be obtained from J. R. Carmichael, clerk of the municipal council.

Winnipeg, Man.—Tenders will be received up till the 14th of August, 1913, for the construction of pavement of highway bridge, St. Andrews, Dam. Plans and specifications may be obtained from W. Z. Earle, District Engineer, Winnipeg and the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

LIGHT, HEAT AND POWER.

Fort William, Ont.—Fort William, which claims the distinction of being the largest city on the continent which has not gas for domestic purposes, is going to offset one of its greatest disadvantages to householders by reducing the cost of electricity for cooking and heating purposes, if the City Council hearkens to the appeals of the Board of Trade and the utilities committee of the Council. At its next meeting the Council will consider a resolution from the utilites committee, advising that the present rate for electricity be cut from 3 cents to 1½ cents a kilowatt hour, where it is used for cooking. Under a long-term agreement the city purchases from the company all the electricity that is used for lighting and domestic purposes, and retails it to the consumer.

Montreal, Que.—Tenders will be received up till the 15th of August, 1913, for the construction of a system of underground conduits, main and service manholes, transformer chambers, etc. Plans and specifications may be obtained from the Board of City Commissioners. L. N. Senecal, Secretary.

▲—**Peterborough, Ont.**—Tenders will be received up till the 20th of August, 1913, for the construction of bitulithic and asphalt concrete pavements. Plans and specifications may be obtained from R. H. Parsons, City Engineer.

▲—**Peterborough, Ont.**—Tenders will be received up till the 20th of August, 1913, for the construction of a reinforced concrete arch bridge. Plans and specifications may be obtained from R. H. Parsons, City Engineer.

Prince Albert, Sask.—At a special session of the city council this afternoon it was resolved to suspend operations on the La Colle Falls dam, owing to the available funds for the purpose being expended. Excavation for the spillway and tailrace will be continued. Other city work will be continued and no reductions in the city staff is contemplated.

+—**Toronto, Ont.**—The city has awarded ED. BENNIS & COMPANY, LIMITED, Little Hulton, Bolton, through G. H. Tod, Toronto, the Canadian representative of the firm, the contract for supplying 3 chain grate stokers.

Toronto, Ont.—The Hydro-Electric Commission have decided to enlarge the power station at Niagara Falls and to double the line between Dundas and the Falls. This will give the Commission the equipment to double the lines between London and Dundas. The towers are already built and the stringing of the double line to supply the western portion of Ontario with Niagara power, will be commenced at once. It is anticipated that the work contemplated will cost not less than $300,000. The decision of the Commission to double the capacity of the transmission lines from the Falls does not commend itself as an indication that the Commission favor the proposition of Sir William Mackenzie of Toronto to take over the Toronto Electric Light, as a contingency to the purchase of the street railway.

GARBAGE, SEWAGE AND WATER.

Montreal, Que.—The matter of the filtration plant contract will not be settled for some little time. Controller Godfrey said that they wish Mr. McLeod, the contractor, to withdraw his protest to make good the damage by frost to show a satisfactory method of protecting the works from freezing in the winter and state what is the earliest time in which he can finish it. Messrs. Henry and Fuller, New York experts, have gone over the ground carefully and the Board of Control is being guided by their advice.

West Vancouver, B.C.—The council will submit a by-law to the ratepayers shortly asking authorization to raise $100,000 by the sale of debentures for a waterworks system.

+—**Moose Jaw, Sask.**—The City Council has awarded the McMANUS CONSTRUCTION COMPANY the contract for

48 in. CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire Machine Banded

WOOD STAVE PIPE

CONTINUOUS STAVE PIPE

RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

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MANNESMANN STEEL TUBES

Seamless or lapwelded—for waterworks, sewage, hydro-electric and gas mains, well boring, boilers and superheaters

SIX HUNDRED AUTHORITIES in Canada and Great Britain are using Mannesmann tubes for water supply systems—in Great Britain in varying quantities up to fifteen miles, in Canada to seventeen miles. Seven hundred miles of weldless steel spigot and faucet tubes—quite apart from flanged tubes and lapwelded spigot and faucet tubes—are in use in the United Kingdom, as well as large quantities in Canada, Australia, South Africa, South America, India, China, New Zealand, and Europe.

Solid drawn tubes are used in places where it is impossible to use cast iron pipe or lapwelded tubes, as well as in places where conditions are more normal. We are constantly adding new customers to our list, and what is of even greater significance, more frequently still receiving repeat orders. In the last five years the sale of Mannesmann welded spigot and faucet tubes increased one thousand per cent.

The saving in joints and the speed with which the mains can be laid makes the total cost of the Mannesmann tubes, when laid, very low. The Mannesmann tubes can be supplied in lengths up to forty feet, and the actual saving by the reduction of from sixty to seventy per cent. in joints, jointing material and labour, is enhanced by the increased safety derived from their being proportionately fewer points of leakage.

Our catalogues treat of the merits of steel pipe versus cast iron and other materials, and show installations of Mannesmann tubes. We can guarantee prompt delivery on all orders and will pay careful attention to any inquiries. Write for booklets.

FIVE STRONG POINTS

1. Our tubes can be bent cold on the spot without trouble.

2. Our tubes can be supplied in lengths up to forty feet, thus effecting a large saving in joints, jointing material and labor.

3. Leakage is reduced to a minimum, as the joints are far tighter and seventy per cent. fewer.

4. Saving in freight, etc., is considerable as a steel tube weighs one third to one-half as much as a cast iron pipe of the same length.

5. Mannesmann steel pipe is covered with a special preparation which acts as a non-conductor, thus preventing any damage to gas or water mains by electrolysis or by extreme variations of temperature. It is impervious to rust in any kind of soil. The outside is covered with special jute cloth. And there are other convincing reasons and illustrations in our booklets.

MANNESMANN TUBE COMPANY, Limited

BOOKLETS ON REQUEST **51 VICTORIA SQUARE, MONTREAL** *BOOKLETS ON REQUEST*

the construction of the high pressure mains system through the business section of the city.

▲—**Toronto, Ont.**—Tenders will be received up till the 19th of August, 1913, for the construction of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, Mayor.

INDUSTRIAL WORKS.

+—**Chatham, Ont.**—The Township Council of Dover has awarded the CHATHAM DREDGING COMPANY, Chatham, the contract for the construction of a cut about 13 miles long and varying in width from 30 to 60 feet, across the township. The estimated cost is $80,000.

Cobalt, Ont.—The Crown Reserve Mining Company and the Kerr Lake Mining Company will undertake to drain Kerr Lake. The pumps used in the draining will be of the semi-dredging centrifugal type, and they will be pumping against a head of no less than 175 feet, a task seldom before attempted with pumps of this type. Some idea of the magnitude of the task may be gathered from the fact that at least three months of constant action by the pumps, leaving mishaps out of consideration, will be required before the lake basin is dry. All arrangements are expected to be completed by August 20th and 31st, and it will thus be almost winter before the water will be lowered sufficiently to allow of any extensive development on the new upper levels.

+—**Edmonton, Alta.**—The Wabamun Power and Coal Company has awarded Mr. H. F. BRACKENRIDGE the contract for carrying out work in connection with the cutting of the first 1,000 feet of tunnel at its mine, located one half mile north of the Grand Trunk Pacific tracks.

+—**Galt, Ont.**—The contract for the construction of the new cement dam across the Grand River has been awarded to THOMAS & HANCOCK. The new structure will be 280 feet long and 10 feet high. It will be located about 35 feet down stream from the present dam, and erected in a straight line across the river.

+—**Montreal, Que.**—The Dominion Government has awarded the DOMINION BRIDGE COMPANY, LIMITED, the contract for supplying the steel work for a freight shed to be built on the Lachine Canal. The contract price is $11,750.

Ottawa, Ont.—Tenders will be received up till the 11th of August, 1913, for the construction of a stone and iron fence to Rideau Hall grounds. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Ottawa, Ont.—The Railway Commission has given judgment approving of the plans and profiles for the new Toronto viaduct which were agreed on by the city railway companies and Toronto Harbor Commissioners, after prolonged negotiations. This practically settles the question of grade separation in connection with the viaduct. Work must be completed by July 29, 1916.

+—**Pitt River, B.C.**—The Dominion Government has awarded the PACIFIC DREDGING COMPANY the contract for dredging. The contract price is $158,220.

+—**Port Burwell, Ont.**—The Dominion Government has awarded the C. S. BOONE DREDGING & CONSTRUCTION COMPANY, LIMITED, Toronto, the contract for dredging required here.

Poupore, Que.—Tenders will be received up till the 2nd of September for the construction of a training pier and revetment wall. Plans and specifications may be obtained from J. L. Michaud, District Engineer, Montreal, J. G. Sing, District Engineer, Toronto and the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

+—**Steveston, B.C.**—The Dominion Government has awarded Messrs. BROLEY & MARTIN, New Westminster, the contract for the completion of a jetty. The contract price is $83,500.

Swift Current, Sask.—The Swift Current Construction Company, a subsidiary of the Western Construction Company, of Reno, Nev., will erect a plant in Swift Current for the manufacture of concrete brick, tile, sewer pipe, trimmings and concrete products. D. Y. Leslie, Board of Trade, Swift Current, is interested.

▲—**Toronto, Ont.**—Tenders will be received up till the 2nd of September, 1913, for the construction of the east pier, eastern entrance, Toronto harbor. Plans and specifications may be obtained from J. G. Sing, Toronto; H. J. Lamb, District Engineer, Windsor, and the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

▲—**Toronto, Ont.**—Tenders will be received up till the 11th of August, 1913, for the construction of two breakwaters. Plans and specifications may be obtained from Frank Barber. County Engineer.

Toronto, Ont.—Engineer Powell and Dr. Nasmith are investigating various proposed methods for abolishing the smell from the sewage disposal works. At present the solid matter is being conveyed to Ashbridge's Bay and covered with clean earth, but this is not entirely effective. A method under consideration is the English filter system, by which the solids are dried, mixed with earth, and made into a fertilizer.

+—**Vancouver, B.C.**—The Dominion Government has awarded Messrs. ARMSTRONG & MORRISON the contract for moving the sections of the Canadian Pacific Railway traffic bridge over the Pitt River, to the government's new traffic bridge.

Victoria, B.C.—The work of dumping rock on the site of the breakwater at Ogden Point is proceeding and the indications are that within the next few weeks the rockbed will be brought to such a level as to permit commencement of the granite blocks. The engineers are concentrating their energies on the first one thousand feet, and this section will be brought to within a few feet of the surface before the next arm of the breakwater is started. By August 14, all the barges, tugs, machinery and other equipment necessary for breakwater construction, that will be needed for the entire contract, will be assembled at Ogden Point. By the middle of the month Engineer McLachlan says that the barges will be dumping 40,000 tons of rock per month at the site of the breakwater.

▲—**Welland, Ont.**—Tenders will be received up till the 25th of August, 1913, for the Port Severn section, Severn Division, Trent Canal. Plans and specifications may be obtained from the engineer in charge, Welland Ship Canal, St. Catharines, Public Works Department, Midland, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Windsor, Ont.—The following by-laws amounting to $15,000, have been passed by the ratepayers. To repair the town dock, $7,000; extending concrete sidewalks, $5,000, and new town hall, $3,000.

MISCELLANEOUS.

Brampton, Ont.—Tenders will be received up till the 18th of August, 1913, for the construction of a clock tower, public building. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—**Bury, Que.**—The Dominion Government has awarded AYTON CROMWELL, Cookshire, the contract for the erection of a drill hall. The contract price is $11,750.

+—**Edmonton, Alta.**—Messrs. Barnes, Cogswell & McCleish have awarded LAURITZEN & RUSSELL the contract or the erection of a warehouse. The contract price is $20,000.

Edmonton, Alta.—The Masons will erect a temple in this city. It will be eight stories in height and cost $500,000.

Edmonton, Alta.—Messrs. Nicholson and Bain will erect a six-story warehouse. The estimated cost is $70,000.

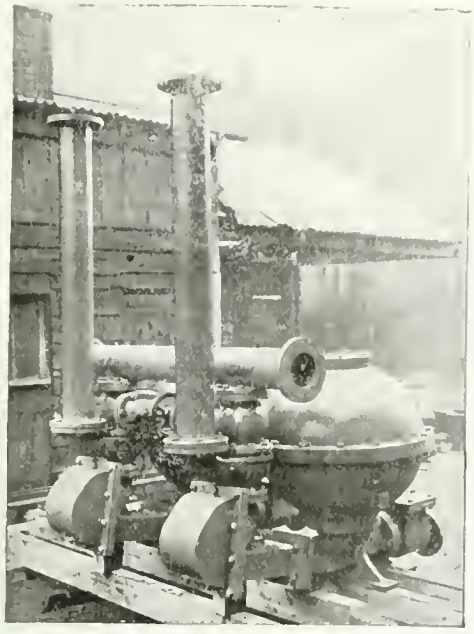
+—**Eganville, Ont.**—The Dominion Government has awarded Mr. L. B. LACHANCE, Ottawa, the contract for the erection of a post-office building.

Kamloops, B.C.—Tenders will be received up till the 16th of August, 1913 for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

+—**Lachine, Que.**—The city has awarded Mr. ADOLPHE GAUTHIER the contract for building an extension to the post-office. The contract price is $20,200.

+—**Moncton, N.B.**—The Maritime Cap Limited, has awarded Messrs. HUMPHREY & DONALD the contract for their new factory building. The contract price is $9,447. Four other tenders were received, that of the Rhodes Curry Company for $17,000 being the highest.

+—**Montreal, Que.**—The Cabinet Council has awarded Mr. JOSEPH BOURQUE the contract for the erection of postal station "F." The contract price is $57,500.



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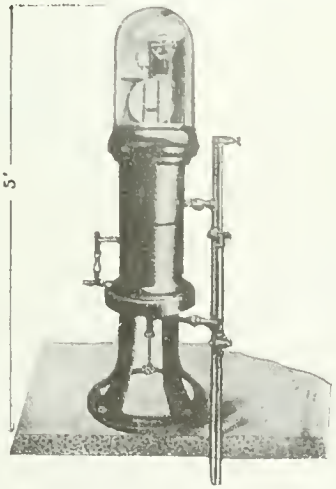

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Also engineers for the electrolytic treatment of water.

+—Montreal, Que.—The Government has awarded Mr. JOHN QUINLAN the contract for the erection of postal station "L." The contract price is $70,000.

New Westminster, B.C.—Tenders will be received up till the 19th of August, 1913, for the building of an addition to the land registry office. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffiths, Public Works Engineer.

+—North Sydney, N.S.—Mr. FRANK REDDING has been awarded the contract for the erection of the Western Union Cable Office. The contract price is $50,000.

+—Ottawa, Ont.—The Dominion Government has awarded the PIERSON U BAR COMPANY the contract for greenhouses and hot water heating in connection with the experimental farm. The contract price is $19,447.

+—Ottawa, Ont.—The Dominion Government has awarded the FOUNDATION COMPANY, Montreal, the contract for the foundation of the new Customs building.

Port Arthur, Ont.—Tenders will be received up till the 11th of August, 1913, for the erection of a pump-house. Plans and specifications may be obtained from J. J. Hackney, Commissioner of Utilities.

Prince Arthur, Sask.—Tenders will be received up till the 25th of August, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Eugene Fiset, Deputy Minister, Ottawa.

+—Quebec, Que.—The L. H. PETERS COMPANY have been awarded the contract for the construction of the new French Presbyterian church. The contract price is $13,000. The CITADEL BRICK AND PAVING COMPANY were awarded the contract for supplying the brick and stone.

St. John, N.B.—Tenders will be received up till the 11th of August, 1913, for passenger elevator in customs building. Plans and specifications may be obtained from D. H. Waterbury, St. John, and the Department of Public Works, Ottawa R. C. Desrochers, secretary.

Toronto, Ont.—Tenders will be received up till the 12th of August, 1913, for the erection of a market building. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

+—Vancouver, B.C.—Mr. GEO B. BAKER has been awarded the contract for the erection of a warehouse. The contract price is $70,000.

+—Vancouver, B.C.—The John Leckie and Company has awarded Messrs. SNIDER & BRITHAM the contract for the erection of an addition to their present factory. The contract price is $50,000.

+—Victoria, B.C.—Mr. A. LACOURSIERE, Victoria, has been awarded the contract for the erection of the first hotel in Saanich. The contract price is $75,000.

+—Victoria, B.C.—Messrs. Adam Bros. have awarded Messrs. DOW & RYDEN the contract for the erection of a new hotel. The contract price is $45,000.

+—Victoria, B.C.—The Swift Canadian Company has awarded the B. C. GRANITOID COMPANY, Vancouver, the contract for the erection of a reinforced concrete warehouse building. The contract price is $55,000.

+—Winnipeg, Man.—The "Tribune" has awarded Messrs. HAZLETON & WALLIN the contract for additions to the present building. The contract price is $173,000.

Winnipeg, Man.—Tenders will be received up till the 3rd of September for the erection of a drill hall. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

Yorkton, Sask.—Tenders will be received up till the 9th of August for the erection of a telephone exchange building. Plans and specifications may be obtained from D. C. McNab, Deputy Minister of Railways and Telephones.

CURRENT NEWS.

Victoria, B.C.—Mr. Napier Denison, has left for Prince Rupert, Atlin and Dawson, in connection with the meteorological service, intends, if a proper foundation and site can be obtained, to set up one of his very delicate horizontal pendulums, in order that the slow movements known to occur in the Alaska district may be measured daily in the Far North. These results will be of great value when studied in conjunction with the similar work Mr. Denison is carrying on here. This northern station will form one link in the grand chain it is hoped to complete along Western America from the Arctic Circle to the Equator, and eventually it may extend far into South America. The day is rapidly approaching when it may not only be possible to predict the approximate date when the earth's rock mantle will be broken, causing an earthquake, but the probable district in which it may take place. The building now being erected on Gonzales Heights will be the first complete seismological research observatory established in America, which speaks well for the progressive policy of this new country. Not only will the work comprise the constant recording of the earth's very "pulse," but tidal strains in the crust due to the sun, moon and other mysterious forces noted here.

Toronto, Ont.—Ontario will break all records this season in the construction of colonization roads, stated Mr. G. W. Bennett, Provincial Superintendent of Colonization roads recently. The department expects to complete between 1,000 and 1,100 miles of roadway before the end of the year. At the present time over 4,500 men are steadily employed upon the work and some 650 overseers have their hands so full that it is proposed to augment their number by an additional 300. It is also the intention to employ 3,000 more men on cutting out, ditching and grading. All the colonization roadwork this year is being done by day labor. Heretofore a certain percentage has been done under contract, but the day labor work has proved more satisfactory to the government. This year, also, for the first time, Mr. Bennett reports that day labor has been plentiful and excellent. Favorable weather conditions have obtained throughout the north country and the work has progressed with almost remarkable speed. Reasons for the plentiful character of labor the superintendent does not attempt to give. Laborers on colonization roads are paid the regular schedule of wage rates for the locality, and the applications for work have always exceeded the requirements. Moreover, the character of the labor has been much superior to that of other years. There are 20 provincial inspectors, and each of them reported to the department that conditions, labor and construction work were never better than at present. Since the work was taken up in the latter part of April over 800 miles of roadway has been completed. Bit by bit, as the maps in the superintendent's offices show, the unorganized districts of the north are being webbed with good roads. By another season it is hoped that the work of construction will have so far advanced that the government will be in a position to inaugurate its prospective campaign for settlement on a large scale.

MONTREAL MARKET REPORT

Local iron and steel circles are taking some encouragement from the report that matters are improving in the United States. However, up to the present there does not appear to have been any improvement to speak of here. Not long since, Americans were selling pig at $13 Buffalo, being the equivalent of about $17.25, Toronto. It is said that these prices are no longer obtainable. So far as can be learned, the only furnace out of blast is the big 300-ton furnace of the Canada Iron Corporation, at Midland. This will probably not start operations till prices improve. Meantime the corporation has enough orders on hand to keep the 150-ton furnace operating for many months to come. The Dominion Steel Corporation is probably not selling pig-iron save to a few of the local foundries and the Scotia Company is probably not selling any at all. As for the Steel Company of Canada, it is said to be selling at $17,25 Hamilton, which with a freight rate of $2 to Montreal, would make $19.25 here. Other merchant furnaces are all operating on orders but consumption shows a considerable falling off and the trade is not looking for any considerable activity for some weeks to come, at least. In another month buyers will be ordering for delivery before the close of navigation and cargoes of English and Scotch iron will be coming along shortly thereafter. It is claimed that prices on Scotch and English iron are stiffening but little interest is being shown in the market just now, so that it makes little difference what the price across the Atlantic is.

The Snyder-Gillett Contracting Company, of New York State, has been licensed by the Provincial Secretary to do business in Ontario.

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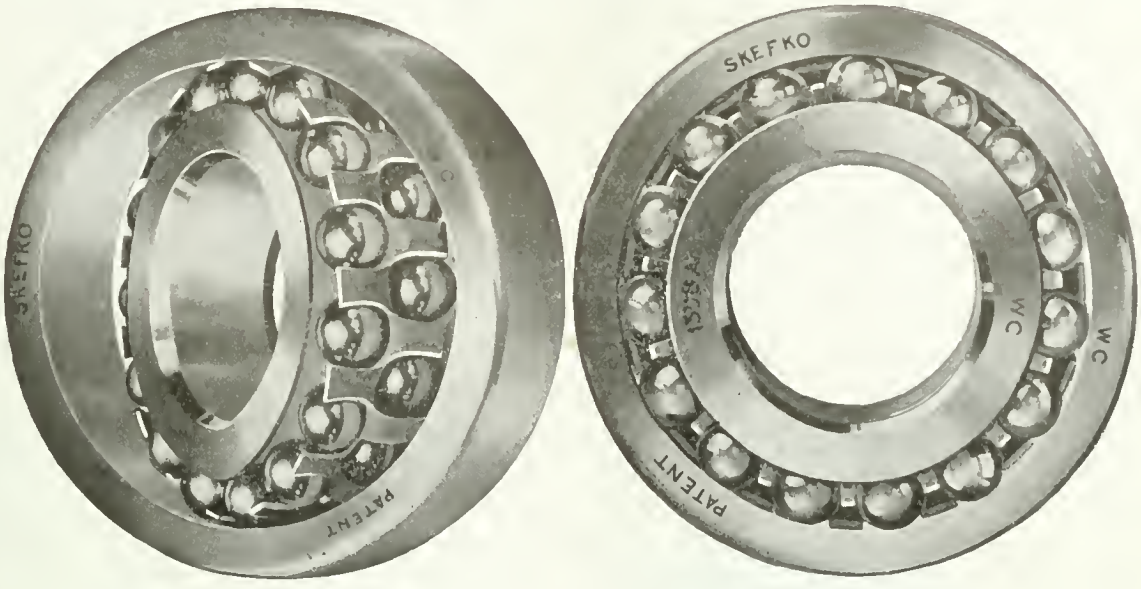

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ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

(Continued from page 75.)

work to be done to satisfaction of an engineer of Board, and completed by November 1st, 1913; after construction roadway be maintained by railway company for one year.

19839—July 14—Authorizing Department of Public Works, Ontario, to construct highway across C.P.R. Sault Ste. Marie Branch, on Lot 7, Con. 1, Tp. Drury, Dist. Sudbury, Ont., by means of grade crossing.

19840—July 12—Authorizing C.P.R. to construct bridge No. 2.92, over Toronto Suburban Railway near Meadowvale, Orangeville Sub.-Div., of C.P.R.

19841—July 11—Authorizing C.P.R. to construct spurs for Laurentide Brick and Sand Co., Ltd., across public road and adjoining lands, Co. l'Assomption, parishes of St. Henry de Mascouche and Lachenaie, Que., at mileage 12.25 from St. Martin Jct.

19842—July 18—Authorizing C.L.O. and W. Ry. (C.P.R.) to construct spur across C.N.O.R. in part Lots 24 and 25, Con. A., Tp. Hamilton (West Riding), Co. Northumberland, Ont., at mileage 122.02 on C.N.O. and W. Ry. line, subject to certain conditions.

19843—July 12—Authorizing G.T.P. Branch Lines Co. to construct its Tofield-Calgary Branch across highway in N.E. ¼ sec. 15-44-21, W. 4 M., mileage 43.9, Dist. North Alberta, Alta.

19844—July 21—Approving (1) location G.T.R. Co.'s proposed new station and freight shed to be constructed at New Lowell, Ont., and its proposed rearrangement of track at that point; (2) detail plans of said proposed station and freight shed, filed with Board under file No. 22492.

19845—July 14—Approving location G.T.P. Branch Lines Co.'s station on Battleford Branch, at Dacer, in Sec. 4-43-16, W. 3 M., Sask; station to be in accordance with company's Standard Structural Plan No. 1, on file with Board.

19846—July 14—Authorizing municipal corporation of St. Thomas, Ont., to lay and thereafter maintain 12 inch water main under P.M.R.R. on Wilson Ave., between Ada street and Elm street, St. Thomas.

19847—July 14—Authorizing city of St. Thomas, Ont., to lay 18 inch water main under G.T.R. on Hughes street, St. Thomas, Ont.

19848—July 14—Granting leave to Canadian Copper Co., of town of Copper Cliff, Ont., to construct crossing, with gates, in nature of farm crossing, over Algoma Eastern Ry., in Lot 11, Con. 4, Tp. McKim, at point shown on plan filed under file No. 22501.

19849—May 30—Establishing collection and delivery limits of express companies in city of St. Boniface, Man., and rescinding Order No. 15024, dated Sept. 15th, 1911.

19850—July 18—Directing that, within 60 days from date of this Order, C.N.R. install improved type of illuminated electric bell at crossing of Fort William Road, at a point about half way between Fort William and Port Arthur, and thereafter maintain bell at its own expense, 20 per cent. of cost of installing bell be paid out of the Railway Grade-Crossing Fund; (2) speed of trains operated over said crossing be limited to 6 miles an hour; a signpost be erected at least 250 feet from crossing, indicating that cars must be kept inside that point on spur track.

19851—July 22—Postponing effective date of modification of Rule 7 of G.T.R. Special Freight Tariff, C.R.C. No. E 2374, I.C.C. No. 1660, contained in Supplement Nos. 5 and 3, respectively thereto, and of Rule 33 of C.P.R. Local Freight Tariff, C.R.C. No. E 2141, I.C.C. No. E 1288, contained in Supplement Nos. 9 and 6, respectively thereto, until otherwise ordered by the Board.

19852—July 21—Authorizing C.P.R. to construct road diversion in Sec. 13-13-15, W. 4 M., and construct Suffield-Blackie Branch, by means of grade crossing, across highway between Secs. 12 and 13-15 W. 4 M., at mileage 41.0 from Suffield.

19853—July 19—Authorizing C.P.R. to construct additional track (double track) of main line, Ont. Div. London Sub.-Div., across G.T.R. in W. ½ of Lot 14, Con. 2, Tp. Trafalgar, at mileage 32.56 from Toronto.

19854—July 17—Authorizing C.P.R. to move present farm crossing, on northern section of Atlantic Division of its railway, from its present position at or near mileage 50, north of McAdam Jct., N.B., to a point 190 feet south, on lands of G. Sterling and James A. Peabody.

19855—July 21—Approving and authorizing clearance as shown on plan showing clearance from G.T.R. side track to one of the buildings of Pratt & Letchworth Co., Ltd., Brantford, Ont.; provided G.T.R. (applicant company) keep its men off sides of cars while operating said side track.

19856—July 12—Directing that, in accordance with terms of agreement entered into between John Purvis, predecessor in title of said land, and W. B. Smellie, secretary of railway company, on Oct. 11th, 1887, the Brockville, Westport and North Western Ry. Co. construct cattle pass 8 feet wide and as high as ground will permit, through embankment near or close to the lane leading out from barn on farm of Messrs. D. H. and C. S. Grey, Tp. Elizabethtown, Co. Leeds, Ont.

19857—July 21—Establishing collection and delivery limits of express companies in town of Grand Forks, B.C.

19858—July 22—Disallowing cancellation of stop-over arrangement at Outremont, Que., in connection with shipments of grain and grain products from Western Canada, as contained in Supplement No. 9 to C.P.R. Co.'s "all-rail" and "lake-and-rail" Special Tariff, C.R.C. No. E 2480, said supplement having been made effective June 19th, 1913; (2) suspending, until otherwise ordered by Board, cancellations of stop-over arrangements at Toronto, West Toronto, Montreal and Outremont, in connection with shipments of grain, grain products, hay and potatoes, items Nos. 22 and 23 of C.P.R. Special Freight Tariff, C.R.C. No. E 2141, as contained in Supplement No. 16, effective July 23rd, 1913.

19859—July 21—Authorizing Moose Jaw Electric Ry. Co. to construct single line track on High St. West, city of Moose Jaw, across C.P.R. Outlook Branch, subject to and upon certain conditions.

19860—July 21—Authorizing T., H. & B. Ry. to cross, at grade, highway between Lots Nos. 26 and 27, Con. 3, Tp. Saltfleet, Co. Wentworth, Ont., with a passing siding extending from at or near a point on its main line a short distance west of Stoney Creek station and marked H.B. 1654.14 (mileage 31.33) to a point marked H.B. 1695.72 (mileage 32.12).

19861—July 22—Authorizing C.P.R. to construct spur for Vermont Marble Co., Proctor, Vermont, in city of Peterborough, Ont.

19862—July 23—Amending Order No. 19676, dated June 25th, 1913, by striking out figures "133.0" after word "mileage" where they occur in recital and operative parts of Order, and substituting therefor figures "123.0."

19863—July 21—Authorizing Michigan Central Ry. to construct weighing scales on side track leading into plant of Canadian Shredded Wheat Co. on Lewis Ave., Niagara Falls, Ont., and (2) approving and authorizing clearances of bridge over said scales, as shown on plan.

19864—July 21—Authorizing municipal corporation city of St. Thomas and Board of Water Commissioners of said city, to lay and thereafter maintain an 18 inch water main from St. Thomas Waterworks under M.C.R.R. on Moore St. between Talbot and Centre Sts., and between Moore St and Mill St., and on Mill St. between Centre and Amelia Sts.

19865—July 22—Approving G.N. Ry. Co.'s Standard Passenger Tariff C.R.C. No. 825, applying a maximum rate of 3 cents per mile between stations on its lines as follows:—Brandon, Sask., and Hudson's Bay Ry.; Manitoba Great Northern Ry.; Midland Ry. of Manitoba; Victoria & Sidney Ry., and line of Victoria Terminal Ry. and Ferry Co.; (2) temporarily approving, pending judgment in inquiry into rates charged generally by railway companies in Province of British Columbia, tariff applying a maximum rate of 4 cents per mile to be charged between stations on its lines as follows:—Bedlington & Nelson Ry.; Crow's Nest Southern Ry.; Nelson & Fort Sheppard Ry.; New Westminster Southern Ry.; Red Mountain Ry.; and line of V.V. & E. Ry. & Nav. Co., and (3) said tariff, with copy of this Order, be published in at least two consecutive weekly issues of Canada Gazette.

19866—July 21—Approving, temporarily, pending judgment in inquiry into rates charged generally by railway companies in British Columbia, G.T.P.R. Standard Freight Mileage Tariff C.R.C. No. 17, including and cancelling C.R.C. No. 15, to apply between stations in British Columbia, Prince Rupert to Morricetown, inclusive; said tariff with copy of this Order to be published at in least two consecutive weekly issues of the Canada Gazette.

19867—July 22—Approving location G.T.P. Ry. station at Cooking Lake, mileage 766.1, west of Winnipeg, in Sec. 6-52-20, W. 4 M., Alta.; station to be erected in accordance with company's design "B."

19868—July 23—Extending until Sept. 15th, 1913, time within which interlocking plant be installed at crossing of C.N.R., by G.T.P.R., at Empire Ave., city of Fort William, Ont., required to be installed by Order No. 19352, May 22nd, 1913.

19869—July 22—Approving proposed location C.P.R. station in N.E. ¼ Sec. 10-8-17, W. 2 M., at Trossachs, Sask.

19870—July 22—Authorizing C.L.O. & W. Ry. (C.P.R.) to construct across Ontario St., town of Cobourg, Ont., at mileage 120.20 from Glen Tay, by means of grade crossing.

19871—July 22—Authorizing C.N.O.R. to construct across and divert public road under Mississippi River Bridge, in Lot 22, Tp. Fitzroy, Co. Carleton, Ont., at Station 1812.87.5.

19872—July 23—Authorizing C.N.O.R. to construct bridge to carry its line across Petawawa River (west crossing), Tp. Deacon, Dist. Nipissing, Ont., mileage 159.3, west of Ottawa.

19873—July 23—Authorizing G.T.P. Branch Lines Co. to construct highway between Secs. 25 and 26-35-23, W. 4 M., across its Tofield-Calgary Branch, at mileage 104.5, in Dist. North Alberta, Alberta.

19874—July 22—Authorizing G.T.R. to construct siding for Farquharson-Gifford Co., Ltd., city of Stratford, Ont.

19875—July 22—Authorizing C.P.R. to construct spur for Medina Shale Brick Co., Ltd., and Streetsville Brick Co., Ltd., in town of Streetsville, Ont.

19876—July 23—Authorizing C.P.R. to construct spur for Abernethy & Lougheed, Ltd., in Lot 398, Sec. 12, Tp. 12, N.W.D., B.C., Haney, N.W.D., British Columbia.

19877—July 23—Authorizing C.N.O.R. to construct across public road between Twps. Saltfleet and Grimsby, Cos. Wentworth and Lincoln, Ont.

19878—July 24—Amending Order No. 19593, dated June 16th, 1913, by striking out word "west" in second line of paragraph 1 of said Order, and substituting therefor word "east."

19879—July 23—Authorizing C.P.R. to construct spur for its irrigation department, from a point on northerly limit of its right of way, in S.E. ¼ Sec. 32-18-14, W. 4 M., at Brooks, Alta., to be completed within three months from date of Order.

19880—July 23—Approving revised location G.T.P. Ry. and location of its station grounds, in Sec. 17-43-2, W. 4 M., Alberta.

19881—July 22—Authorizing C.N.O.R. to construct across fourteen (14) highways in Tp. Saltfleet, Co. Wentworth, Ont.

19882—July 23—Approving plans showing overhead highway bridge to be constructed by C.P.R. at Asylum Side Road, at London, Ont.

19883—July 23—Authorizing C.P.R. to construct two (2) bridges (1) No. 33.5, near Cavan station, and (2) No. 5.75, near Norwood station, Toronto Sub-Div., Ontario Division, Ont.

19884—July 23—Authorizing C.P.R. to construct four (4) bridges—Nos. 55.8, near Station Rooth, St. John Sub-Div., Atlantic Div.; 7.1, near Norwood station, Toronto Sub-Div., Ontario Div.; 33.6, near Dunsford, Bobcaygeon Sub-Div., Ontario Div., and 16.9, near Ops, Ont., Bobcaygeon Sub-Div., Ontario Div.

19885—July 24—Recommending to the Governor-in-Council for sanction, indenture of lease, dated June 2nd, 1913, between Kettle Valley Ry. Co., as lessor, and C.P.R., as lessee, executed in duplicate and filed with Board under file No. 11738.79.

(Continued on page 88.)

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16mo, Morocco, 1200 cuts, 500 tables, 1483 pages.

Price, $5.00 net.

TENDERS CALLED FOR

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

TRENT CANAL.

PORT SEVERN SECTION—SEVERN DIVISION.

NOTICE TO CONTRACTORS.

SEALED TENDERS, addressed to the undersigned and marked, "Tender for Port Severn Section—Severn Division, Trent Canal," will be received at this office until 2.00 o'clock p.m., on **Monday, August 25th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after July 26th at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa; at the office of the Superintending Engineer, Trent Canal, Peterborough, Ont.; at the office of the District Engineer, Public Works Department, Midland, Ont., and at the office of the Postmaster, Orillia, Ont.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labour, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered Bank of Canada, for the sum of $10,000, made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 29th July, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—45677.

SEALED TENDERS addressed to the undersigned, and endorsed, "Tender for East Pier, Eastern Entrance, Toronto Harbour, Ont.," will be received at this office until 4.00 p.m., on **Tuesday, September 2nd, 1913,** for the reconstruction of part of superstructure of East Pier of Eastern Entrance to Toronto Harbour, in the County of York and Province of Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and H. J. Lamb, Esq., District Engineer, Windsor, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering declines to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, August 1, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—43525.

TENDERS FOR PAVEMENT.

Sealed tenders addressed to William Buller, Chairman Board of Works, Peterborough, Ontario, and endorsed "Tenders for Pavement" will be received until 5 p.m., Wednesday, August 20th, 1913, for the construction of Bitulithic and Asphaltic Concrete Pavements on George and Charlotte Streets and for Bitulithic Asphaltic Concrete and Portland Cement Concrete pavements on Hunter Street, Peterborough.

Plans and specifications may be seen at the City Engineer's Office, Peterborough, Ontario. Each tender must be accompanied by an accepted cheque for five (5) per cent. of the amount of the tender.

The lowest or any tender will not necessarily be accepted.

R. H. PARSONS,
City Engineer.

Peterborough, Ontario,
August 5, 1913.

(For Further Tenders see page 88.)

Agent Wanted

We are open to negotiate with a reliable firm to act as agent for Canadian business.

W. H. ALLEN, SON & CO.
LIMITED
Queen's Engineering Works
BEDFORD - - ENGLAND

Engineers and Builders of
STEAM, HYDRAULIC, AND
D.C. ELECTRIC MACHINERY

(See Advertisement on Page 103.)

Address firm's representative:
A. LEO MIEVILLE,
c/o Box 92, *Canadian Engineer*,
62 Church Street, Toronto.

Contractors' Locomotives

6-WHEELED SADDLE TANK SWITCHING LOCOMOTIVE BUILT FOR THE HAMILTON STEEL & IRON CO. LTD.

Diameter and stroke of cylinders 17×24 ins. Diameter of driving wheels 50 ins. Total wheel base 11 ft. Weight of engine in working order 108,000 lbs. Tractive power 21,220 lbs. Tank capacity 850 Imp. gals. Coal capacity 1¼ tons.

We can make excellent delivery of locomotives for every variety of service—for industrial work, mines, contractors, etc. All sizes —all types—all practicable gauges.

Duplicate parts are carried in stock for immediate shipment. We build locomotives to meet the Government regulations of the various Provinces.

We have had fifty years' experience as builders of locomotives. Our expert workmen are in many cases the sons or grandsons of men who worked in our shops many years ago. Combined with this long experience and expert workmanship, we have new equipment, efficient management and expert designers.

Special attention is paid to economy of maintenance; also to design of boiler and fire box to ensure ample steam capacity and economy of fuel. Consult us before purchasing a locomotive!

Handsome catalogue, 108 pages, 38 illustrations, with valuable tables and data, free to engineers, contractors or manufacturers — on request.

Canadian Locomotive Company, Limited

Kingston - Ontario - Canada

SECOND-HAND MACHINERY

Second Hand Rock Crushers

100% of service in these machines, at **50% of their cost** when new. Send for complete Price List.

1—30"x 14" "Buchanan" Crushing Roll
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1—25"x 16" "Mosser" Crushing Roll
1—No. 5 "Gates" Gyratory
1—No. 4 "McCully" Gyratory
2—No. 3 "McCully" Gyratory
1—9" x 15" "Farrell" Jaw
1—No. 3 "Champion" Jaw
1—8" x 8" "Jeffrey" pulverizer

L. F. SEYFERTS' SONS, Inc.
437 North Third St., PHILADELPHIA, Pa., U.S.A.

New and Second-hand
Contractors' Machinery For Sale
IMMEDIATE DELIVERY.

1—8"x12", double cylinder, double drum hoist with boiler (new).
1—7"x12", double cylinder, double drum hoist with boiler (new).
1—6"x12", double cylinder, double drum hoist with boiler (new).
1—6½"x8", double cylinder, double drum hoist with boiler (new).
1—5"x6", double cylinder, single drum hoist with boiler (new).
1—1 yard "Fairvrette," clam bucket (new).
1—No. 2 Boom Swinger (new).
1—No. 21 Ransome Concrete Mixer on wheels (used).
1—No. 2 Austin Rotary Stone Crusher on wheels (used).
1—10"x10"x10", Steam Driven Air Compressor (new).
1—8"x10"x8" Steam Driven Air Compressor (used)
4", 5" and 6", Centrifugal Pumps, d.-c. to Vertical Engines (new).
5, 8 and 12 ton stiff leg Derrick Irons (new).

H. W. PETRIE, Limited Front Street W. TORONTO

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

FOR SALE at a snap: 60-H.P. Cowan and Co. engine and 80-H.P. Cowan and Co. boiler. Write for particulars, J. F. Barnard and Son, Spencerville, Ont.

Tenders Called For

CAYUGA, ONT.

Sealed tenders will be received up to noon on the 16th day of September, 1913, by the undersigned at Cayuga, Ontario, for the construction of twenty-six and one-half miles of stone macadam road in the county of Haldimand.

The work will be let in three separate and distinct contracts, not necessarily to the same individual.

Tenderers are required to examine the localities of the work and are requested to be present at the opening of the tenders at 2 p.m., on Wednesday, the 17th day of September, 1913.

Plans and specifications may be seen at the office of the County Engineers, Messrs. Jackson and Kyd, Dunnville, or may be had from them on the payment of $10, which sum will be refunded on return of the documents.

Lowest or any tender not necessarily accepted.

T. A. SNIDER, K.C.,
County Clerk,
County of Haldimand,
Cayuga, Ont.

TENDERS FOR CONCRETE BRIDGES.

Sealed tenders addressed to William Buller, Chairman Board of Works, Peterborough, Ontario, and endorsed "Tenders for Concrete Bridges" will be received until 5 p.m., Wednesday, August 20th, 1913, for the construction of a reinforced concrete arch bridge of twenty-six (26) feet span, sixty-six (66) feet long on Park Street and of a reinforced concrete slab and beam bridge of twenty-seven (27) feet span, sixty-six (66) feet long on McDonnel Street. Separate tenders for each bridge shall be made.

Plans and specifications may be seen at the City Engineer's Office Peterborough, Ontario. Each tender must be accompanied by an accepted cheque for five (5) per cent. of the amount of the tender.

The lowest or any tender will not necessarily be accepted.

R. H. PARSONS,
City Engineer.

Peterborough, Ontario,
August 5, 1913.

(For further Tenders see page 86.)

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

(Continued from page 84.)

19886—July 24—Extending, until Aug. 31st, 1913, time within which C.P.R. and G.T.R. Co.'s install bells at crossing of Perth Road by their railways, one mile north of Kingston, Ont.

19887—July 24—Extending until October 31st, 1913, time within which C.P.R. install gates at crossing Centre St., Chatham, Ont.

19888—July 23—Approving location G.T.P. Branch Lines Co. station at Siding No. 7, Sec. 10-45-23, W. 3 M., Sask., mileage 47 on its Cut Knife Branch.

19889—July 24—Extending time within which G.T.R. install interlocking plant at Paris, Jct., Ontario, until Oct. 15th, 1913.

19890—July 24—Authorizing Chatham, Walaceburg & Lake Erie Ry. Co. to take, for purposes of convenient accommodation of the public and traffic on its railway, and to secure efficient maintenance and operation of its railway, Lot 18, city of Chatham, Ont.

19891—July 24—Approving location C.N.R. station at Radville, Sask.

19892—July 21—Authorizing M.C.R.R. to construct extension to siding, from present terminus thereof, on Moore St., between Centre and Talbot Sts., St. Thomas, Ont., northerly along Moore St., a distance of 28 ft. to a point distant 20 ft. from southerly limit of Talbot St.; to be completed within three months from date of this Order.

19893—July 24—Directing G.T.R. to install Hoschen type of electric bell at crossing of Mill St., town of Milverton, Ont., and thereafter maintain bell at its own expense; detail plan showing layout to be submitted for approval of an engineer of Board within 30 days, and work be completed within 60 days from date of this Order; 20 per cent. of cost of installing bell to be paid out of the Railway Grade-Crossing Fund, and remainder to be paid by railway company.

19894—July 24—Approving location C.P.R. proposed new station on S.W. ¼ Sec. 30-9-26, W. 4 M., at Nolan, Alberta.

19895—July 24—Directing G.T.R. remove board fence and cut down hill, or bank, on right of way, at Marsh Winery Road, Stamford, Ont., for a distance of 930 ft., so that no portion of said bank be more than 4 ft. above level of track.

19896—July 25—Approving proposed location C.P.R. station on Sec. 34-4-3, E.P.M., Man., at Arnaud, subject to condition that company construct suitable sidewalk and driveway from station to north side Smith Ave., and maintain same until land east of roadway is subdivided and taken over by the municipality; or that in the alternative Railway company be at liberty to construct sidewalk and driveway on its right of way; station to be erected in accordance with C.P.R. Standard Structural Plan "A2."

19897—July 25—Approving By-Law No. 14 (superseding By-Law No. 11), passed at meeting of directors of G.T.P. Ry., held on 16th July, 1913, authorizing J. E. Dalrymple, vice-president, and A. E. Rosevear, general freight agent of company, to prepare and issue tariffs of tolls to be charged for carriage of traffic over company's railway or any portion thereof, and rescinding Order No. 15186, dated Oct. 25th, 1911.

19898—July 25—Authorizing James Bay & Eastern Ry. Co. to construct across con. road, mileage 38, side road, mileage 38.7, Mill road, mileage 39.3, road to Mt. Albert, mileage 40.35, side road, mileage 40.6, and side road, mileage 41.6, Tp. of Gwillimbury, Co. York, Ontario.

19899—July 25—Authorizing G.T.P. Branch Lines Co. to carry passenger traffic over portion of Tofield-Calgary Branch, between Trochu, mileage 121.4, and Beiseker, mileage 162.6, Alta.; provided trains be operated over said portion at a speed not exceeding 12 miles an hour.

The debris shown at the left of this photograph carried away a steel bridge, but was powerless to hurt this concrete bridge. At one time the water was higher than the arch rings and flooded right across the approaches.

Concrete Defied the Flood

FIREPROOFNESS has been perhaps the greatest reason for the rapid rise of concrete in the favor of builders.

Another striking advantage has been demonstrated. Tornadoes have left concrete structures standing alone amidst the ruins of other buildings.

And now the greatest flood the world has seen in years has added "flood-proofness" to concrete's established list of merits.

Concrete buildings in the flooded districts of Ohio and Indiana suffered practically no damage—Concrete bridges withstood the terrible pressure of millions of tons of water and held firm under the terrible strain of debris that pounded itself to pieces in futile effort to destroy.

SPECIFY CANADA PORTLAND CEMENT

CANADA CEMENT COMPANY
Limited
MONTREAL

Write for your copy of the book "Factories and Warehouses of Concrete"—Your bookshelf needs it.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

ENGINEER WANTED.—For erection of refrigerating, pumping and power plants with a Western Canadian Company, some commercial and drawing experience preferred. Must invest One Thousand Dollars ($1,000.00). Box No. 98, *The Canadian Engineer*, Toronto, Ontario.

MAN, (40), with university and technical education, engineering experience, both office and field, desires employment with Civil Engineer, or would become articled to Dominion Land Surveyor. Can report immediately. Presently residing in Winnipeg, will go anywhere. Box 100, *The Canadian Engineer*, 820 Union Bank Bldg., Winnipeg.

MECHANICAL ENGINEER—Experienced Designer, Cost Estimator and Salesman, Works Supervision, all kinds of steam engines, boilers, hydraulic pumps, air machinery and mining plants, seeks position with Consulting Engineer, Contractor, Manufacturers or agency business. Highest references, some capital. Box 102, *The Canadian Engineer*, Toronto.

REINFORCED CONCRETE ENGINEER, 27, married, graduate, broad experience capable of designing and estimating all kinds of structures, buildings, tanks, jetties, bridges, grain elevators, retaining walls, etc., possesses initiative and ability to meet architects, engineers and contractors, best references, wants responsible position with reinforced concrete firm or contractor. Box 104, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Notice is hereby given in regard to Canadian patents 100,707, 100,980 and 129,756, steam turbines, and 135,000, 135,001, 136,321 and 137,222, classifiers, that Canadian Allis-Chalmers, Limited, Toronto, owner of rights under said patents, is prepared to supply devices covered by these patents.

NOTICE.—Anyone desiring to obtain the invention covered by Canadian Patent No. 134877, granted on August 8th, 1911, to Adolph A. K. Nowak, for Pilger Rolling Mills, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, 53 Queen Street, Ottawa, Ontario. Russel S. Smart, Resident.

NOTICE.—Anyone desiring to obtain the invention covered by Canadian patent No. 135037, granted on August 15th, 1911, to Thomas Martin Sandiford for Apparatus for Lighting and Extinguishing Gas Lamps, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, 53 Queen Street, Ottawa. Russel S. Smart, Resident.

ELECTRIC FURNACE.—The proprietors of Canadian Letters Patent No. 134,772 of 1911, are prepared to sell, or license Canadian manufacturers to work in Canada, this patent, which relates to a furnace to be used for the refining of steel or for other refining or smelting operations. Address, International Acheson Graphite Co., Niagara Falls, Ont.

PATENTS.

Below will be found a complete list of patents recently granted to inventors in Canada and United States, which is furnished by Messrs. Fetherstonhaugh & Co., patent barristers, solicitors, etc., head office, Royal Bank Building, 10 King Street East, Toronto. Offices in Hamilton, Montreal, Ottawa, Winnipeg, Vancouver and Washington, D.C., from whom all information may be readily obtained.

Canadian Patents.

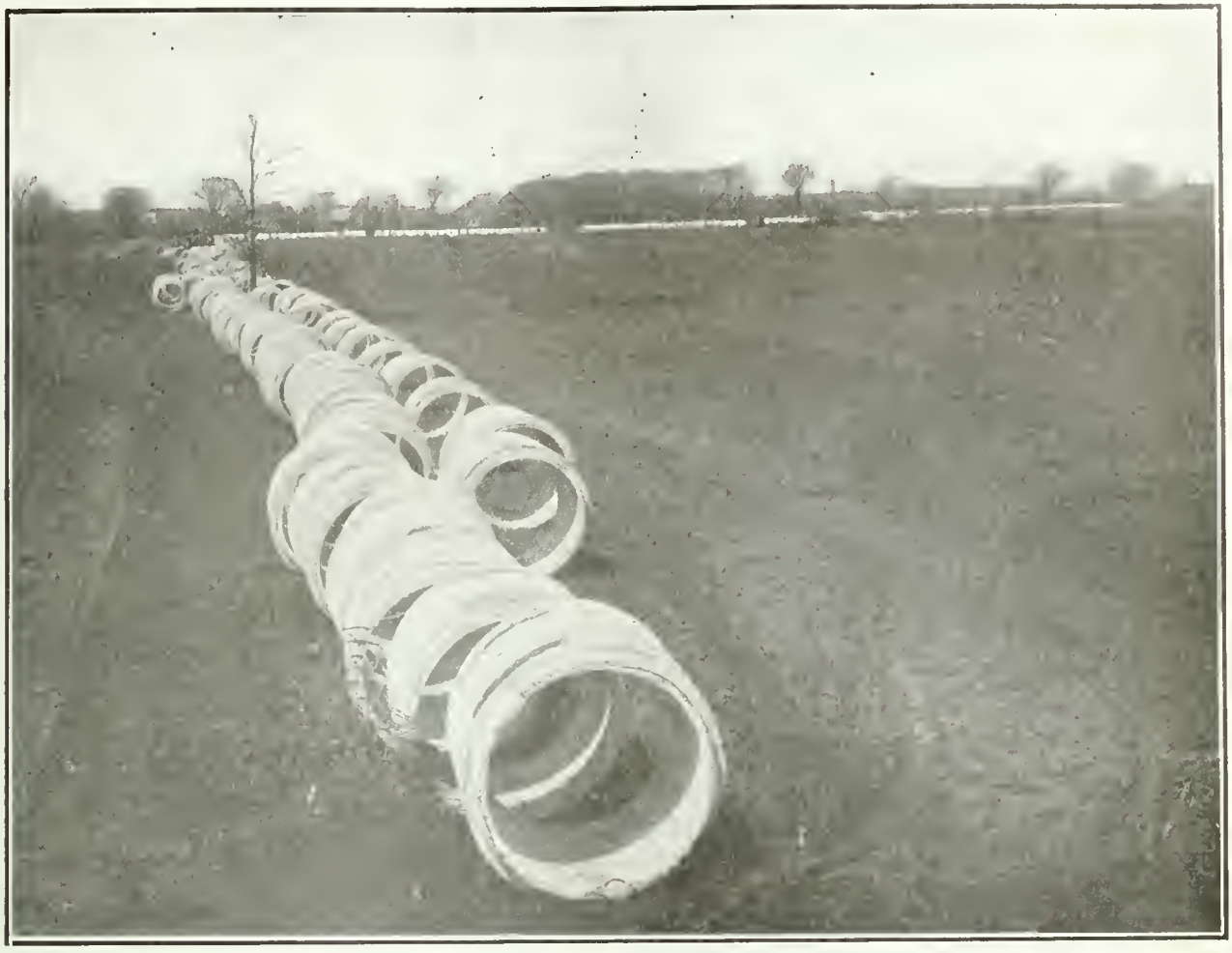
S. Schopflocher, composition for flooring and the like; W. P. Armstrong, dummy figures; F. A. Winterson, lanterns; A. Hackett, steam generators; A. Hilliard, combination tools; H. C. Jarvis, wall paper display standards; A. E. W. Langford, attachments for stoves; G. P. Maud, swinging stall-posts; B. Moore, stove pots; G. W. Morey, baby jumpers; N. E. Nash, boiler feeding apparatus; T. G. Priestland, devices for opening or closing screw-sealed vessels; A. E. Trentowsky, cooking utensils; F. A. Warner, sounding devices; I. Therrien, smoke consumers.

United States Patents.

A. S. Hamilton, detonator magazine; I. Therrien, smoke consumers.

AMERICAN CONCRETE INSTITUTE.

The first annual Convention of the American Concrete Institute, which is in reality the tenth Convention of the National Association of Cement Users, the name having been changed by amendment of charter on July 2nd last, will be held in Chicago, February 16th to 20th, 1914, and promises to be one of the most successful and important in its history. Announcements will be made from time to time as to programme and other features.



54-inch pipe distributed for sewers at Montreal, Canada.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED

CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, August 2nd, 1913.

Prices hold very steady, being again unchanged, as follows:—

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ¼ base; tire steel, $2.30 for 1 x ¼ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Copper.—Prices are 16¼c. Excellent demand.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are: Queen's Head, $4.35; Colborne Crown, $4.25; Apollo, 10¼ oz., $4.25. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lead.—Prices are firm at $5.35.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $2.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is active and strong:—$36 for 6 and 8-inch pipe and larger; $37 for 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the followiog is 73½ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.40; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black and 63½ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, August 6th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16½ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ¼ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1¼ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in., $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Clevelaod, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.30	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gange, $2.80; 26-gange, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, August 5th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $12.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie nut, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.90; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gange, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gange American, $5.15; Fleur de Lis, 22 to 24-gange, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.90; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 13½c.

Tool Steel.—8½ to 15c. per pound

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Contents of this issue on page 309

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

RAILWAY TRANSPORTATION PROBLEMS OF THE FUTURE

PRECEDENTS OF PIONEER RAILROADING OVERTURNED BY NEW FACTORS—THE QUESTION OF GRADES A HANDICAP TO CO-OPERATION—SYSTEM OF GRADE PROFILE ANALYSIS IN NEED OF REVISION—ELECTRIC TRACTION SHOULD NOT BE DELAYED.

By J. GRANT MACGREGOR, C.E., Mem. Can. Soc. C.E.
Chief Engineer, The Alberta Central Railway Company.

THE building of so many transcontinental lines across the Dominion, and the opening up of new inland and ocean waterways for the transportation of the produce of the country may be regarded as the dawn of a new era in the history of railway transportation.

The rapidity of the pace set by competitive lines is in a measure responsible for the state of bewilderment in which the country now finds itself when confronted with the most important railway building and transportation problems of the age. The situation has been the subject of much controversy both among members of the engineering profession and those concerned financially in the economics of present-day railway construction and operation. Precedents based on past experience in pioneer railroading have been disregarded, and the researches and life work of the greatest authorities on railway economics have been found antiquated when compared with the progress of recent events.

There is also a decided lack of harmony between different departments of the various railways in regard to the advantage of the present practice of building railways with long stretches of low ruling grade, all of which tend to unnerve the engineer who may have placed too much faith in the adaptability of old and well-known rules to modern conditions.

The question that now arises is, to what extent are the conditions changed that require a departure from well-known rules and practice in railroad building. The two greatest factors that have entered into, and hold sway in all problems of railway engineering and operation since the invention of steam, are those of "Tractive Power" and "Train Resistance," and as long as the law of gravitation exists we shall have at least one of them to contend with. In considering the other factors, the development of steam tractive power and its application to overcoming train resistance, we find that no great strides have recently been made whereby increased efficiency in the hauling power of locomotives should bring about a change in the conditions affecting grade and alignment. Until closer co-operation is instituted between the operating and engineering departments of the various railways very little will be accomplished in the way of building railways on a basis by which the best results can be obtained in their operation. Too frequently is advantage taken of a new line with low grades as an accessory for the use of old or obsolete engines whereby a saving can be affected to the operating department at the expense of the construction department.

If by constructing railways with lower ruling grades a solution is not obtained to the problem of hauling heavier train loads with present engine efficiency, then a step has been taken in the wrong direction, which is not at all unlikely. The solution, however, will not be found in any further development of the increased weight of the present unit of steam tractive power. More likely it shall be found where a greater number of units are used whether of steam, electrical or oil gas propulsion, whereby the load to be hauled can be increased to a proportion consistent with the proper train unit for minimum cost of operation.

But, to return to the question of the value of lower ruling grades, it should not be necessary at the present time to make a strong plea for their use wherever they can be introduced at a reasonable cost. The fact that millions are being spent annually by the various trunk lines on grade reduction should be sufficient evidence that the movement has got beyond the experimental stage. The wisdom of such a course is apparent from the beneficial results obtained in the way of increased revenue and lower cost of operation. The changes and modifications of grade profile designed to produce the beneficial results obtained have invariably been based on well-known rules in railway location and data obtained from experiments of the actual performance of trains under the conditions sought. If there should be any uncertainty about the continuous performance or endurance of certain classes of locomotives on long stretches of low ruling grades the sooner the value of such a factor is taken into account the better. In the meantime, are we to assume that the defect is of a mechanical nature and that, until such time as it can be removed the grade profile should be modified to provide suitable resting places for the recuperation of the "old horse"?

Under present conditions what is most urgently required is a more definite system of grade profile analysis, by which the proper amount of tractive power can be as-

signed to the requirements of each division of road to be operated. The analysis referred to once carefully prepared and put in graphic form should show the performance of each class of engine between stations, with a load line adjusted to conform to the requirements of minimum speed over long stretches of ruling grade. To obtain satisfactory results close co-operation is necessary between all departments affected.

The growth of the trade of the Dominion affecting transportation companies is so rapid that greater caution than ever should now be exercised in constructing new arteries of commerce. It would appear that in determining the main arteries of commerce of the future, greater consideration should be given to conditions affecting their future development than to questions of rapid transit and shortest route under present conditions. The fact must not be overlooked, however, that there will always be a limit to the extent to which physical obstacles can be removed from a route, and for this reason it may be necessary to look for developments along other lines. Some of the sources from which relief must be expected are already to some extent receiving attention from the principal transportation companies, such as greater facilities for a more speedy and continuous flow of traffic in both directions along the main arteries, with corresponding facilities for the better handling of freight at distribution and terminal points.

If the demand, however, for increased train loads should continue to find favor a change in the present principle of the application of tractive power to the hauling of trains must be expected. It is to be hoped the day is not far distant when it will be found more economical to combine the power now developed by such a huge fleet of locomotives into stationary engines for the distribution of power in a manner better adapted to modern requirements so that it shall no longer be necessary to have one or two portable power houses attached to each train unduly wasting the products of our mines and diffusing the sparks which destroy the combustible products of the forests and prairie.

THE USE OF EXPLOSIVES.

The mining engineering profession is accustomed to consider the use of high explosives as its especial field. It is probably not generally realized how widely explosives are used otherwise. Disregarding the strictly engineering work of excavation in rock or compact material on a considerable scale, explosives are finding an increased application in more varied lines. Dynamite seems to be not only available, but highly efficient for such purposes as extracting stumps; breaking subsoils to assist drainage and the entrance of plant roots; digging post holes; ditching, especially for drainage purposes; blowing out holes for planting trees; breaking up unwieldly boulders and excavating in connection with road work.

The National Paving Brick Manufacturer's Association will hold its tenth annual meeting at Cleveland, Ohio, on September 17 and 18. This is the first summer convention the association has held, the former custom of holding winter meetings having recently been altered to afford opportunity for investigating actual work on brick street and road construction. Officers of the National Paving Brick Manufacturers' Association are:—Charles J. Deckman, Cleveland, president; Will P. Blair, Cleveland, secretary.

INSULATION OF JOINTS IN PIPE LINES.*

By William R. Conard,
Inspecting Engineer, Burlington, N.J.

SOME years ago it was the writer's privilege to secure pipe for carrying high-pressure gas, or rather that was the term used in speaking of it, and the thought was that it might be of interest to the New England Waterworks Association to have a short description of the manner in which these pipes were laid in an endeavor to get a line as nearly proof against electrolytic action as possible.

The pipe were of the ordinary bell and spigot type with the bell made 5 in. deep and with no lead groove (see Fig. 1), and were tested to 50 lb. of air per sq. in. at the foundry in addition to the regular hydrostatic test. In all there were about 15 miles of 6-in. pipe.

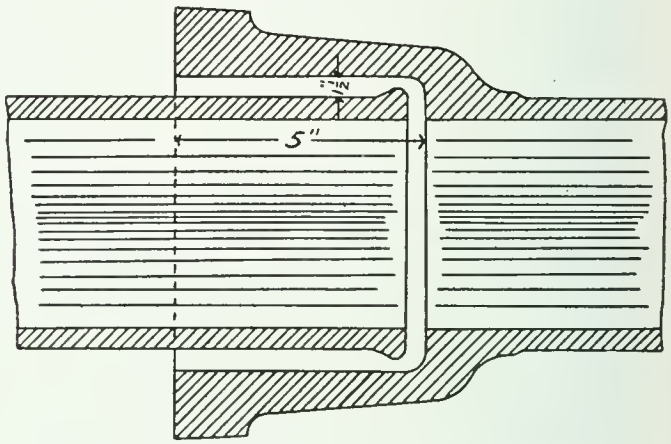

Fig. 1.—Cross-Section of Bell and Spigot.

In laying these pipe the joints were made up by placing at the base of the bell ¼-in. wooden ring, oil-soaked; the spigot of the pipe next to be used was then encircled with a rubber band about 1/16 in. thick and 2½ in. wide placed about 5½ in. from the spigot end of the pipe to prevent an iron ring, afterwards put on, coming in contact with the pipe; the pipes were then put together, the spigot going home against the wooden ring, and about 1½ in. of untarred jute packing calked tight; instead of lead being poured in to make the rest of the joint, an insulating compound about 3 in. deep, black in appearance, which melts readily at 200° F., was poured, after which a square rubber packing was put on, and then a No. 4½ Dresser coupling was applied to the joint and clamped tight (see Fig. 2).

To those unfamiliar with the Dresser coupling, it may be described as consisting of two split clamp rings; one split clamp ring fitting around the outside of the base of the bell, the other around the outside of the spigot end of the pipe, entering the bell, with a 1-inch square rubber packing ring between it and the bell. The two rings are connected and drawn towards one another by four bolts, one ring pressing against the square rubber packing.

The line, after laying and in sections, was tested with 20 lb. per sq. in. air pressure, and all the joints found tight.

Joints made up in this manner are as flexible as poured lead joints, acting just as readily as expansion joints,

*Read before the New England Waterworks Association, February 12, 1913.

and electric tests made shortly after installation indicated no flow of electricity at all, although, the entire pipe line parallels an electric car line.

The expense of a line like this figured about three times greater than for an ordinary lead joint, but for a gas line it was considered very desirable that it should be no conductor of electricity.

It is probably true that the rubber used in these joints will in time disintegrate, but it is also true that it will last for quite a number of years, for the moisture in the earth and the absence of exposure to the atmosphere should keep the volatile particles of the rubber alive for a long while.

As an insulated joint to prevent pipe lines from carrying stray currents of electricity it would appear that it would be fully as serviceable for water as for gas lines.

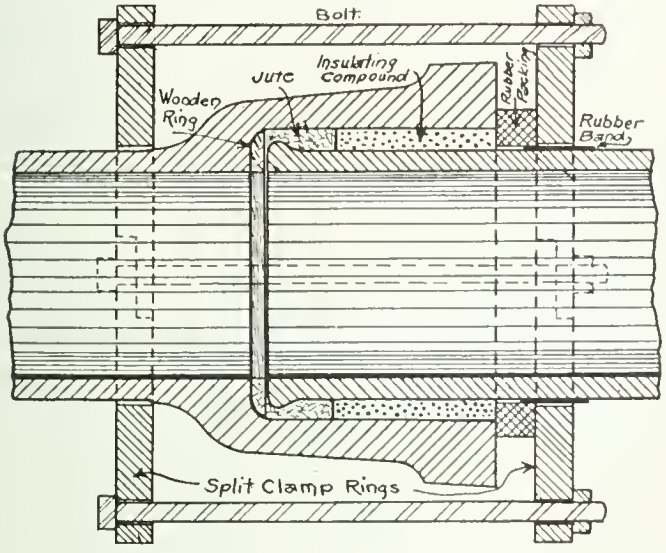

Fig. 2.—The Joint Constructed.

Since writing the above I learn from Mr. Brackett, chief engineer of the Metropolitan Waterworks, that rubber insulated joints have been used by them and were successful when installed, but due to a large amount of current charging the pipe from a heavy electric storm, the rubber was in part carbonized and thereby became a conductor rather than an insulator. It would appear, therefore, that so long as electricity can be prevented from collecting in large volume, the joint described is an efficient insulator, but one can never tell what is going to happen during an electric storm. If the rubber once becomes carbonized or loses volatile properties, it fails as an insulator.

The Lincoln Highway Association, formed to secure the establishment of an ocean-to-ocean highway, to be a memorial to Abraham Lincoln, has established headquarters at Detroit. The highway, plans for which are nearing completion, is to cost approximately $10,000,000, of which $4,200,000 has already been subscribed. The association proposes to co-operate with local communities in procuring the establishment of the highway, to be engaged in the improvement or reconstruction of existing highways, which will constitute a part of the route. Several States along the line have already taken steps towards the construction of improved highways from east to west to connect with the coast-to-coast route. Mr. H. B. Joy is president of the association.

THE SYDNEY COAL FIELDS.

By Joseph G. S. Hudson.

THE mines branch, Department of Mines, Ottawa, in a bulletin specially prepared for the International Geological Congress, by Mr. J. G. S. Hudson, gives some interesting historic facts concerning the Sydney coal fields of Cape Breton, Nova Scotia. The sketch is as follows:—

The maritime provinces of Canada, owing to their geological position on the Atlantic seaboard, were the first in Canada to have their mineral resources explored. Among these resources coal is one which stands pre-eminent, and Nova Scotia has for over 200 years had an enviable reputation as a producer of bituminous coal.

The first printed notice of the existence of coal in these areas appeared in 1672, when Nicholas Denys published in Paris, "La Description Geographique et Historique des Costes de l'Amerique Septentrionale." Eighteen years before, in 1654, Denys had obtained from Louis XIV., a concession granting the right to explore and work mines of gold and other minerals; for this privilege he agreed to pay the King a royalty of one-tenth. In 1677, M. Duchesneau, the Intendant of New France, issued a proclamation, exacting a royalty of 20 sous per ton, from all persons taking coal from Cape Breton. In 1711, Admiral Walker—who commanded an expedition to reduce Quebec—mentions in his journal, that he procured a supply of coal from the cliffs, with no other appliances than crowbars.

The initial attempt at systematic mining was made in 1720, when it was found necessary to procure a supply of fuel for the men who came from France to lay the foundations of the fortress of Louisburg. The pit openings then made, can be seen even at the present day, at Port Morien, Table Head, and other places. During the next 100 years, very little work was done, the coal mined being used almost exclusively by the garrison at Halifax. In 1820, however, when Cape Breton Island became part of the province of Nova Scotia, a considerable tonnage of coal was being mined. In 1827 all the mines were transferred to the company known as the General Mining Association by the London firm of goldsmiths (Rundle, Bridge, and Rundle) who had secured the mines and minerals concession for the entire island province of Cape Breton, from the Duke of York. The new owners immediately organized, opened out, and systematically operated, mines in Cape Breton, Pictou, and Cumberland counties. A formidable agitation had been started in the province for some years previous to 1858, claiming that the monopoly of the coal lands by the General Mining Association was seriously retarding the legitimate expansion of the coal trade; this agitation eventually resulted in the whole subject being referred to the privy council of Great Britain for equitable adjustment. In 1858, the Mining Association surrendered its claims to the provincial government of Nova Scotia. The government, in return, agreed to abolish the fixed rental of £3,000 per annum, together with the royalty on slack coal; to reduce the royalty on all screened coal up to 250,000 tons, to 4.80 pence per ton; and to reduce the royalty on all coal sold over 250,000 tons to 3.20 pence per ton. To the association, however, was reserved the exclusive right to 20 square miles in Cape Breton, and to 4 square miles each in Pictou, Joggins, and Springhill counties respectively. Under this new regime, mining developed to such magni-

tude that, in 1865, the provincial government appointed an inspector of mines (John Rutherford, M.E.)—the first on this continent.

In, 1854 the government of the United States removed the duty on coal. This "open door" policy greatly increased the trade with the New England States; in 1866, the exportation of coal thereto amounted to 404,252 tons. In 1867, however, (year of Confederation) the United States once again discriminated against Canadian coal, imposing a duty of $1.25 per ton. This duty was maintained at this rate until 1872, when it was reduced to 75 cents per ton; at which figure it remained until 1894. During this latter period, the exports fluctuated from 228,132 tons to 13,883 tons. During the period 1894-97, the tariff was reduced to 40 cents, but in 1897 it was advanced to 67 cents, at which figure it still remains. Notwithstanding the tariff barriers, the exportation of Nova Scotia bituminous coal to the New England States continued to increase, and in 1903 the shipments reached a maximum of 968,832 tons. There has been a gradual decrease since that date, and in 1912 the shipments were 412,531 tons. The total production has, however, increased enormously; in 1912 it was 6,802,997 tons (of 2,240 pounds). Of this production 5,197,601 tons are to be credited to the coal fields of Cape Breton.

This marked increase in the production is due in part to the increased market offered by St. Lawrence ports. In 1877 a select committee of the Dominion parliament, appointed to inquire into the condition of the coal trade, recommended the imposition of a duty on United States coals; this duty has had the desired effect of opening up the markets of the St. Lawrence to the Nova Scotia coal trade, and in 1912 the St. Lawrence market alone purchased 2,159,005 tons, most of which came from Cape Breton.

On February 1, 1903, the Dominion Coal Company was organized with a capital of $18,000,000 by a special Act of the Legislature of Nova Scotia. This corporation amalgamated the principal interests in the coal areas on the south side of Sydney harbor, Cape Breton. These included the Caledonia, International, Gardiner, Old Bridgeport, Glace Bay, Reserve, Gowrie, Victoria, and Ontario mines, also the Sword areas, in all comprising 70 square miles; the areas controlled have now been extended to 142 square miles. With the advent of this great industrial organization, a new era in Nova Scotia coal mining began; new mine workings, railway extensions, new shipping and discharging facilities were developed, old coal markets were expanded, and new ones opened out, so that the whole coal trade was revolutionized. In the first year of its operations (1893) the coal mined was 834,019 tons; in 1912, the production amounted to 4,332,320 tons; or an increase of nearly 520 per cent. in 20 years.

In 1900, the Nova Scotia Steel and Coal Company acquired all the mining rights still held by the General Mining Association. In addition to operating the existing collieries, they have opened out new mines, erected iron and steel works, and built a modern coke oven plant, all in close proximity to the working collieries. Their Princess Pit—now known as Sydney No. 1—was, in 1873, the first submarine mine in North America, the coal being won from workings under the sea. The shafts are of unique construction, consisting of metal cribbing or tubbing. The total length of metal tubbing is 842 ft. 9 ins., weighing some 776 tons. Here, also, was erected the first Guibal ventilating fan in Cape Breton.

The most important of the Cape Breton coal fields is that known as the Sydney field. It is an extraordinarily rich tract of coal bearing rocks, having an area of approximately 250 square miles. It extends along the northern coast of Cape Breton island for a distance of about 35 miles. Geologically the coal bearing strata are bounded by the outcrops of the Millstone Grit, as seen at Mira Bay, and they terminate at Cape Dauphin, where the intrusive syenites of the Ste. Anne hills form the northern boundary of the Great Bras d'Or Lakes. The Sydney field is divided into four main basins, as follows:

(1) Cow Bay or Morien Basin, defined on the east by the Millstone Grit and on the west by an anticlinal fault that dips seaward at Cape Percy.

(2) Glace Bay Basin, bounded by the Cape Percy anticline on the east, and by the Bridgeport anticline on the west.

(3) Lingan-Barasois—Victoria Basin. This basin has not so well defined boundaries as the two preceding basins but it extends from Bridgeport anticline, passing the eminence known as David Head, to a submerged fault which exists midway in Spanish Bay and Sydney Harbor.

(4) Sydney Mines or Bras d'Or Basin. This basin extends from the submerged fault in Spanish Bay to the western termination of the coal measures at Cape Dauphin.

Mr. Richard Brown, the well-known author of "The Carboniferous System of Cape Breton," states that the thickness of the productive measures of the Sydney field will not exceed 6,000 feet. This measurement is taken from Burnt Head in the Glace Bay Basin, where the highest known bed occurs, down to the Millstone Grit. It is possible that the extended deep workings at this point may, in the future, accurately determine their actual thickness.

The bulletin includes a set of summary records of analyses of Sydney coals, and fifteen plates of sections of coal seams and strata, some of them representing a depth of over 1,500 feet. An index map of the fields is appended.

Logan Waller Page, Director of the United States Office of Public Roads, will read a paper at the Road Congress at Detroit on the "Selection of Road Materials." Before he was appointed to his present post Mr. Page assembled at Harvard University the first road material testing laboratory in America, following his studies at the French School of Roads and Bridges, and his name is now identified with some of the best-known apparatus for road material tests. The selection of road materials is an exceedingly important factor in the building of a road, and it is certain that Mr. Page's paper will receive the closest attention.

The world's largest power plant is projected to be located at Big Eddy, on the Columbia River, a few miles above the Dalles. The gorge at this point is of such a character that comparatively little work will be required to impound a great quantity of water, sufficient to develop 300,000 horse-power. The river can be entirely closed by the construction of a dam only 300 feet long and 180 feet above its foundations, and the construction of a canal 300 feet wide, 20 feet deep and a mile and a half in length. The head of water is 73 feet at low tide and 42 feet at high water, and the mean flow of the river throughout the year is 235,000 cubic feet per second. The hydro-electric units would be each of 32,000 horse-power. The total cost of the scheme would be about $23,000,000.

DESIGN AND GRAPHIC METHOD FOR CALCULATING A STEEL TRUSS.

By Leonard Goodday, C.E., M.E.,
Late of the British Admiralty.

IT is very well known by engineers that the graphic method is the best, quickest and most practical way for calculating the various stresses on the different members in steel work, etc., the diagram showing at a glance what the actual stress is on each strut or tie. The following is for a truss which was calculated some years back for the roof of a gymnasium built for the accommodation of 1,600 naval cadets. The building is 136 ft. 6 ins. by 60 ft. in the clear, the trusses being placed 10 ft. 6 ins. apart, so that there are 12 trusses in all. Fig. 1 shows details of design for one half span, and also stress diagram.

Starting with the weight on the truss, and taking the wind into account, dead weight, when worked out, equals 55.8172 lbs. per sq. ft. Superficial area equals 10.5 × 35.125, or 368.85 sq. ft., from which the total weight is found to be 9.20 tons. The truss is of the Warren type, and the distributed weight equals 0.92 tons at each end of half span, and 1.84 tons on each apex.

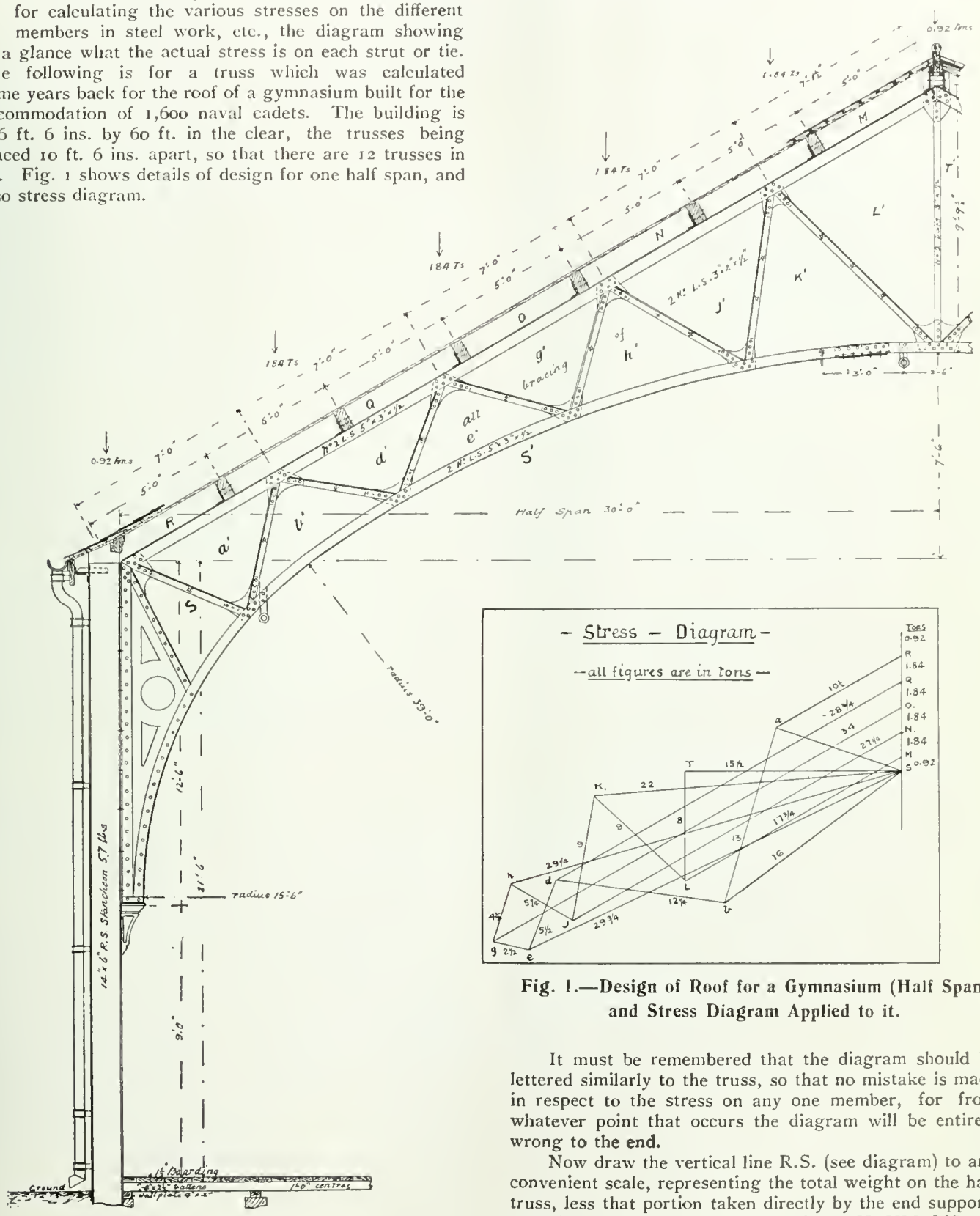

Fig. 1.—Design of Roof for a Gymnasium (Half Span) and Stress Diagram Applied to it.

It must be remembered that the diagram should be lettered similarly to the truss, so that no mistake is made in respect to the stress on any one member, for from whatever point that occurs the diagram will be entirely wrong to the end.

Now draw the vertical line R.S. (see diagram) to any convenient scale, representing the total weight on the half truss, less that portion taken directly by the end support, and divided into the lengths RQ, QO, ON, NM, MS, re-

presenting the various weights in tons, as shown. It will be noticed that the lettering of the panels, and the naming of a member by the letters on either side simplifies the process throughout.

From R	and	S	draw	Ra, Sa,	parallel to	Ra′	and	Sa′	on sketch	until	they	intersect	at	a
" a′	"	S	"	ab, Sb	"	a′b′	"	Sb′	"	"	"	"		b
" Q	"	b	"	Qd, bd	"	Qd′	"	b′d′	"	"	"	"		d
" S	"	d	"	Se, de	"	Se′	"	d′e′	"	"	"	"		e
" O	"	e	"	Og, eg	"	Og′	"	e′g′	"	"	"	"		g
" S	"	g	"	Sh, gh	"	Sh′	"	g′h′	"	"	"	"		h
" N	"	h	"	Nj, hj	"	Nj′	"	h′j′	"	"	"	"		j
" S	"	j	"	Sk, jk	"	Sk′	"	j′k′	"	"	"	"		k
" M	"	K	"	ML, KL	"	ML′	"	K′L′	"	"	"	"		L
" S	"	L	"	ST, LT	"	ST′	"	L′T′	"	"	"	"		T

S′ represents the curved tie in each panel. The stress on each member in the truss is represented by the line parallel to it in the diagram, i.e., stress in K′L′ equals 9 tons and in M′L′ equals 17¾ tons, etc.

The check on the diagram can be seen at once, as the lines TL and TS representing the tension on the vertical and horizontal members at centre will also be vertical and horizontal respectively. These stresses can also be calculated mathematically as a further check.

The accompanying table shows the actual sectional area required for the various members.

The holes for rivets are generally made ⅛ in. larger in diameter than the rivets.

The plates at joints are ½ in. in thickness. In no cases should they be less than ⅜ in., otherwise they are liable to cut through the rivets. Cutting the plates to the shape shown makes a far neater job, makes the truss lighter, and looks more workmanlike. The larger rivet of ⅞ in. makes a better "snap," and each head has a better grip, which makes the structure more rigid and less likely to wear lose, and consequently makes the truss more durable. The bracings should be neatly chamfered at the ends, so that the flats can fit properly together, and have a good bearing with the plates. The riveting should be carefully done so as to fill the holes, otherwise they are not reliable. In heavy work extra rivets are put in to allow for defective work, especially in girder work. This work was made extra stiff to allow for vibrations which would be caused by the trapeze which were slung from the main ties by rings fixed for that purpose.

Lastly, one of the main points to be observed in constructing the stress diagram is to work from the eaves, and to have three forces complete at each step.

Table Showing Sectional Areas and Scantling.

	Principal and bottom curved tie									Bracings									
Scantling	Ra′	Qd′	Og′	Nj′	ML′	bs′	e′s′	h′s′	K′s′	Sa′	a′b′	b′d′	d′e′	e′g′	g′h′	h′j′	j′K′	K′L′	L′T′	T′S′
Stress in tons	10½	28¾	34	27¼	17¾	16	29¾	29¼	22	9½	13	12¼	5½	2½	4½	5¼	9	9	8	15½
Net area required	1.8	4.8	5.7	4.5	3.0	1.7	5.0	5.0	3.7	1.6	2.2	2.0	0.9	0.4	0.8	0.9	1.5	1.5	1.3	2.6
Gross area required	No. 2 ⅞" rivets area = 1.20 + 5.7 = **6.9 gross**									No. 2 rivets = 1.20 + 2 + 2 = **3.4 gross area**										
Bars at centre	No. 2 ⅞" rivets area = 1.20 + 1.3 (L′T′) = **2.5** against No. 2 vertical bars at centre = 2 × 3 × ½ = **3.0**																			
Principals, &c.	No. 2 L.I.S. 5" × 3" × ½" = 2 (5 + 2½) × ½ = **7.5 sq. ins.**—No. 2 L.I.S. 3 × 2 × ½ = 2 (3 + 1½) × ½ = **4.5 sq. ins.**																			

The stress allowed in this case is 6 tons per sq. in. It will be noticed that stress on the different panels for the principal and curved or main tie naturally changes at each end, and also for the bracing, and that, for economy as well as simplicity in construction, it is always best to have one sectional area only. Consequently the greatest stress in each case is taken, i.e., for the principal and curved tie 34 tons is taken, and for the bracing 13 tons. This becomes 5.7 and 2.2 sq. in. respectively when worked out, and, adding in each case 2 holes of ⅞ in. diameter, the final results amount to 6.9 and 3.4 sq. in. gross area respectively. It will be seen that the principals and curved ties composed of No. 2 L.S. 5 in. by 3 in. by ½ in. gives 7.5 sq. in., against 6.9, and that the bracing composed of No. 2 L.S. 3 in. by 2 in by ½ in. equals 4.5 sq. in., against 3.4. At the centre of truss L′T′ has a tension of 1.3 tons and for two rivet holes 1.20, so that the total amounts to 2.5 sq. in., and No. 2 vertical tension bars having 3.0 sq. in. will be about right. The rivets should never be less than ⅞ in. for this span of 60 ft., although ¾ in. diameter rivets are sometimes used, but then more rivets are needed at the joints, and consequently the plates are much larger and therefore clumsy. In work of this kind it is not always wise to consider the rivets in double shear where this occurs, as practically no rivet is ever sheared in two places at once. It must be remembered that at the joints there must be enough rivets in the end of each bracing or tie to take the thrust or pull in either case. The pitch of rivets for the principals and curved or main tie equals 3½ ins., and for the bracing 2⅝ ins.

A new hard alloy of platinum has been produced by Dr. Fritz Zimmerman, of Newark, N.J., by the addition of osmium. It is claimed that this alloy, containing from one-half to 10 per cent. of osmium, having physical and electrical properties fully equal to the platinum alloy containing a much higher percentage of iridium.

September 22nd, 23rd and 24th are the days of the annual meeting of the American Mine Safety Association, the membership of which is composed of coal and metal mine operators, mining engineers, etc., and having for its object the reduction of the number of accidents in mines and quarries. The Convention will be held in Pittsburg, Pa. An interesting paragraph in the prospectus recently issued is the following: "Since fifty-eight per cent. of all industrial accidents are shown by statistics to be due to negligence, carelessness or lack of knowledge of employers or employees, the vital necessity of learning everything possible about the causes and means of preventing these accidents must be evident to every man concerned in mining. To the operators it spells business success or failure; to the miner, life or the physical ability to work and support a family."

THE CONTROL OF RIVER FLOODS.*

By Col. C. McD. Townsend, M.Am.Soc.C.E.
United States Corps of Engineers.

THE subject of land drainage is intimately associated with that of river improvement. The cultivation of the soil largely increases the amount of sediment entering our streams; the direction of the furrow markedly affects the amount of rainwater that flows from its surface, and every ditch or subsurface drain promotes a more rapid flow into our rivers during floods and possibly affects their discharge during low water. On the other hand, no satisfactory system of land drainage can be accomplished in a country subject to periodic overflow by river floods. In the Mississippi Valley protection from floods is absolutely required before any regular system of drainage can be inaugurated. The overflow is so great and the amount of sediment carried by the river so large, that the drains would be annually destroyed or filled. The floods not only insure the destruction of any crops that might be planted, but also usually occur at such times as to prevent the harvesting of a second crop the same year.

Sources of Floods.—Before entering upon such a discussion of the means of preventing these floods, it is desirable to have a clear conception of the sources from which floods arise. The greater Mississippi Valley is bounded on the east by the Appalachian chain and on the west by the Rocky mountains. These mountain ranges exert a great influence on its floods. The winds blowing from an easterly direction deposit most of the moisture they absorb from the Atlantic Ocean on the eastern slope of the Alleghenies, and therefore cause little rain in the Mississippi Valley; the Rocky Mountains intercept the moisture from the Pacific Ocean. While showers occur from winds blowing over the Great Lakes, the original source of the floods of the Mississippi is to be sought in the Gulf of Mexico.

During the winter and spring the land of the Mississippi Valley, no matter what its soil or the nature of its covering, is cooler than the waters of the gulf, and a southerly wind becoming saturated with moisture as it passes over the water will precipitate that moisture on the land in copious rains, or in snow when the temperature is sufficiently low. A wind from the southwest sweeps up the Ohio Valley; one from the south carries moisture to the Upper Mississippi; one from the southeast to the valleys of the Arkansas and the Missouri; but in all cases there is a tendency for the greatest rainfall to occur near the coast, and gradually to decrease as the wind currents travel inland.

Generally speaking, the rainfall is very unequally distributed over the Mississippi Valley, being least at the upper sources of the tributaries, and rapidly increasing as the main stream is reached, though an exception is to be noted in the southern tributaries of the Ohio, whose sources are nearer the gulf than are their outlets.

The maximum discharge of the Upper Mississippi River is estimated at 450,000 second-feet; the Missouri, 900,000; the Ohio, 1,400,000; the Arkansas, 450,000; and the Red, 220,000. There is also a large discharge from the Yazoo, St. Francis, White, Tensas, and Ouachita rivers. The maximum discharge of the Mississippi during the flood of 1912 was about 2,000,000 second-feet at Cairo, and 2,300,000 at the mouth of the Red River. It overflows its natural banks when the flow exceeds 1,000,000 second-feet.

While the influence of forests on stream flow has received little attention in this country until recently, the scientists of Europe have discussed the subject pro and con during the past forty years. It is generally accepted by both sides that the leaves falling from forest trees as they decay form a humus which has a large capacity to absorb water, and that when the forests are felled this humus is seriously injured by forest fires. It is also admitted that snow is more rapidly melted when it is exposed to the direct rays of the sun in an open field than when sheltered from such action in the forest. In fact, it has been found by the United States forestry service from experiments recently made in the White Mountains that the flow from cleared fields under such conditions is about twice that from forests. The forest advocates claim that this is sufficient proof that forests absorb water during flood periods, which percolates through the ground and flows from springs later in the season, thus reducing flood heights and increasing the low water flow of rivers. Its opponents do not admit that the problem is thus easily solved. They claim that floods do not arise from the melting of snows by the direct action of the sun; that this process is so slow that the water which flows off would not raise a river to mid-stage; that floods occur when on a layer of snow there falls a copious supply of rain, and both the rain and melted snow enters the stream simultaneously; and that under such conditions the forest, instead of being beneficial, is injurious. On cleared land the wind tends to blow the snow from the ridges and piles it in immense masses in the ravines, while in the forests the snow is uniformly distributed. A few days of sunshine dries out the ridges in the open field and melts sufficient snow in the forest to saturate with water the underlying humus.

If a heavy rainfall then occurs, the forest humus, being saturated, can absorb no more water, and the combined rain and snow of the forest flows into the streams, while in the cleared land, the ridges having dried out, absorb a large portion of the rainfall, and the snowdrifts expose a much smaller surface to the action of rain. Moreover, during periods of great drouth the forest humus and long, deep tree roots also absorb more water than grass and farm crops, and retard the run-off at a time when it is most needed for low water navigation. They therefore maintain that a forest is a fair-weather friend of some use in regulating the mid-stages of a river, but an utter failure when most needed—that is, during extreme floods or extreme low water. While I consider this discussion valuable, my objections to reforestation are not based solely on a scholastic argument.

It requires from twenty to fifty years to produce a good forest growth, and over a century for the leaves of that forest to decay in sufficient quantities to produce the humus which will be satisfactory as an absorbent of rainfall. We can not afford to delay the drainage of the Mississippi Valley even to produce the forest growth, without taking into consideration the time required for the humus to form. We are more vitally interested in the height that the river will attain in the next few weeks than in what will occur in the year 2013.

It is also pertinent to this discussion to determine what would be the extent of the forest reservation which would be required to reduce the flood heights on the Mississippi River a given amount. To solve this problem

*Paper read at a recent meeting of Drainage Congress in St. Louis.

it is necessary to make certain assumptions, and for purposes of argument we will take it for granted that reforestation will reduce the flood discharge of a stream one-half. The Mississippi flood of 1912 attained the greatest height of any then recorded at all gauge stations, except at Vicksburg. That of January and February, 1913, while 5 feet lower at Cairo, was the next highest flood at Memphis, and for a considerable distance along the river. We will endeavor by reforestation to reduce the flood of 1912 to the heights attained in the winter of 1913. For this purpose it will be necessary to reduce the maximum discharge of the river 500,000 second feet. It will also be necessary to distribute this reduction among the tributaries, reducing the maximum discharge of the Missouri River from 900,000 to 700,000 second-feet, that of the Upper Mississippi from 450,000 to 350,000, and that of the Ohio River from 1,400,000 to 1,200,000.

As stated in the introductory remarks, the flood discharge of the Missouri River at its headwaters is about 1 cubic foot per second per square mile of drainage area, and if the reduction in discharge of one-half is to be secured by reforestation 2 square miles of forest would be necessary for every second-foot of reduction of flood discharge, or 400,000 square miles of forests to reduce the discharge of the Missouri River 200,000 second-feet. At the headwaters of the Upper Mississippi the ratio of flood discharge to drainage area is about 2 second-feet per square mile. A reduction of this discharge by one-half would require a forest reservation of 100,000 square miles to reduce the floods of the Upper Mississippi 100,000 second feet. On the Ohio River the ratio is six to one, and it would therefore require forests at the headwaters of the Ohio having an area of 66,000 square miles to reduce its flow 200,000 second-feet. In other words, to reduce the height of a flood at Memphis by reforestation at the headwaters of the river from that of 1912 to the next highest on record would require a forest reservation of about 566,000 square miles, an area exceeding that of the portions of Montana and Wyoming drained by the Missouri River and North and South Dakota, the portion of Minnesota drained by the Upper Mississippi River, and the States of Wisconsin, Iowa, Illinois, and Indiana. But even such a forest reservation would afford only partial protection, and large expenditures for levees would still be required. Under the above assumptions, to prevent any overflow by reforestation would necessitate a practical abandonment of the valley for agricultural purposes, and the development of an extensive irrigation system to produce tree growth in arid regions of the west.

It is therefore apparent that even under the most extravagant claims of forestry advocates, reforestation as a means of reducing flood heights on the Mississippi requires the conversion of too much farming land into a wilderness to be practicable. The waste land that can profitably be converted into forest reservations is too limited in area to produce an appreciable effect on the floods.

Reservoirs.—To have retained the Mississippi flood of 1912 within its banks would have required a reservoir in the vicinity of Cairo, Ill., having an area of 7,000 square miles, slightly less than that of New Jersey, and a depth of about 15 feet, assuming that it would be empty when the river attained a bank-full stage. If the site of such a reservoir was a plane surface, the quantity of material to be excavated in its construction would be over 100,000,000,000 cubic yards; and its estimated cost from 50 to 100,000 million dollars. Such a volume of earth would build a levee line 7,000 miles long and over 150 feet high.

Cairo is the logical location for a reservoir to regulate the discharge of the Lower Mississippi. It will not only control the floods from the Ohio, but also the discharge from the Missouri and Upper Mississippi. But if the reservoirs be transferred from the mouths of the tributaries to the headwaters, their capacity must be largely increased. No two floods have the same origin, unless they are referred back to the Gulf of Mexico. The wind bloweth where it listeth. If the prevailing winds in the early spring are from the southwest, the southern tributaries of the Ohio furnish the crest of the year's flood; if more nearly from the south, reservoirs will be required on the streams of Ohio, Indiana, and Illinois; a slight varying of the wind will produce a flood in the Upper Mississippi, while if it blows from the southeast the principal sources of trouble will be the Red, Arkansas, and Missouri rivers. To control the flow of every stream in the Mississippi Valley by reservoirs is a pretty large job, even for the United States Government, but that is what the control of the Mississippi during floods by reservoirs signifies.

The advocates of the control of the floods of the Mississippi by reservoirs do not, however, have in mind any such radical control as is above indicated. They limit the control to the headwaters of the various tributaries, and while every stream that flows in the valley may be considered a headwater of some tributary, I judge from the discussions of the reservoirs and their proposed employment for power purposes, which requires a considerable height of dam, that by headwaters is meant the sources of the rivers in mountainous countries as distinguished from the more level plains, and more specifically the sources of the Missouri above the mouth of the Yellowstone, those of the Upper Mississippi in the State of Minnesota, and those of the Ohio in the Appalachian range.

The flood which is now devestating the country affords data for determining the effect of such a system of reservoirs and its lessons are the more valuable because no effort is necessary to refreshen the memory. When, on April 2, the gauge at Cairo attained a height of 54 feet, there was flowing down the Mississippi River at least 2,000,000 cubic feet of water per second. It requires about eleven days for a flood wave to be transmitted the 966 miles between Pittsburgh, Pa., and Cairo; on March 22, the Pittsburgh gauge read 5.3 feet, which is produced by a flow in the Ohio River at that locality of about 15,000 second-feet. In ten days a flood travels the 858 miles between St. Paul, Minn., and Cairo; on March 2 the reading of the St. Paul gauge was 0.5 foot, corresponding to a discharge of the Mississippi of about 2,500 second-feet. In eight days the effect of a flood at St. Joseph, Mo., is felt at Cairo; on March 25 the gauge at St. Joseph read minus 0.1 foot, representing a discharge of the Missouri River of about 17,000 second-feet. If a system of reservoirs had been constructed which would have prevented all flow from the Allegheny, the Monongahela, the Mississippi above St. Paul and the Missouri above St. Joseph, it would have reduced the 2,000,000 second-feet discharged by the Mississippi River at Cairo on April 2 less than 35,000 second-feet.

The water which passed Cairo on the 2nd of April came principally from the White and Wabash, and the lower tributaries of the Ohio, and after the water of these rivers started to subside the flood from Cincinnati, though increasing from 57 to 69 feet on the gauge, could

increase flood heights at Cairo less than 1 foot. The flood of 30 feet at Pittsburg on March 28 produced its effect on the Cairo gauge on April 8. It has merely prolonged the flood without increasing its height.

The proposed system of reservoirs would have cost hundreds of millions of dollars and its effect on this year's flood height of the Lower Mississippi could not possibly have exceeded 6 inches.

Neither the rain nor snow which falls upon the mountainous portions of the Mississippi watershed has much effect upon the floods of the lower river. The principal source of the floods is the great alluvial plain between the mountains. As pointed out, excepting the southern tributaries of the Ohio, the rainfall is relatively slight at the upper sources of the tributaries and their maximum flood discharge does not usually coincide with that of the mid-valley.

Great floods do not arise from average conditions, but from exceptional variations such as are caused by a series of heavy rains rapidly succeeding one another. Each rainstorm starts down a stream a flood, the volume of which can be absorbed by a reservoir with comparatively little trouble, but if a second storm sweeps over the valley the reservoir to be effective must be emptied or its capacity doubled. To hold all the excess rainfall till low water would require reservoirs of enormous capacity. Economic considerations usually require that the reservoirs should be emptied as soon as the crest passes, in order to utilize the same space for a second rainfall; so that while reducing the crest of a flood at a given locality they necessarily prolong the period during which the river remains at a high stage.

The water which is abstracted from the Gulf of Mexico is usually precipitated in the Mississippi Valley within a period of two days. The return flow extends over a period of two or three months. The sum of the maximum discharges of the various tributaries of the Mississippi River is nearly 4,000,000 second-feet, while the greatest measured discharge of the river itself is about 2,300,000. This apparent discrepancy arises from the fact that the floods of the tributaries do not reach the gulf at the same time. The crest of the Ohio River flood usually passes down the river in March or April, that of the Missouri in May or June. Moreover, the same law applies to the tributaries of a tributary. The waters of the southern branches of the Ohio tend to discharge into that river before those in Ohio, Indiana, and Illinois.

By the construction of reservoirs, this beneficient law of nature is deranged. Instead of the crest of the flood of one stream passing down the river before that of another reaches it, two prolonged high stages will obtain which will tend to synchronize and the resultant combination may be higher than either flood would have been by itself.

A system of flood control designed to be satisfactory for one city may be most disastrous to another locality further down stream. If a system of reservoirs had been in operation in the Allegheny and Monongahela rivers during last January, it would have protected Pittsburgh from overflow and diminished the flood at Cincinnati when it was 50 feet on the gauge, but only to increase it when it attained a height of 60 feet. And this effect would have been propagated to the gulf.

Pittsburgh, moreover, would never consent to such a manipulation of reservoirs on the upper tributaries of the Ohio as would insure the reduction of floods at Cincinnati or on the Lower Mississippi. Source stream control on the Mississippi River and its tributaries would therefore soon reduce itself to the question, Whose ox is to be gored?

Levees.—While the use of forests or reservoirs as a means of flood control is still in an experimental stage all over the world, the employment of levees for this purpose has been tested for centuries. The Po, Rhine, Danube, Rhône, and other rivers of Europe have been successfully leveed. The laws governing the flow of water in a confined stream have been carefully studied and the construction of levees is just as susceptible of mathematical analysis as other engineering problems. There is an element of uncertainty in all the forces of nature. No one can say positively, for instance, that St. Louis may not at some future time experience an earthquake or a cyclone of greater intensity than that which swept the city in 1896 There is also a possibility that there will be some combination of meteorological conditions which will create a flood of greater volume than has heretofore occurred in any drainage area. But the height to which levees should be constructed is as susceptible of determination as the strains to be permitted in an office building due to wind pressure or the moving load allowable on a bridge. The city engineer solves a similar problem whenever he constructs a sewer to carry off the storm water from the city streets.

Nor is there any evidence either that floods have been increasing in recent years, due to the cutting off of forests or that the beds of our main rivers are rising as they are leveed. The effect of forests on rainfall in Europe has been carefully investigated by Profs. Schlichting and Hagen. The records at London, Paris, St. Petersburg, and other localities where the rain has been recorded for long periods fail to show any tendency to an increased fall in recent years.

The meteorological records of the United States have not been maintained a sufficient length of time to be of much value in solving the problem. Such data as we possess indicate that the flood discharge has not increased in recent years. The greatest flood of the Mississippi at St. Louis occurred in 1844, the next largest in 1875. On the Great Lakes the high water of 1838 is the greatest on record. In the Ohio the flood of 1884 exceeded that of 1913 at Cincinnati, and that of 1832, while 5 feet lower at Cincinnati, was 5 feet higher at Pittsburgh than this year's flood. The gauge records at the bridges over the Upper Mississippi, which cover a period of thirty years, would indicate that the flow from Minnesota and Wisconsin, where the forests have been most extensively destroyed during the period, has been slightly improved, though the river shows signs of deterioration where it receives the flow from the prairie lands of Iowa and Illinois.

On the Merrimac River where the mill owners have accurate observations extending back to 1849 there appears to be some increase in flood discharge, though reports of the forestry commission of the State of New Hampshire and census returns from the State of Massachusetts indicate that the forest area of its basin is 25 per cent. greater than forty years ago, due to the abandonment of farms. Such records as we have in this country appear to confirm the conclusions of the German forestry authorities that the influence of forests on drainage is concealed by other causes more powerful in their effects.

The flood of 1912 was not due so much to excessive precipitation as to the fact that the surface of the ground was still frozen over the States of Illinois, Indiana, and Ohio, so that there was not the soil absorption of rain water that usually occurs.

There is not the remotest connection between deforestation and the disasters which have just occurred at numerous cities in Ohio and Indiana. The flood of 1832 was similar to that of 1913, but it was discharged by streams of the dimensions the Creator intended they should have. Since then cities have sprung up and land has become so valuable that riparian owners have encroached upon the waterways. Where the floods formerly flowed untrammeled, factories and dwellings have been constructed and numerous bridges have further restrained the stream's discharge.

The question of the rise of the river bed by levee construction has been exhaustively investigated. On the Rhine the maximum effects were observed at Dusseldorf, where the same discharge at low water appears to attain a height 8 inches greater to-day than it did one hundred years ago, while the same discharge at high water has lowered about 1 foot in a century. On the Po the maximum observed change in low-water conditions was 0.02 of a foot per year, but it is by no means proved that even these small changes have resulted from levee construction. They may have arisen from the improvements in the river bed which were made simultaneously with levee construction. The observations of the Mississippi River Commission agree with the Dusseldorf observations, in that the Mississippi River appears to be slightly enlarging its section, at least at mid-stages.

The present contents of the adopted levee line of the Mississippi River is about 243,000,000 cubic yards. It has been computed that with an addition of 200,000,000 cubic yards and at an estimated cost of $57,000,000 this line would be safe against any flood which has occurred in the Mississippi River. This sum, though large, is less than $4 per acre of land protected from overflow, and appears insignificant when compared with the amounts which are being expended per acre for irrigation purposes in the arid west. The increase in the value of land or the damage caused by one overflow like that of 1912 would pay for the completion of the levee system.

When a levee line contains but one-half the material that safety requires, crevasses afford no argument against levee construction. During the flood of 1912 hundreds of miles of levees were topped with earth in sacks to a height of from 2 to 4 feet, to prevent the water flowing over them, and water was seeping through their narrow bases in copious streams, which was unheeded until mud began to flow. The levee which failed at Beulah, Miss., this winter was held till the pile of sacks exceeded 20 feet in height.

The holding of 1,525 miles of such levees through the flood of 1912, even though 13 miles failed, is a powerful argument in favor of a properly constructed levee line. There was no failure where levees were built to a suitable grade and adequate dimensions, as in the Upper Yazoo District.

Conclusion.—While of the opinion that levees afford the only practicable method of controlling the floods in the case of the Mississippi River, I am strongly in favor, nevertheless, of both reforestation and reservoir construction, but limited to the purposes for which they are adapted, just as I am in favor of reinforced concrete for small bridges, though not considering it applicable to one spanning the lower Mississippi River. The price of lumber to-day is a sufficient argument for planting trees, without attempting to associate forestry with the climate or with the flood conditions of our rivers. If the Federal Government or the states do not conserve the forests, the time will soon come when the farmer will raise his crop of timber just as he now plants a field of wheat, and for the same reason, because it will pay him to use his waste land for the purpose.

Reservoirs are necessary for municipal water supplies, for purposes of irrigation, for the development of power and for feeders to canals. They can be successfully employed on small streams to diminish floods or increase the low-water flow. The trouble arises when an attempt is made to utilize them for too many purposes at the same time. There must be a paramount issue to which the others will be subsidiary.

If the main purpose is to supply a city with water only the excess can be used for power development. If the dams are constructed to produce power, the reduction of floods and the improvement of river navigation must be subordinate thereto. Water required for irrigation can only be used to develop power when the dam of the storage reservoir is given a greater height than is necessary for its flow over the land to be reclaimed.

During the next decade there will be an enormous development of reservoirs both for irrigation and for power purposes, which I hope will be utilized to correct man's folly and prevent many disasters similar to those which have recently occurred in Indiana and Ohio.

MINERAL PRODUCTION IN BRITISH COLUMBIA.

The year 1912 was exceedingly favorable to mining in the province and the mineral production made therein was the greatest in the history of its mining, according to statistics contained in the annual report of Wm. F. Robertson, provincial mineralogist for the Province of British Columbia. The gross value of the mineral production for 1912 was $32,440,800, an increase over that of the year 1911 of $8,941,728, or about 33.3 per cent. The greatest output formerly made was in 1910, amounting to $26,377,066, which is exceeded by the production of 1912 by $6,063,734, or 23 per cent., thus showing by comparison, even with what had been the record year, how much the mineral production has increased during the past year. The tonnage of ore mined in the lode mines of the province during the year 1912 was also greater than ever before, amounting to 2,688,532 tons, exceeding the greatest tonnage formerly mined in any year—1910—by 472,104 tons, equivalent to 21.3 per cent. increase.

As compared with the year 1911, the tonnage mined last year shows an increase of 917,777 tons, or about 52 per cent. The tonnage mined in 1912 was produced by the various districts in about the following proportions: Boundary, 74.00 per cent.; Rossland, 9.07 per cent.: The Coast District, 8.03 per cent.; Slocan District, 5.07 per cent.; Nelson, 1.94 per cent.; East Kootenay, 1.87 per cent. and all other parts of province combined, 0.02 per cent.

An electrical process for purifying clay, brought to the notice of the English Ceramic Society by Dr. W. R. Ormandy, depends upon the fact that clay is electro-negative, while its chief impurities are electro-positive. The emulsified clay is partially coagulated by adding electrolytes, and is further purified by passing through a vessel having electrodes differing by 60 to 100 volts. The clay-substance, with as little as 18 to 20 per cent. of water, is deposited as a continuous blanket 4½ feet wide and a quarter of an inch thick. Even fine particles are removed and the solid product may contain as much as 99.5 per cent. of china-clay.

POINTS IN THE PROGRESS & INSPECTION OF SURVEYS

HISTORICAL SKETCH OF THE GROWTH OF THE DEPARTMENT OF THE INTERIOR, SURVEYS BRANCH — REMUNERATION FOR SURVEYORS — POINTS WHERE CONTRACTOR AND INSPECTOR SOMETIMES DIFFER.

By E. W. HUBBELL, L.D.S.,
Chief Inspector of Surveys, Canada,

THE Department of the Interior was established July 1st, 1873, the first Minister being the Hon. Alexander Campbell, who had under his control the following branches of the service:—

1. The affairs of the N. W. Territories.
2. The lands and affairs of the Indians of Canada.
3. The ordnance and Admiralty lands and all other public lands, not under the control of the Department of Public Works, or of those of Militia and Defence, and Marine and Fisheries.
4. The Crown Lands in Manitoba and the N. W. Territories, styled "Dominion Lands."
5. The Geological Survey of Canada.

Prior to the first of July, 1873, the management of the N. W. Territories and the Lands and Affairs of the Indians, devolved upon the Department of the Secretary of State for the provinces, to which department the Geological Survey was attached. On the other hand, the Dominion Lands and the Ordnance and Admiralty were under the control of the Secretary of State for Canada.

In July, 1869, instructions were issued by the Minister of Public Works to Lieut.-Col. Dennis, P. L. Surveyor, requesting him to suggest a scheme or system upon which to base the surveys of the West. This was done and approved, and the survey of the Principal Meridian by Milner Hart and A. C. Webb was the first survey performed under authority of the Dominion Government, in the Territories. At this time the outbreak known as the Red River troubles occurred, and put an end to further surveys for the time being.

In 1870, no surveys were undertaken.

In March, 1871, Col. Dennis was appointed the first Surveyor General of Dominion Lands, and during the same month the administration of the Dominion Lands was transferred to the Department of the Secretary of State, and the Dominion Lands Branch was created. The first Manual of Surveys for the guidance of surveyors was issued in this year, and instructions were given to twenty-one surveyors, Mr. Lindsay Russell being appointed Inspector of Surveys.

In 1872, Captain Cameron, R.A., British Commissioner, was appointed in conjunction with the Hon. Archibald Campbell, named by the United States Government, to determine in accordance with the Second Article of the Convention of London of the 20th October, 1818, the International Boundary Line between Canada and the United States, from the northwest point of the Lake of the Woods, due south to the 49th parallel of latitude, thence westward to the Rocky Mountains. Along the south of the province of Manitoba, iron pillars were placed at two-mile intervals, west of the province the line was indicated by cairns, generally three miles apart.

*Paper read at 7th Annual Meeting of the Association of Dominion Land Surveyors, March 5th, 1913.

In this year instructions were issued to Mr. W. S. Gore, P.L.S., to survey certain reserves granted to the Hudson Bay Company. The first map to show the results of the surveys of Dominion lands was issued this year with the surveyor general's report, also the first official map of the province of Manitoba.

In 1871-72, all surveys were performed by contract, at so much per mile, but in 1873 all the surveyors except those employed in subdivision, were paid by the day.

During this year (1871), 3,800 miles were surveyed and surveyors were paid as follows, all under contract:—

	Prairie.	Poplar woods.	Heavy timber, windfalls, etc.
Block surveys	$9.00	$15.00	$25.00 per mile
Subdivision surveys	$7.00	$11.00	$18.00 per mile

In April, 1872, an Act was passed called the Dominion Lands Act, in which the manner of administrating the lands in Manitoba and the N. W. Territories was dealt with and the system of survey explained. The Act also provided for a Board of Examiners, who were to examine candidates for admission to practice as deputy surveyors, and provided for the admission to practice of surveyors from the different provinces.

In May, 1873, the bill creating the Department of the Interior was assented to, and on the 30th June the management and control of Dominion lands was transferred from the Department of Secretary of State to the Department of the Interior. The Geological Survey was also attached to the department, as was the administration of Indian affairs.

It might be of interest to note here two important Acts passed by Parliament. 1st, in 1873 an Act authorizing the establishment of a mounted police force in the Territories. We all know the incalculable value this magnificent field force (since its inception) has rendered our great country, and whose jurisdiction now extends to Hershel Island in the Arctic Circle. 2nd, in 1874 an Act prohibiting the importation into and manufacture in the N. W. Territories of all intoxicating liquors. This Act was rescinded in 1891.

In this year (1873), the first surveys of Indian reserves were undertaken, six surveyors being employed for that purpose, and on the 28th February, 1874, an order-in-council was passed authorizing a special survey of bases and meridians through the N. W. Territories, and extending to the Peace River. This important survey was placed under the control of Mr, Lindsay Russell, assistant surveyor general, and carried on for some years, one of the assistants being Mr. W. F. King, D.T.S.

It may be of interest to know that from 1871 to 1876, the cost of block outlines averaged $36.83 per mile. The cost of subdividing blocks of four townships into sections and quarter sections was 2.91 cents per acre, adding the cost of the block lines to the above acreage rates made the

total cost of all the township lands surveyed to date (1876), to be 3.83 cents per acre.

In 1877, the Geological Survey became a branch of the Interior Department and the Museum was moved from Montreal to Ottawa.

In 1878, the charge of the N.W.M.P. was transferred from the Department of Secretary of State to the Interior Department. In this year, Col. Dennis was made Deputy Minister of the Interior and Mr. Lindsay Russell became surveyor general.

In 1879, a new branch was erected and added to the department, called the School Lands Branch.

In 1880, the Indian branch was created a separate department and assumed control of the Indian reserves in Manitoba and the North West Territories which had been carried on by the surveyor general.

The surveys of this year have consisted of two classes, outline, or governing ones, performed under the system of daily pay and allowance of actual expenditure incurred, and the subdivision surveys under contract, at rates of so much per mile for certain kinds of work; the rates of the latter having been fixed by competitive tender.

In 1881, 55 surveyors were engaged, 6,400 miles of meridian and outlines were run, and 16,800 miles of subdivisions.

Road allowances were reduced from 1.50 chains in width to one chain, and three of the east and west road allowances in a township done away with.

A new edition of the Manual of Survey was issued containing many improvements and much information to surveyors, as well as several useful tables prepared by Messrs. Deville and King, who were in this year appointed inspectors of surveys, succeeding Messrs. A. H. Whitcher and Milner Hart.

In 1882, Mr. Deville was appointed chief inspector of surveys and took charge of the surveys branch of the department, and Mr. Lindsay Russell became Deputy Minister of the Interior.

An important change this year was the substitution of iron posts for wooden ones at the section corners, the markings for each corner were stamped on a square tin about six inches square, placed over the bar and fastened to it by a nail.

In order to prepare the number of copies of township plans required, it was found necessary to establish a lithographic office in connection with this branch. Plans were printed by a cheap process, and although not presenting the appearance of good lithography from engraved stones, they met all requirements.

On the 8th of May an order-in-council was passed dividing the North West Territories into four provincial districts, called respectively Assiniboia, Saskatchewan, Alberta and Athabasca.

In 1883, 119 surveyors were employed. The extensive operations (the greatest on record) during this year and the previous season became necessary owing to the rapid construction of the Canadian Pacific Railway, which in the fall of this year, reached the Rocky Mountains. During the season surveying operations were conducted on a gigantic scale, over 70,000 miles were surveyed, providing 27,000,000 acres of land for the agriculturist.

Owing to the rapid growth of work in the department, the offices of Deputy Minister and Surveyor General, held by Mr. Lindsay Russell, were separated. Mr. Russell remained surveyor general, and Mr. A. M. Burgess became Deputy Minister of the Interior. The supervision of the surveys at headquarters was under the control of Mr. Deville, chief inspector of surveys, while Mr. King, inspector of surveys, had the direction of the operations in the field, and a third edition of the Manual of Surveys was issued.

In this year we have our first information regarding the examination of survey contracts.

In 1884 the Settlement Act was passed by the British Columbia Government, and the transfer under its provisions to the Dominion Government of a belt of land 20 miles in depth on both sides of the Canadian Pacific Railway was effected, and surveys within this belt were commenced, also the survey of old trails in the Territories.

In June, Mr. Lindsay Russell, surveyor general, retired from service on account of ill-health.

In 1885, owing to the Riel rebellion, surveys were limited. Mr. William Ogilvie was engaged in making a survey of the railway line in British Columbia, to be used as a base for the future subdivision of surveys at points along the line. In March, Mr. Deville, then chief inspector of surveys, was appointed surveyor general, which position he is faithfully, conscientiously and intelligently occupying to this day. Mr. W. F. King was promoted to chief inspector of surveys.

In 1889, iron posts of a larger diameter were substituted at section corners, and the markings cut on the bars with cold chisels, a vast improvement on the original method of marking.

In 1890, Mr. King became chief astronomer of the department, and in May, 1893, Mr. J. S. Dennis became chief inspector of surveys.

In 1891, the Immigration Department was transferred from the Department of Agriculture to the Department of the Interior.

In 1892, Mr. W. F. King, D.T.S., was appointed international boundary commissioner, and in February of the same year, the Board of Examiners for Dominion Land Surveyors at Ottawa, passed the following resolution:—

"That this board, after due consideration, have come to the opinion that examinations for provincial land surveyors in Ontario and Manitoba are not sufficiently similar to those prescribed by the Dominion Lands Act, for Dominion land surveyors to entitle provincial land surveyors of those provinces to the privileges of Clause 109, and the board is further of the opinion that it is desirable in the interests of a uniform standard, that no candidate should be granted a commission as Dominion land surveyor unless he has passed the full examination prescribed by the Dominion Lands Act."

"Surveyors of the province of Ontario and Quebec are accordingly required to fulfil now the same conditions as surveyors of Dominion lands, instead of as formerly, being admitted after examination in the system of survey only."

It may be of interest to note here, that all western provinces now have separate surveyors' associations, and in order to obtain a commission to practice as a surveyor in any of the provinces, it is necessary for a Dominion land surveyor to pass an examination in conformity with the laws of each province.

Space does not permit touching upon the following very important surveys which have been administered by the Department of the Interior:—

The triangulation survey in British Columbia, commenced in 1889, under the superintendence of Mr. W. H. Drewry, D.L.S.

The photo-surveying in British Columbia, commenced in 1886, under the superintendence of Mr. J. J. McArthur, D.L.S.

International boundary survey of the 141st meridian, under the superintendence of Mr. W. F. King, D.T.S., boundary commissioner, commenced in 1906.

The irrigation survey in Alberta, under the superintendence of Mr. S. J. Dennis, D.T.S., then chief inspector of surveys, commenced in 1894.

The perusal of the reports on the above mentioned surveys are most instructive and interesting, and can be readily found in the annual reports of the department.

In 1901, Mr. Wm. Pearce was appointed chief inspector of surveys, and upon request was superannuated in 1904. In this year also the office of the surveyor general was moved from its quarters on Wellington Street, to its present location on Metcalfe Street, but owing to the growing increase of the staff in recent years, it was necessary to move part of the staff to the Imperial Building on Queen Street.

The present numerical strength of the surveyor general's staff is about 140, which is an indication of the clerical work performed by this important branch of the department.

In the surveyor general's report of 1903 it was provided by the Dominion Lands Act that the township subdivision surveys of Dominion lands should be performed under contract at a certain rate per township, per mile or per acre fixed, from time to time, by the governor-in-council or by competitive tender, as the governor-in-council would from time to time direct. The rates fixed under the provisions of this clause, at the inception of the surveys of Dominion lands more than 30 years ago, were, per mile of line surveyed, $7 for bare prairie, $18 for solid woods, and $11 for woods alternating with prairie. These rates remained in force until 1901, although the cost of labor and supplies had advanced considerably. In May, 1901, the rates were increased to $7, $13 and $21 respectively, but the cost of labor and supplies having continued to advance, the increase proved inadequate. The situation was aggravated by a succession of wet seasons, which made survey operations slow and costly. Survey contractors made little or no profit, and showed great reluctance in accepting new contracts. It was deemed reasonable that the rates should be increased sufficiently to leave a fair margin of profit to the contractors, and at the same time that the classification be revised so that the remuneration should be more nearly proportional to the cost of the survey. After consultation with all the surveyors who were engaged recently on township surveys, and who are conversant with present conditions, a new classification and schedule of rates was prepared and approved by order-in-council of February 3rd, 1903. The remuneration for prairie work was not increased, but surveys in the woods were, in some cases, paid as high as $38 per mile. The classification was entirely new and somewhat complicated; it was to be expected that experience would show the necessity of amendments.

Manual of Survey.—The last edition of the manual of instructions to surveyors for the survey of Dominion lands was issued in 1892; it was a revision of the previous edition (1883) prepared, under instructions of the Deputy Minister, by the chief astronomer, Mr. W. F. King, and the chief inspector of surveys, Mr. J. S. Dennis. A new revision had become necessary to bring our methods in accordance with the best modern practice, and to provide for the changes made in the system of survey during the last eleven years. The revision was prepared by the surveyor general, and issued to surveyors before the beginning of the present season's operations. An important departure from the previous practice is that township plans, instead of being made by the surveyors as formerly, will now be plotted from their field notes by the office staff. The plans will thus be made uniform and accurate —they will be made in better style and will contain all the information necessary for the record of a land survey; there will also be less delay between the completion of the surveys and the issue of the plans. Throughout the manual, the governing idea is that the plan of a land survey must be a true representation of the survey as it exists on the ground, and not a conventional illustration of the survey which it had been the intention to make. For this and other purposes, new clauses and numerous amendments to old ones were inserted. The old tables have been re-arranged and a new one compiled for the determination of the azimuth by the observation of Polaris. This last table will, it is believed, prove a most useful one to township surveyors; by its means, they may, at any time, in a few minutes, and almost without calculation, ascertain the astronomical bearings of the lines of survey. A very complete index is provided to facilitate references, and a large number of speciman plans and illustrations add to the value of the book. It is confidently expected that this manual will be found a very great improvement upon previous editions.

Remuneration of Surveyors, 1908.—At the inception of the survey of Dominion lands, nearly forty years ago, Dominion land surveyors were paid five dollars per day. Shortly after, six dollars per day was allowed to surveyors of base lines. These rates remained in force until 1901, when they were increased to $6.50 and $7.50 respectively. The advance proved inadequate; in order to induce properly educated men to qualify as Dominion land surveyors, so that there should be no difficulty in securing the services of competent surveyors when they are wanted, a further increase of $8 and $10, respectively, was granted by order-in-council of March 30th, 1908. The increase, it will be observed, is for ordinary surveyors, 60 per cent. over the rate of forty years ago; for surveyors of base lines it is a little over 60 per cent. Considering the enhanced cost of everything, the increase does not appear too large. By the same order-in-council the salary of the inspectors of surveys was fixed at $9 per day in the field and $5 per day at office work.

In August, 1911, an order-in-council was passed authorizing the payment of $12.50 per day to surveyors engaged upon the survey of base lines and initial meridians.

Inspection of Surveys.—In the earlier prosecution of the surveys, inspection was confined to a visiting of the various parties in the field by the inspector to satisfy himself that they were really at work, and to judge by what he saw of their manner of doing it, whether the requirements of the contract were being duly complied with; but, unless he became aware of something to give him suspicion of error or neglect, no check measurements were made beyond that of an occasional rough testing of an angle, with a pocket sextant that could be carried about by a person travelling on horseback or on foot, and generally alone. This kind of inspection, though certainly

inexpensive, proved to be correspondingly ineffective. It became evident that the cost must be incurred of applying check measurements to portions, chosen unsystematically, of each contract in order thus to insure the obtaining average samples of the work. Inspection surveys were therefore established. At first this consisted of lines run at random diagonally through a contractor's township and closing on the surrounding block outline surveys, with the object of having a rigid check both on the contractor and on the work of the inspection survey itself. This method was, however, abandoned on account of the labor it entailed in the office in obtaining, from the data, comparison of the actual position of boundaries checked, with that which theoretically they would occupy, and also because that the inspecting surveyor could judge but from what he saw at points where his lines intersected those of the contract, what care had been taken in placing its monuments.

To make a thorough inspection of a survey, it would be necessary to remeasure all its lines; in fact, an exhaustive inspection means a duplicate survey. This forms a fundamental objection to survey by contract. It is impossible that any government officer can certify that the full value has been received by the public for the contract money paid, unless he has so executed or caused to be executed, a duplicate survey. The most, therefore, that is practicable, within reasonable limits of cost for inspection, is that tests should be applied here and there at hazard, throughout a contractor's work, and the inspecting officer report the resulting facts, together with a presumptive opinion based thereon, respecting the necessarily very much larger untested portion of the contract.

To obtain a contract, a surveyor makes written application to the department for the sub-division of a number of townships (these contracts are limited in size from 4 to 8 townships). Before his application is accepted, he is requested to make himself conversant with the nature of the country in which his contract is situated. If he asks, he is given all the information possible that the department has relative to the description of the country, i.e., means of access, transportation, nearest post-office, railway and express offices. It is therefore through no fault of the department if he accepts blindly a contract and does not take sufficient time to complete his work. Contractors in general would find it to their advantage if they paid more attention to entering on the contract forms the dates of commencement and completion of their work, as it would save both themselves and the department a lot of unnecessary correspondence, besides worrying their sureties for an extension of time, etc. I would like to suggest that when contractors have a knowledge that the country they are going to work in is interspersed with numerous muskegs and unusually wet, it would be more advantageous to them to leave their work until the ground freezes. Nearly all our survey work now is in timber, in which there are great areas of swamps and muskegs, and the survey work (except mounding), can be done cheaper and just as accurately in the winter as in summer.

Every surveyor has his own particular method of conducting a survey, it therefore would appear presumptious to offer suggestions. However, I take the liberty of telling younger members of the profession, who are commencing contract work, that it is unnecessary to purchase a lot of horses, they are expensive and not absolutely necessary. Before going into your contract, establish a cache as near your work as possible and engage teamsters, half-breeds preferably, to haul your supplies there, and no matter what happens thereafter, you will at least have sufficient supplies to keep things moving; men will not work on empty stomachs. Make provision for your mail service at least once a month, it is absolutely necessary that you keep the department informed of your movements and progress, many vexatious delays are apt to occur if you do not, and the department is the one to suffer least.

One thing to be impressed strongly upon contractors is the incorrect placing of ¼ section monuments on chords. The inspectors find this a very common error, after the chords have been cut out and chained, the contractor is apt to leave the offsetting of these monuments to the mounders, who in many cases (as experience has shown) are apt to be careless and offset, if at all, the wrong way, this makes a very bad showing in the bearings of the chords and the error appears worse than it really is.

At this juncture it should be in order and to the best interests of all concerned if we discuss a few of the most salient points in connection with contract work. The points that most frequently arise between the inspector and contractor, are the following: Opening of lines; blazing of lines; marking on posts; classification; mounds and pits, and traversing.

There are frequent complaints that some contractors do not open their lines widely enough. Personally I do not think it is the intention of the department to require the surveyor to open lines wide enough to drive a wagon through, or cut off all trees and brush to within six inches of the ground. On the other hand, it is certainly not the intention to have lines so narrow that the line of sight can barely pass the trees. There should be a mean, and my own opinion is that no tree should be left standing that is within, say a foot of the line on either side of the line of sight. Of course there are exceptional cases, when the contractor runs against a tree close to the line, that is about three feet in diameter. In such isolated cases, I do not think the inspector would worry the contractor very much if this tree was not cut down, but rabbit runs and lines of the "key-hole" variety should be condemned, and the bush and wind fall cut low enough so as to insure accurate chaining.

Blazing.—Clause 76 of the Manual, reads in part as follows: "All lines are to be further marked by blazed trees not more than 75 links apart, and are not to be omitted when there are trees more than two inches in diameter within 50 links from the line. If this is not done, a maximum penalty of $2 per mile may be applied, see Clause 314."

In my opinion, the blazing of trees two inches in diameter is rather absurd, after a tree of this size is blazed on three sides little of the tree remains, at all events so much blazing is apt to kill it, thus rendering it useless as a permanent mark. I think this clause should be amended to read 3 inches in diameter. I also think that trees blazed 50 links from the line is too far away, 25 links is quite sufficient for all practical purposes.

Markings on Posts.—These should always be distinct and cut well into the iron, and care taken not to mark on the crown or penalty side of the bar. The markings on the iron posts, in many cases, are but indifferently done and sufficient care not given to the driving of them into the ground. At witness corners, in addition to the distance of bearing from the true corner, the reverse side is to be marked with the section number only, and but one side of a quarter section post is marked. A quarter section corner falling in a lake or marsh not more than three

feet deep is marked by a wooden post, flattened on two sides and marked. The post must not be less than five inches in diameter and long enough to be driven three feet into the ground and to show six inches above the water (Clause 152). Where there is a witness mound and a wooden post for the same corner, in my opinion the witness corner in case of dispute should govern.

Penalties are sometimes exacted for not driving the bars deep enough in the ground. There are cases where it is impossible to drive the bars the required limit, in rocky country, hard frozen ground, gravel and sand or in gumbo, and if you attempt to drive them in the top breaks off. The inspector in such cases should use his judgment. Care should be taken that all posts are lined in correctly by the instrument, as upon their "exact location" depends the bearings of the lines, and precision of future surveys. In my opinion the square ends of the bars are not long enough, there is not sufficient room for marking large numbers. I have spoken to the surveyor general about this, and he has promised that the next issue will have longer flattened ends. Bars should be driven in plumb.

Classification.—Clauses 311 to 314 of the Manual describe in detail what is expected from the contractor.

As our subdivision surveys are now nearly all in bush country, interspersed with muskegs and marshes, it is therefore only in the openings, across water or marshes where there should be any doubt in the ratings. As all openings of half a chain are required to be recorded, it appears to me that there should be but little difference of opinion as to the nature of classification (Clause 316). The contractor is given the benefit of the doubt, as whenever he shows proof of actual cutting, no matter how small the scrub, he is paid 100% for his work. This also applies to park country, where he may only have to cut down a tree in every five or six chains. Where surveys are made in the winter and examined in the summer, or vice versa, there is apt to be a difference of opinion between the contractor and inspector, as the topographical features are somewhat different, especially is this noticeable across muskegs, lakes, etc., etc. There appears to me good reason for argument in this proposition, as the inspector's returns are apt to vary from the contractor's. If the work of the inspector and contractor is done at different seasons of the year, consequently the returns in ratings will not agree.

Mounds and Pits.—There is a standard for the dimensions of all mounds and pits in the Manual of Survey (Clauses 154 and 155). It is no trouble to build mounds or dig pits in accordance with the standard, when the ground permits, and under such circumstances there is no excuse if not properly made, and a rigid enforcement of the regulations should be enacted. On the other hand, it is almost impossible to comply with these regulations, such as building mounds and digging pits in swamps and muskegs, the composition of the soil is such that when the mounds have been made the standard size, they will not retain their formation for any length of time, but shrink to almost half their original size; the same applies to the pits. The contractor builds them in water and muck and the inspector frequently examines them in drier weather, when the water has evaporated and the mounds and pits have in consequence shrunken considerably since being constructed. In such cases it seems to me hardly fair to impose a serious deduction on the contractor, unless the inspector is thoroughly satisfied that the mounds and pits were carelessly constructed in the first place. In such cases the inspector should use his own discretion, and when submitting his report to the department, explain in full his reason for condemning or approving these mounds and pits; a little give and take on the part of the inspector is in my opinion most desirable. Personally I have never been in favor of mounds in scrubby country, as experience has shown that they serve as an incentive to cattle and wild animals to stamp down, and supply additional material for filling in the pits, and now-a-days most farmers keep a few cattle. In the wilder regions the cut lines are regular pack trails for the wild animals. I consider that mounds built of earth, sod, stones and other material, will last longer and retain their formation better than if built of earth alone. Stone mounds, when properly built, form a good permanent mark, and if the iron bar is bent at right angles about the centre and one-half of it placed under the mound, it will, unless wilfully removed, remain in position for many years. It occasionally occurs that contractors place the iron posts at the east and west corners of the mounds, and sometimes build mounds and pits square with the line, when they should be placed diagonally. These are small errors, but should not be overlooked.

Traversing.—Clause 105, states that a hub shall be planted firmly where the line intersects the bank of a lake or river which has to be traversed. Do all surveyors comply with this regulation?

Clause 137 states that along tidal waters, the line to be traversed is the high water mark at ordinary tides. For a lake or navigable river, and also where the Irrigation Act applies, for a river not navigable, the line to be traversed is the bank. The bank, be it understood as applicable to a lake or navigable stream, is the edge of the bed of the lake or stream, and the limit of the bank is the line where vegitation ceases, and the shore is the space between high and low water mark at ordinary tides. As the edge of a marsh is inadmissible as a boundary, and subject to change, it follows that an inspector when making a traverse, should select a well defined boundary of a lake or river so that upon comparison there will be less likelihood of a disagreement between the contractor and the inspector's returns. Lakes that are traversed in the summer and inspected in the winter cause some trouble, as shore lines in many cases are bound to vary under the changed climatic conditions. It is permissible to make traverses with the chain, stadia or micrometer, if by the latter, the closing error must not exceed one chain in one hundred and the distances measured must not exceed half a mile. Traverses of lakes, rivers and connecting traverses are paid for at the rate of $11 per mile, and the distance paid for is between fixed points in a straight line.

Observations.—Clause 111, states that in subdividing townships at least one astronomical observation for ascertaining the direction of the meridian is made in each township, but two or more are desirable, etc., etc. When the weather is not favorable for observing, work may be commenced with an assumed meridian, and if possible connected by angular measurement with a base line. The telescope now used is powerful enough to show stars of the second magnitude within a few hours from noon, and stars of the third magnitude in twilight when it is still clear enough to read the graduation. The observation should be taken in daylight whenever practicable. A complete observation under favorable conditions, gives a result correct within a few seconds. An observation for time should be taken either shortly before or after every azimuth observation.

COAL PRODUCTION IN BRITISH COLUMBIA.

The collieries of the province made in 1912 a gross production of 3,025,709 tons (2,240 pounds) of coal, an increase over the preceding year of 727,991 tons equivalent to an increase of 31.5 per cent., according to statistics contained in the annual report of the Minister of Mines by Wm. F. Robertson, provincial mineralogist for British Columbia.

While this comparison is true, it must in fairness be stated that the producton for 1911 was much below normal, due to the labor troubles in the East Kootenay coalfield, whereby the collieries of that district were closed for the last eight months of the year.

It might be better, therefore, to make comparison with the year 1910, in which the coal production was by far the greatest in the history of coal-mining in the province and during which the gross coal production was 3,139,235 tons, or only 113,526 tons greater than last year.

Had it not been for labor troubles in the mines of the Canadian Collieries, on Vancouver Island, during the latter part of 1912, whereby the company's output was reduced to a point 150,000 tons lower than the preceding year, there is little doubt but that 1912 would have been the record year to date, instead of occupying second place; but, with the exception noted, it is greatly in advance of any other year.

The greater part of this production is still mined by three companies—the Crow's Nest Pass Coal Company of East Kootenay, the Canadian Collieries and the Western Fuel Company, of Vancouver Island, which mined, collectively, 75 per cent. of the gross output, their respective production representing 31.5 per cent., 34.5 per cent. and 19 per cent. of such total.

Of the other collieries: In the Coast District, on Vancouver Island, the Pacific Coast Coal Mines, Limited, produced 151,589 tons and the Vancouver-Nanaimo Coal Company, 88,253 tons and in the Nicola Valley section of the district, the Nicola Valley Coal and Coke Company mined 142,973 tons, the Inland Coal and Coke Company 31,300 tons, the Princeton Coal and Land Company, 28,174 tons, the Diamond Vale Coal Company, 3,310 tons, while the United Empire Coal Company made a start, producing some 500 tons of coal.

In the East Kootenay District, in addition to the Crow's Nest Pass Coal Company, which produced 950,706 tons, the Hosmer Mines, Limited, produced 188,243 tons and the Corbin Coal and Coke Company, 122,263 tons. In addition to those companies actually shipping, several other companies have been installing plant and have approached the shipping stage.

The collieries of the Coast District, including the Nicola Valley field, are to be credited for 1912 with about 58.3 per cent. of the total coal output.

The gross output of the collieries for the past year was, as already stated, 3,025,709 tons, in addition to which some 17,809 tons of coal was taken from stock, making the gross amount of coal distributed 3,043,518 tons. Of this gross amount, there was sold for consumption in Canada, 1,263,427 tons; sold for consumption in the United States, 858,981 tons; while 108,157 tons was exported to other countries, making the total coal sales for the year 2,230,565 tons of 2,240 pounds.

In addition to the coal sold, there was used in the manufacture of coke 396,905 tons, all in the East Kootenay field; and used under companies' boilers, etc., 240,304 tons; while 175,744 tons was lost in washing and screening.

There was no coke made last year in the Coast District, although some 4,266 tons was sold from stock, the total coke production having been made by the Crow's Nest Pass Coal Company, and Hosmer Mines, Limited, in the East Kootenay field, where from 306,005 tons of coal, 264,333 tons of coke was manufactured, of which 91 tons was used under the companies' boilers.

WATER POWERS IN NEW QUEBEC.

In extracts from reports published in bulletin form by the Department of Colonization, Mines and Fisheries on the district of Ungava, recently added to the Province of Quebec under the name of the territory of New Quebec, a vast amount of information is obtainable concerning this addition and that respecting its water powers is most interesting.

The interior of Ungava or New Quebec is a huge plateau which rises somewhat abruptly within a few miles of the coast line to a height of 1,500 to 2,500 feet. The various streams, therefore, afford numerous water-powers, more especially where they leave the interior plateau to flow through the strip of lowlands, a few miles wide immediately adjoining the coast. For instance, on Great Whale River, within 20 miles of the mouth, there are three falls 150 feet, 230 feet and 65 feet respectively. On the South branch of this same river, a few miles from its mouth, a fall of the river gives 136 feet. Nastapoka Falls near the coast has falls 170 feet. Near Richmond Gulf, the Wyachuan River falls give a head of 315 feet. A remarkable case of very high waterfalls in the interior is that of the Hamilton River. The Grand Falls of this river are situated some 300 miles from Rigolet. These falls were first viewed by a white man, John McLean, in 1839. McLean was in charge of the Hudson's Bay Company's post at Fort Chimo and crossed overland from that post to Hamilton Inlet.

The falls themselves have a sheer drop of 302 feet and Low estimated their discharge at 50,000 cubic feet per second. For twelve miles above the falls, the river rises rapidly, so that in the distance the difference of level, including the falls proper, is 760 feet. Adopting the discharge estimated by Low, these figures would give approximately 1,500,000 H.P., for the falls proper and 3,660,000 H.P. for the twelve miles of falls of the river. However, Dr. Low only saw the river during a period of high water and the above figures are probably much too high. In the data compiled by the Commission of Conservation and published in the "Report on Water-Powers in Canada," the possibilities of Grand Falls are based on a low-water drainage of 0.4 c.f. per second per square mile of drainage area, which is the quantity generally adopted under the climatic conditions of the country. Under these conditions, the estimated H.P. of the falls would be 120,000 and of the total fall for a distance of twelve miles 300,000.

A factory in Grenoble, France, utilizes the water of a reservoir situated in the mountains at a height of 200 yards. The water reaches the factory through a vertical tube of the same length, with a diameter of considerably less than an inch, the jet being used to move a turbine. Experiments have shown that the strongest men cannot cut the jet with the best-tempered sword; and in some instances the blade has been broken into fragments without deflecting a drop of water, and with as much violence as a pane of glass may be shattered by a blow from an iron bar. It has been calculated that a jet of water a small fraction of an inch in thickness, moving with sufficient velocity, could not be cut by a rifle bullet.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Reports From Municipal Engineers 309
Strength of Concrete, Wet vs. Dry 309

Leading Articles:

Railway Transportation Problems of the Future 293
Design and Graphic Method for Calculating a Steel Truss 297
The Control of River Floods 299
Points in the Progress and Inspection of Surveys 303
Coal Production in British Columbia 308
Drainage as Affecting Highway Traffic 310
River Crossings for Water Mains at Fort William 311
Municipal Water Softening 313
New Industry for Canada 317
The Financing of Municipal Works 318

Coast to Coast 322
Personals 324
Coming Meetings 324
Railway Orders 75
Construction News 76
Market Conditions 92-94
Technical and Municipal Societies 94

REPORTS FROM MUNICIPAL ENGINEERS.

There is a great tendency among Canadian municipal engineers to evade written reports where possible. They surpass engineers of other countries in this respect, despite the fact that municipal engineering is comparatively young in Canada and requires as much benefit from reports of accomplished work as can be derived, if it is to hold its own with respect to the country's demands.

The value to one municipality of how work is progressing in others, what methods are being employed to advantage, and where warning notes should be sounded against unscientific or untried tactics, is obvious, and to the municipal engineer falls the duty of supplying his corporation with exact, concise and complete data, in order that the information may be of use, not only to itself but to sister municipalities.

But it is the value of these reports to the engineer himself that we wish to emphasize. So long recognized by engineering and business institutions, many of whose clerical compilations are nothing short of stupenduous, the value of records to him is as his confidence in future success. There are numerous occasions when reference to past work is needed at a moment's notice, and to come into contact with the advantages of written reports, one needs but to experience one or more embarrassments ensuing from the fallacy of attempting to recall the wording of previous oral reports, owing to the wanton traits of memory. If alone for the purpose of having an exact record of all his reports of progress, proposals, opinions, etc., to committees and to council, so that when desired, immediate and exact repetitions of statements made perhaps months before, may be presented, the engineer will find in it a safeguard to his professional standing in the community.

The exhortation applies more to the municipal engineer than to those of other branches of the profession owing to the wider and more diversified knowledge of engineering which he must necessarily possess. As his success generally depends upon his up-to-date knowledge of hydraulics, sanitation, surveying, railways, roads and pavements, electricity, structural work, etc., etc., his calling does not admit of traditional, rule-of-thumb, or unbusinesslike methods in any phase, and his brain will work up closer to the knee of its efficiency curve if it is not hampered by a continual trusting, or mistrusting, of memory. Finally, a municipal engineer's report should contain all that it is desired to express; it should be complete in itself, not requiring to be supplemented by oral explanations. It should be clear to avoid misconception or liability to distortion, and should be clothed in language understandable by men not fully conversant with engineering terms.

STRENGTH OF CONCRETE, WET vs. DRY.

Concrete has developed into a prominent essential of construction. Knowledge of the percentage range of water used in the making of it does not appear to have ever been apace with its widening scope of usefulness. Experiments on the relative strength of concrete having different degrees of plasticity have been comparatively few. There seems, nevertheless, to be a sufficient variation in strength between what is ordinarily known as wet concrete and dry concrete to endorse a more thorough investigation of it than has yet been carried on. The correct proportion of the other ingredients, and quality of

material, appear to have been receiving the bulk of the attention which has been given to the mixing of concrete in late years.

Some experiments, carried on nearly fifteen years ago, and claiming to be the first on the problem, brought out the advantages of working a wet mixture over a dry or moderately dry one, simultaneously stating that a moderate excess of water was in no way injurious to strength. Another report, the outcome of experiments by Mr. Irving Hiltz, of the Chicago, Milwaukee and St. Paul Railway, stated that it was impossible to get a compact concrete without using what might be theoretically termed an excess of water, while others claimed that a moderate use of water, tending, if anything, toward excess, was necessary for the strongest concrete.

Then, in 1903, Mr. J. W. Sussex, of the University of Illinois, arrived at a few conclusions that were a little less indefinite. His experiments were quite elaborate, as experiments with concrete went at that time, and from them he deduced the conclusion that dry concrete should never be used at all; that medium concrete might be used where immediate strength is desired, but that a wet mixture would produce concrete stronger and cheaper than either dry or medium, at any age beyond three months.

It will be interesting for engineers conversant with the more recent reports of special committees of our technical societies and of engineering testing laboratories to compare them with the conclusions of earlier experimenters as mentioned above.

EDITORIAL COMMENT.

The third annual congress of the Canadian Public Health Association will be held in Regina on Thursday, Friday and Saturday, September 18, 19 and 20, instead of 16, 17 and 18, as previously announced. The programme of papers promises to be an exceptionally attractive one, and the Provincial Government and the city of Regina are co-operating in plans for the entertainment of the delegates.

* * * *

Canada's side of the boundary dispute arising from the proposal of the Michigan-Lake Superior Power Company, referred to editorially in July 10th issue of *The Canadian Engineer*, is being prepared by Mr. Chas. S. MacInnes, K.C., of Toronto. The lease, as proposed, occasions a diversion by dam of the St. Mary's River flow at Sault Ste. Marie, Ont., and has aroused a good deal of discussion.

* * * *

Owing to the number of requests for copies of Mr. J. M. M. Greig's "Sewer Discharge Diagram," reprints of which were made from the article appearing in June 5th issue of *The Canadian Engineer* for distribution to interested engineers, our supply was soon exhausted, and the continued accumulation of requests has occasioned the printing of another edition. These are being mailed to readers upon request.

The mineral production of Alaska for 1912 amounted to $21,850,000, of which $16,650,000 was in gold, $4,630,000 in copper, $300,000 in silver and $260,000 in tin, marble, gypsum, coal and petroleum.

DRAINAGE AS AFFECTING HIGHWAY TRAFFIC.

THE increasing use of highways by heavy traffic has brought forcibly before those who have charge of them the weakening effect of water which is allowed to remain on the surface, in the subsoil, or in close proximity to it. Mr. W. Gregory, who has had over twenty years' experience in English road construction and maintenance, writing in Contractors' Record and Municipal Engineering, London, covers many important points that will be of interest to highway engineers who have to contend with the difficult drainage of stretches of road where surface water is not disposed to depart without a struggle.

To a casual observer, it might seem to be efficient drainage to conduct ordinary surface water by cross channels to back ditches, and away by the natural outfalls.

There are, however, miles of roads which, by reason of their cross section and situation, are practically waterlogged, as, for instance, where passing between high banks, with surrounding land several feet higher than the road surface, while the roads are so narrow that two vehicles can barely pass at walking pace; it will be obvious that in such cases ditches at sides are sources of more or less danger, while their absence produces mudholes in wet, and ice in frosty weather.

Even where there is sufficient width of surface and greensward to construct back ditches, there are not always sufficient to drain a road effectively. Roads passing over clay lands, in a wet season, are, regarding their subsoils, in a tremulous condition.

The experience of the writer, for some years, has been with roads resting on clay, chalk, or a combination of both, where this state of things has given rise to much difficulty.

The increased use of mechanical means for agricultural work has produced serious effects on roads only made to carry ordinary light vehicular and farm traffic; the passage along roads of heavy steam ploughs, usually in couples, and with vans and tackle totalling in weight anything from 40 to 60 tons, traction engines drawing laden trucks, threshing equipment, heavy motor lorries, etc., has produced such an alteration in the shape of the road crust that it was puzzling at first to know how best effectively to deal with it.

Some years since the writer decided to lay deep side drains in these weak roads, which should act in a threefold capacity, as surface water drains, subsoil drains, and abutments for the thrust of heavy vehicles. In many instances the passage of heavy engines had squeezed the ordinary side ditches up higher than the road surface, rendering them useless, and the constant attention, digging out and levelling was of little avail in draining the road.

These side drains were dug to at least 3 feet in depth, the outfall being in some ditch or natural watercourse, and where, owing to the variations in levels, the drain came near to the surface, iron pipes were used until a minimum cover of 2 ft. 6 in. was obtained, when glazed earthenware socket pipes of 6 in. diameter were used, these being laid with open joints and the trench carefully filled with large lump hardcore, or boulders, and finished near the surface with smaller stones, down to 1¼ in. size.

At intervals, depending on local circumstances, 9-in. brick catchpits, 24 in. by 18 in. by 3 ft. 6 in. depth, were

constructed, with ordinary cast iron, hinged gulley gratings as covers.

Where these have been laid the effect on the roads has been most marked, the sides being firm, and the aerating effect on the subsoil has diminished the rolling movement of the clay to a minimum, although the engine traffic has enormously increased.

There has been considerable opposition by local people, and the work has been referred to as useless and a waste of ratepayers' money, the prevalent idea being that what was good enough for the former generations is good enough for the present day; and the instilling of scientific knowledge into the minds of such ratepayers is not a pleasant occupation, but the sooner they realize the benefits to the roads from these works the more likely are the highway surveyors and engineers to be able to improve roads to meet the requirements of modern traffic.

One instance of the effectiveness of these drains will illustrate the whole. During a dry portion of the year, the outfall of the longest drain (half a mile) was gauged, and found on different occasions to discharge 10,000 gallons per 24 hours; previously the road absorbed or carried this water, forming a slough in damp weather and being almost impassable in frost.

The cost in the district under reference would be much higher, no doubt, than in many other parts, as there is no suitable local material (in fact, no local road metal at all), and the distance from railway stations varies from 3 to 7 miles.

The work, with the exception of the catchpits, is done by the ordinary roadmen, and the cost (including pipes, metal, labor, carting, brickwork, etc.) does not exceed $1.85 per lineal yard, and in some cases less.

The extended use of by-roads by heavy traffic calls for a much higher standard of surface than formerly, and the above method, in the writer's opinion, will do much towards bringing this desirable state to pass, and enabling a road with a thin crust of metal to carry a greater amount of heavy traffic than it otherwise could, with less damage to the surface.

In many cases, the effect of the enormous weights on these roads appears to be the alteration of minor springs in the subsoil, and forcible closing of some of the capillary passages of water, resulting in springs bursting through the crust in places not previously known.

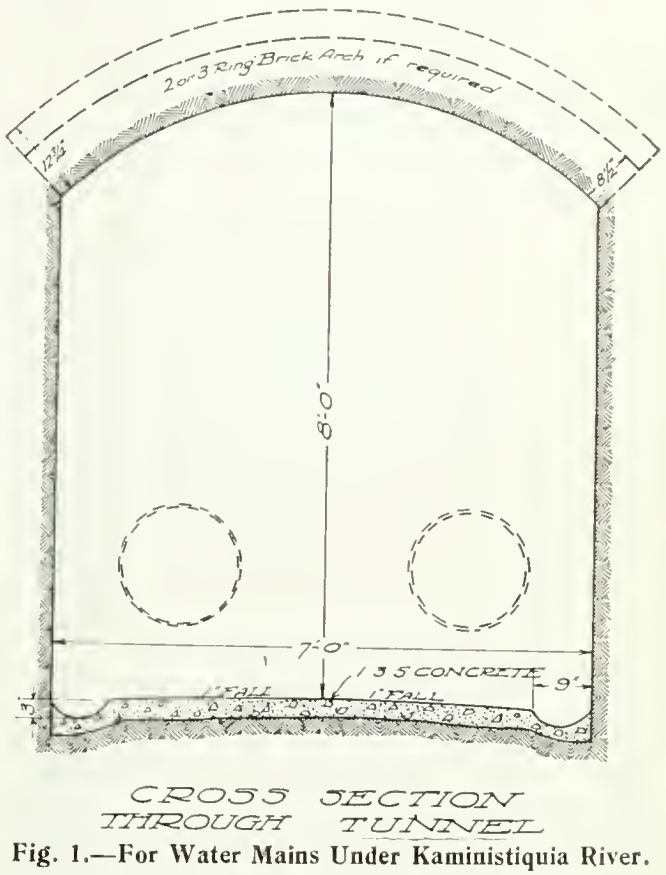
An instance of this occurred some years since, where, owing to months of wet weather, the high, clayey fields adjoining a road (in a cutting) presumably became surcharged with water, which burst out on the face of a hill in the centre of the road, the whole surface suddenly giving way as a vertical quagmire, to a depth of 3 or 4 feet.

The immediate remedy was to start lower down the hill with two trenches at sides of road, and work upwards, gradually increasing the depth until level with the bottom of the burst and joining the two trenches in the centre of same. Pipes were then laid from centre along each trench, and the water conducted so as to emerge at sides further down the hill, the trenches and centre being filled in with brick rubble, etc., that could be obtained, and, when settled, the surface coated with metal.

Similar cases, but in a minor degree, occur on trunk roads which have been tarred, one helping cause, no doubt, being the prevention of ventilation by the tarred surface, and the retention of the water until the pressure of same, or the heavy traffic, causes the surface to give way.

RIVER CROSSINGS FOR WATER MAINS AT FORT WILLIAM.

THE city of Fort William obtains its water supply from Loch Lomond, a lake located about six miles from the city, about 10 square miles in area, draining a watershed of about 30 square miles; at an elevation of 332 feet above Lake Superior. The system at present laid out consists of tapping this source with a 36-inch diameter steel intake pipe, which, at normal lake level, has a capable discharge of 32,000,000 Imperial gallons per day into a gate chamber. From the gate chamber to a fore bay a tunnel is constructed about 5,000 feet in length, 5 ft. by 4 ft. in size. This tunnel is so laid that it serves simply as an arm of the lake, the water level in the fore bay being the same as the lake level. The capable discharge of the tunnel approximates 54,000,000 gallons per day. From the fore bay a gravity



CROSS SECTION THROUGH TUNNEL

Fig. 1.—For Water Mains Under Kaministiquia River.

18-inch diameter cast-iron pipe is laid for a distance of 3,356 yards, discharging into a reservoir which provides the static head to the city supply. With normal lake level and the reservoir standing three-quarters full (with 15 feet depth of water) the discharge of this pipe is about 3,657,000 Imperial gallons per day, which can be increased up to 4,198,800 gallons per day at the expense of lowering the water in the reservoir to zero, with consequent loss of static head to the city supply.

The 18-inch pressure main crosses the Kaministiquia River at a point south of and in line with Syndicate Avenue. The pipe is laid in duplicate on concrete slabs practically in the river bed, and is provided with controlling valves at each side of the river.

Desiring to increase its water supply, the city contemplates a duplication of pipe lines between the fore bay and the city and the addition of a 24-inch pipe line, pro-

viding then an available supply of over 11,000,000 gallons per day.

The proposed extensions necessitate the abandonment of the present Kaministiquia River crossing and the provision of tunnel crossings about 650 feet in length under the Mission and McKellar Rivers, while the Kaministiquia River will be crossed in another spot by a tunnel some 1,285 feet in length, and with cross-section and dimensions as shown in Fig. 1. The design of this shaft and tunnel system presents some very interesting

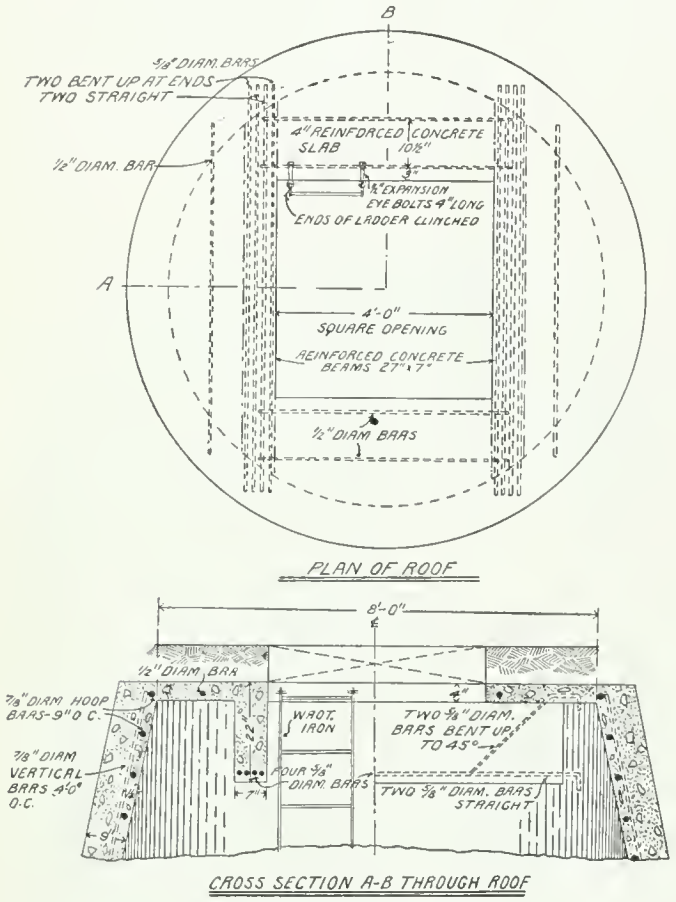


Fig. 2.—Details of Shaft on Each End of River Tunnel.

features, particularly with respect to the shafts. Those at the Kaministiquia River crossing are typical, and, being the largest, they are chosen for this description. Figs. 1 and 2 show details of roof and platform respectively.

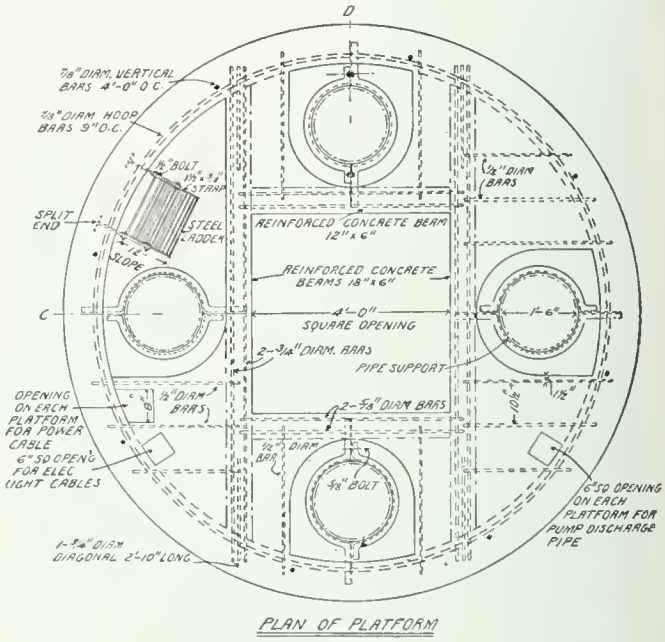
The typical shaft is lined with reinforced concrete and is provided with reinforced concrete platforms, at normal intervals of 20 ft. to serve as landings for the ladders and to provide support for the pipe lines. At the Kaministiquia crossing there will be two reinforced concrete lined rock cut shafts each 10 ft. in diameter. They are 121 ft. 9 ins. and 116 ft. deep, traversing sand, blue clay, dyke, broken rock and Hudson shale. The concrete shaft lining is carried into the shale for at least 6 ft. Below this point the shaft is rock cut and a lining is not necessary. The tunnel lies wholly in the Hudson shale.

The reinforced lining is a 1 :2 :4 concrete, 9 ins. thick. The vertical reinforcement consists of ⅞-in. round rods spaced 4 ft. apart The horizontal rods are also ⅞ in. round, and are spaced 9 ins. on centre.

The sinking of these concrete linings provides an interesting problem. If the choice of the contractor is to build them at or near the ground level, and then sink them by gravity, steel shoes will be required to form the footing, and the concrete will require at least 48 hours in which to properly set before lowering.

The use of the lubricant between the lining and excavation walls will likely be taken advantage of to facilitate sinking.

For this form of construction care must always be exercised to excavate to a true circle of not more that ½ in. larger diameter than the outside of the concrete linings. If deemed necessary the linings should be slowly and evenly lowered by means of screw jacks. For this form of construction it is also specified that three times the number of vertical reinforcing rods shown in the accompanying illustrations be used. When the shoe reaches



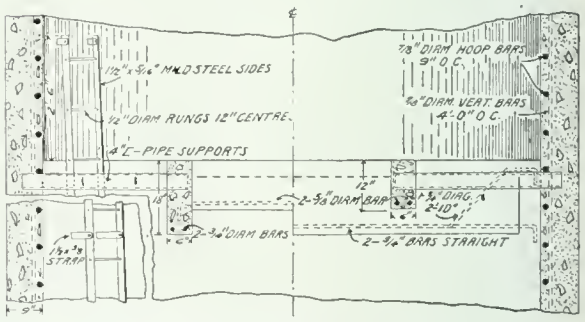

½" x ⅝" M.S. STEEL SIDES
½" DIAM RUNGS 12" CENTRE
4" C-PIPE SUPPORTS
⅞" DIAM HOOP BARS 9" O.C.
⅞" DIAM. VERT. BARS 4'-0" O.C.
2-⅞" DIAM BARS
⅞" DIAG. 2'-10"
⅞" DIAM BARS
2-¾" BARS STRAIGHT
CROSS SECTION C-D THROUGH PLATFORM

Fig. 3.—Details of Shaft Platform.

the rock an excavation will be made into the rock to a depth of 1 ft., so that the shoe will have an even bearing. The cavity left will be built up with brickwork and grouted in. Air and grout pipes at 2-ft. intervals will be provided for this purpose.

Only steel forms will be used on the concrete shaft linings. These forms will be well braced and stiffened to prevent deflection or twisting. Variations in the line and level exceeding ¼ in. will not be permitted in placing the forms

In case the reinforced concrete platforms are built after the shaft lining is completed, holes will be drilled for reinforcing bars, and cuts at least 1½ ins. deep will

be made in the lining to receive the ends of the beams and slabs.

Where shale or loose rock is encountered in the roof of the tunnels this material will be removed and replaced with a brick arch. Permanent sumps and segmented drains will be cut in the rock at the bottoms of the shafts and along the floor of the tunnel. At intervals of 12 ft. along the tunnel floor, hardwood blocks 3 ft. long by 8 ins. wide by 3 ins. deep will be placed for pipe supports.

The work was designed by Mr. T. Aird Murray, consulting engineer, and will be carried out under the direction of Mr. R. R. Knight, city engineer, of Fort William.

A HANDY PLUMB BOB HOLDER.

The carrying of the plumb bob from station to station, or to and from the line, has always been a source of annoyance to the transit-man. It will persist in punching holes in pockets and getting lost.

A device is described by F. H. Kitto, D.L.S., in the latest annual report of the Association of Dominion Land Surveyors, that will serve to overcome a great deal of annoyance from this source. It consists of a simple attachment on one leg of the tripod, for holding the plumb bob when not in use, and forms, in fact, a neat permanent receptacle for it, so that it is always with the tripod when required.

The attachment is briefly described as follows: The point of the plumb bob is safely disposed of by dropping it into a hole ¼ inch in diameter bored to a depth of ½ inch in the centre of the wood cross-piece of the tripod leg. The neck of the plumb bob rests in a strip of brass extending across the split of the tripod leg, and fastened at each end by two half-inch screws. This brass strip is bent to a curve at the centre so as to fit the neck of the tripod. The outer strip is also of brass and hinged at one end on a round-headed inch screw, which passes through the inner plate and screws firmly into the wood. The other end hooks over a pin which is fitted as a clamp screw, so that by a slight turn of the mill-headed thumb nut the plate cannot come unfastened and allow the plumb bob to drop out. This screw extends through the wood of the leg and tightens in a nut, which is fitted by two ⅜ inch screws to the inner side of the leg. The inner plate is bent in such a way that the neck of the plumb bob does not exactly fill it, but is gripped on either side. This is to allow for string which is generally wrapped around the neck. As the plate will spring according to the thickness of string, the plumb bob is always held firmly.

This is a very simple contrivance, easily made and easily fitted to the tripod; and a great deal of satisfaction may be received from this little arrangement. There is no place more convenient for the plumb bob when carrying the transit, or when the transit is in camp, on transport, or in the office. It cannot be lost and it cannot be forgotten.

A calculation has been made of the time that elapses before a drop of water evaporated on the surface returns to the ocean. The total volume of water brought annually to the sea is 1/3460 of the total contents of the ocean. A particle of water before evaporation has stayed in the ocean on an average 3,460 years. Once evaporated, the drop becomes condensed in about ten days and is then speedily drawn back to its ancient home.

MUNICIPAL WATER SOFTENING

By Geo. A. Johnson.

HARD waters—those containing high quantities of lime and magnesia in a dissolved state—are less desirable for domestic and industrial use than soft waters. Hard water produces scale in boilers, wastes coal, and shortens the life of the boiler. It is ill-suited to the needs of many industries, particularly those in which chemicals are used, such as paper mills. Hard water wastes soap in the laundry and frequently makes necessary the use of washing soda or other compounds which have an injurious effect on some fabrics. It almost always affects the skin unpleasantly, and is more or less undesirable and uneconomical in various ways for general household use. A careful treatment of the subject forms a part of a paper by Mr. Johnson entitled "The Purification of Public Water Supplies," and published by the United States Geological Survey. Important features of the subject of water softening for domestic purposes are therein discussed.

Waters which have a total hardness of over 50 parts per million (3 grains per gallon) are usually classed among the hard waters. Such waters as these are found in scores of cities in this country, particularly in regions where limestone deposits predominate. To illustrate this point a few examples are given of some of the hardest water supplies of the United States. This is, of course, a very incomplete list, and could be added to almost indefinitely. The figures given for total hardness are necessarily approximate, for the hardness of a water naturally fluctuates widely during the year, becoming greater during the months of low stream flow and least during high-water periods.

Approximate Total Hardness of the Raw-water Supplies of Some U.S. Cities.

	Parts per Million.		Parts per Million.
Warren, Ohio	580	Starke, Fla.	165
Shreveport, La. ..	360	Vincennes, Ind. ...	165
McKeesport, Pa. ..	300	Minneapolis, Minn.	160
Dayton, Ohio	290	St. Paul, Minn....	150
Columbus, Ohio ..	275	Lancaster, Pa.	120
Toledo, Ohio	200	Quincy, Ill.	105
Oswego, N.Y.	190	Washington, D.C..	100
Philadelphia, Pa. ..	180	New Orleans, La..	95

Water softening is not widely practiced in America except by private industries. Among the cities where the public supply is softened may be mentioned Freeport, Ill., Oberlin, Ohio, St. Louis, Mo., McKeesport, Pa., New Orleans, La., and Columbus, Ohio, the municipal water-softening plant at Columbus, first placed in operation in the fall of 1908, being the largest and the most complete. For complete details of the chemistry of the water-softening problem at Columbus, the reader is referred to an article by A. E. Kimberly, published in the supplement to the Journal of Infectious Diseases, May, 1909.

Dissolved Mineral Constituents.—In problems of water softening, the most important features requiring thorough and reliable data are particularly the nature and the relative amount of the dissolved mineral constituents to the presence of which the water owes its hardness. Such data indicate, in large measure, the treatment of the water best adapted to its softening. With rare ex-

ceptions the hardness of water is due to the presence of calcium and magnesium radicles.

There are two kinds of hardness, temporary and permanent. Waters in which carbonate or bicarbonate radicles are equal or greater in reacting value than the calcium and magnesium may be almost completely softened by boiling and their hardness is known as temporary. Waters in which carbonate and bicarbonate radicles are less in reacting value than the calcium and magnesium can not be effectively softened by boiling. The removal of all the calcium and magnesium from such water can be effected only by the addition of chemicals that will cause the formation of insoluble calcium and magnesium compounds. Hardness corresponding to the excess in reacting value of calcium and magnesium over carbonate and bicarbonate radicles is termed permanent.

Lime and Soda Ash as Softening Agents.—The process of softening water consists primarily in removing from it the calcium and magnesium radicles. This is accomplished with lime and soda ash by the formation of insoluble compounds of these radicles, but these chemicals also react with other substances in the water. The lime is introduced as calcium hydroxide and the soda ash as sodium carbonate. The effects are:

(1) Hydrogen (acidity) is neutralized, forming water; (2) carbon dioxide is changed to carbonate radicle and water; (3) bicarbonate is changed to carbonate radicle and water; (4) iron, aluminum, and magnesium form their insoluble hydroxides and fall as precipitates; (5) calcium present in the water and added as lime is precipitated as calcium carbonate; (6) the sodium of the added soda ash remains in solution in the water.

From the foregoing it appears that lime must be added in quantity sufficient to provide hydroxyl (OH) to combine with the iron, aluminum, magnesium, bicarbonate, and hydrogen radicles, and carbon dioxide. Moreover, if the carbonate radicle in the water plus that formed by the change of the bicarbonate radicle and carbon dioxide is not sufficient to precipitate the calcium present in the water and added as lime, a larger quantity must be provided by the addition of soda ash in order that all the calcium may be precipitated. This latter consideration determines the amount of soda ash to be added. In terms of pounds of 90 per cent. (CoO) and 95 per cent. soda ash (Na_2CO_3) per 1,000 gallons of water, these statements may be expressed in the following formulas, in which the symbols represent the number of parts per million of the various radicles, respectively, found by analysis. The symbol "r" represents the "reaction coefficient." The indicated product represents reacting value in parts per million.

1. Lime required:

$$= 0.26\ (rFe + rAl + rMg + rH + rHCO_3 + 0.0454CO_2)$$
$$= 0.00931\ Fe + 0.0288Al + 0.0214Mg + 0.258H + 0.00426HCO_3 + 0.0118CO_2.$$

2. Soda ash required:

$$= 0.465\ (rFe + rAl + rCa + rMg + rH - rCO_3 - rHCO_3)$$
$$= 0.0167\ Fe + 0.0515Al + 0.0232Ca + 0.0382Mg + 0.462H - 0.0155CO_3 - 0.00763HCO_3.$$

In the latter formula a negative value indicates that the water has no permanent hardness and that the use of soda ash is unnecessary.

The formulas may usually be simplified for practical use by the omission of iron, aluminum, and hydrogen, for they are not often present in sufficient quantity to affect the results. Total incrustants in parts per million (as determined by the standard method of the American Public Health Association) multiplied by 0.0093 will be practically equal to the value of Formula 2.

Manufacture of Lime.—The raw material for the manufacture of lime is carbonate of lime, either as a natural limestone or in the form of the shells of mollusks. By subjecting the raw material to a temperature of 900° to 1,000° C., the carbonic acid is driven off and calcium oxide or quicklime is left.

There are two distinct types of furnace in use for the manufacture of lime, namely, periodic and continuous kilns. In the continuous system the kilns, once charged with alternate layers of limestone and fuel, are never allowed to cool down, resulting in great economy of heat. In this country more lime is perhaps burnt in kilns operated periodically. In this system the charged kiln, after the burning, is allowed to cool down, the lime is removed, and the kiln is recharged and reheated for the following run. In comparison with the continuous system, the periodic method of operation is uneconomical, owing to the losses involved in fuel and in time.

As the result of the burning a good limestone is broken into lumps; it suffers no change in volume, its weight and properties only being affected. The loss of weight during the decarbonization is about 50 per cent. Well-burnt and entirely satisfactory lime should be porous, nearly as hard as the original limestone, and should contain little, if any, magnesium and but inappreciable quantities of silica and iron. For softening water, economy and expediency demand that the highest grade of lime obtainable should be used. It is evident that for softening water the value of a given lime is dependent on the amount of available calcium oxide it contains. As lime is bought and sold on this basis for softening water, the chemical analysis should be the standard under all circumstances.

Manufacture of Soda Ash.—The manufacturing process of soda ash depends on the fact that bicarbonate of soda is insoluble in ammoniacal solutions of common salt. Common salt, ammonia gas, and carbonic acid gas constitute the raw materials. Strong brine saturated with ammonia is pumped to the top of carbonating towers and allowed to descend through iron baffle plates up through which a stream of carbonic acid is constantly flowing. Under these conditions bicarbonate of soda is formed and separates out, falling to the bottom of the tower, whence it is removed. The crude product is subsequently calcined, carbonic acid and water are driven off, and the pure normal carbonate of soda or soda ash is left.

Soda ash of a high degree of purity may be obtained in the market, and such soda ash alone should be used in all water-softening plants. The percentage of soda ash will vary from 95 to 98 per cent.

Cost.—The cost of high-grade lime and soda ash is subject to considerable fluctuation. Speaking generally, a high-grade lime, containing 90 per cent. available calcium oxide or more, may be obtained for about $4.50 a ton in bulk in carload lots. Soda ash, containing upward of 95 per cent. sodium carbonate, may be obtained in bags of 300 pounds each for about $20, or somewhat less, a ton in carload lots.

Preparation of Lime Solution.—It may be stated, practically without reservation, that it is advisable to use limewater for softening water. The reason for this is that limewater, being a true solution, is much more readily applied in uniform quantities than milk of lime. In water-softening plants which are operated on an intermittent basis it is possible to make use of milk of lime, owing to

the fact that the application of the desired amounts of chemical may be kept under strict control. In plants which are operated on a continuous basis it is obvious that the effect of errors relating to the faulty application of lime must in a great measure vary inversely with the amount of water to be treated, or, in other words, with the amount of chemical to be used.

Although it is true that milk of lime is used in a small number of continuously operated water-softening machines of considerable size, the agitation factor is more particularly emphasized in such apparatus than would perhaps be feasible in larger plants. Without adequate mixing of the raw water and the milk of lime there is a marked loss in softening efficiency on the part of concentrated suspensions of lime, owing to the fact that the suspended particles of calcium oxide become coated over with the precipitating carbonate of lime and hydrate of magnesium, and thereby become inactive. With vigorous agitation this vitiating factor—the inactivity of a part of the lime suspensions—is greatly diminished, but doubtless it is still to be considered as important in proportion to the amount of suspended calcium oxide which the milk of lime contains.

From the evidence available it appears to be clear that limewater possesses distinct advantages over milk of lime in continuously operated water-softening plants for two reasons—first, because of the relative ease with which accurate and uniform application of this chemical may be maintained when it is applied in solution, and, second, because the softening efficiency of limewater is relatively higher. This second consideration involves questions of cost, which must be considered.

In a system of water softening operated on the continuous plan the device in which limewater is prepared is an important feature. In practice limewater is generally produced by diverting a portion of the raw water to the bottom of a tank or reservoir, sometimes known as the lime saturator, where it meets a continuous flow of cream of lime in slight excess of the quantity necessary to soften the raw water and to produce a saturated limewater. Thorough mixing of the cream of lime and the raw water is obtained by means of a stirring device situated at the bottom of the lime saturator. The raw water, softened to the fullest extent possible by treatment with cream of lime alone, becomes a saturated solution of lime. In order to obtain limewater which shall be practically free from undissolved lime and the precipitated salts of lime and magnesium the saturator is made sufficiently deep so that, as the water passes upward to the outlet at the top of the tank, the suspended matter will largely subside.

Preparation of Soda-Ash Solution.—Available evidence indicates that a 20 per cent. solution of soda ash in hot water should be used. Such a solution has a specific gravity of 1.23. A solution of approximately this composition is made by dissolving 20 pounds of soda ash in 100 pounds of water.

Limitations in Water Softening.—When once raw water, charged with carbon dioxide, has in its course over or through the earth become impregnated with calcium and magnesium there is no practical process applicable to municipal use which can restore the water to its pristine condition.. The reactions and the resulting precipitation will vary in completeness with conditions of temperature, mixing, and sedimentation. Furthermore, the precipitates formed are not wholly insoluble. In a water softened under ideal conditions there may remain in solution 5.2 parts per million of calcium and 3.4 parts per million of magnesium, together with equivalent amounts of negative radicles, representing an alkalinity of nearly 30 parts per million. These figures may be increased by the presence of other substances, so that it is apparently certain that a water once hard can not be softened in a practical plant to less than 34 to 37 parts of alkalinity per million.

With regard to the permanent hardness, it is not generally thought economical or advisable to remove all of the incrustants. As soda ash, which is used for the removal of these constituents, constitutes one of the chief items of expense in softening a selenitic water, its use should be restricted to the lowest limit commensurate with the benefits to be derived therefrom.

Factors Influencing the Speed of Softening Reactions.—The process of softening water requires considerable time for its completion. Chief among the factors that influence the rapidity with which the chemical reactions involved in the softening process may take place are the temperature of the water, the thoroughness of the agitation to which the water is subjected following the addition of the softening chemicals, and the maintenance in suspension of the precipitating salts during the period allowed for the reactions to take place.

It is a well-known and accepted fact that the majority of chemical reactions take place with relatively more rapidity as the temperature is increased. Those chemical reactions which are involved in water softening belong distinctly to this class. Cold weather during softening retards the process to such an extent that considerably more time is required for the completion than when the water is at a higher temperature; in extremely cold weather the maximum softening effect is often not obtained.

Even when the amounts of chemicals theoretically necessary for complete softening are applied to a given water, a satisfactory removal of the dissolved calcium and magnesium salts will not be obtained without thorough agitation. The importance of agitation in softening water has long been recognized, the means for effecting this end constituting an important feature in the design of the majority of proprietary water-softening machines.

It is a well-known fact that the presence in suspension of the precipitate previously formed or of that formed in the initial stages of the reaction generally assists materially the completion of the process, its success depending on the removal of dissolved substances by the formation of a precipitate as the result of chemical reactions. In water softening this matter is of particular moment, owing in large measure to the fact that the chemical changes involved are taking place in solutions of a high degree of dilution. The importance of the presence of the suspended precipitates throughout the course of the softening reaction has been recognized for many years, and many water-softening machines have been designed with the view of retaining these precipitates.

Available information indicates clearly that at the beginning of the softening process it is highly advantageous to apply the entire amount of lime required to the major portion but not to the total amount of the raw water to be softened. Mention has already been made of the fact that the maintenance in suspension of the forming precipitates materially accelerates the softening reactions. By overdosing a major portion of the water to be softened, the initial softening reactions are greatly accelerated. The action is particularly marked in the precipitation of the magnesium, which is much more rapidly and completely removed under the conditions outlined above than would otherwise be the case. Further, the indications are

strong that by splitting the flow of water to the reaction chamber, overtreating with lime the major portion at the inlet end of the reaction chamber, and, some time after the application of the soda ash, introducing the minor portion of the raw water, the undesirable factor of residual causticity, true of all water-softening processes, would in a large measure be overcome.

In general, therefore, it may be said that the concentrated action of the total amount of lime on the major portion but not on the total amount of water serves to speed up and to render possible a more complete lime reaction, not only as relates to the removal of magnesium but also to the removal of the calcium.

Elimination of Residual Causticity.—In all processes of softening hard water in which lime or caustic soda are used as softening agents, there is a possibility that the softened product will at times contain an excess of free caustic alkali, owing to the frequent changes in the character of the raw water, or to carelessness or accident in the operation of the plant, or to the method of application of the softening chemicals to the raw water. Another condition instrumental in the production of a caustic effluent is the retarding effect caused by low temperature on the rapidity and completeness of the softening reaction. In systems of water softening where the period allowed for the softening reactions to take place is comparatively short, particularly where such plants are designed to furnish water for drinking, rigid precautions are demanded to overcome the occasional inevitable residual causticity. In some plants the matter is controlled by installing carbonating devices for the purpose of subjecting the softened water to the action of carbon dioxide. If properly distributed in adequate amounts through a water possessing causticity, this gas is effective in overcoming this inadmissible condition.

This process is known as "carbonating," the principle involved being the same in all devices designed to accomplish this end. The features essential to successful carbonating are the uniform rate of application of the gas, and the thoroughness with which it is disseminated through the water. Although the process is without doubt practicable for small water-softening plants, its use in large plants would probably entail too great an expense to justify its installation. Further, aside from the cost, which perhaps might be reduced, it appears that the application of the gas to large volumes of water would cause great uncertainties in this feature of the plant, which must be under perfect control at all times.

Causticity that the raw water can neutralize is obviously equal to the amount of caustic lime (or caustic soda) required to soften the water. As a substitute for the carbonating devices in use in small water-softening plants, the application to the softened water of a small percentage of raw water may be practiced. It is apparent that the percentage of raw water required for each part of free causticity which may remain in the softened water will be one hundred times the reciprocal of the number of parts of lime (CaO), required to soften the water. In other words, all unchanged caustic alkalinity which the softened water may contain will be neutralized by the addition of a small percentage of raw water, the caustic neutralizing power of which is at a maximum.

Sedimentation of Softened Water Prior to Filtration.—Where river waters are to be softened, filtration usually follows the softening process. The necessity for the sedimentation of the softened water after the reaction period and prior to its filtration refers to the removal of an economical percentage of the precipitated salts of lime and magnesium, together with the suspended mud, silt, and clay carried by the water at flood seasons. It is clear that it would not be practicable or economical to apply to filters the softened water as it leaves the reaction chamber. As the precipitating salts are purposely held in suspension during the reaction period, the major portion of them passes out with the water as it leaves this chamber. The volume of this precipitate will be so great as probably to preclude the direct application to the filter of the water as it leaves the reaction chamber. Furthermore, at times when the river water carries high amounts of sediment, economy in filter operation demands that a period of sedimentation be allowed to intervene before such water is applied to the filter in order that a substantial removal of the mud, silt, and clay may take place in the settling basins.

For still other reasons it appears advisable to provide for several hours' subsidence as a means for compensating irregularities in the operation of a softening plant, namely, to guard against incomplete softening in the reaction period; to overcome uncertain factors introduced by winter weather, producing retardation of the softening action; to avoid the undesirable effect produced by possible after-reactions, which cause deposition of slow-forming precipitates on valves, boiler-water condensers, and the like, and to remove the esthetic objection introduced by the presence in the water, as delivered to the consumer, of small particles of precipitated lime and magnesium compounds.

RATING REFRIGERATING MACHINES.

In this country there are two generally accepted units for rating a refrigerating machine. These are commonly called the ice-melting or refrigerating capacity and the ice-making capacity. Both are expressed in tons of 2,000 lb. per day of 24 hour. When a machine is rated at one ton ice-melting or refrigerating capacity, it would mean that under an assumed range of operating temperature it would remove from the refrigerator the number of heat units equivalent to that required to melt one ton of ice at 32 deg. F. into water at 32 deg. F. The latent heat of ice has been variously taken as 142, 143, 143.7 and 144 B.t.u., but 144 B.t.u. is now the figure generally accepted. Then

$$2{,}000 \times 144 = 288{,}000 \ B.t.u.$$

is the equivalent of a ton of refrigeration per day of 24 hr. This would give 12,000 B.t.u. per ton per hour and 200 B.t.u. per ton per minute, all convenient figures to work with. The machine is supposed to work between a condenser temperature of 90 deg F., and a temperature of zero in the expansion coils.

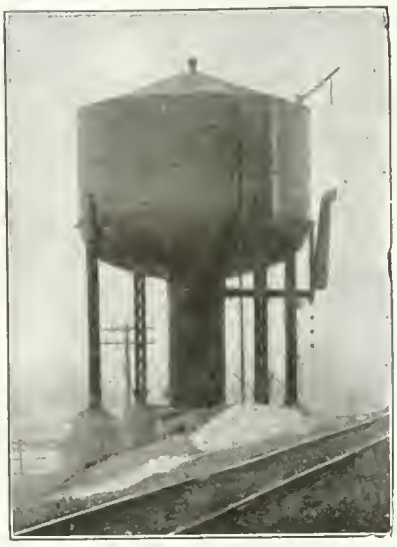
The ice-making capacity is a measure of the actual weight of ice made by a machine, designed for the purpose, in tons per 24 hr. For a machine not designed for ice making this unit would appear of little value, but for the sake of comparison it is approximately six-tenths the ice-melting or refrigerating capacity.

The Board of Railway Commissioners for Canada has issued to the railways a circular calling attention to the advisability of warning employees about the absolute necessity of keeping away from all electric light or power lines, and also to the advisability of becoming familiar with the recently revised rules for "Resuscitation from Apparent Death from Electric Shock."

NEW INDUSTRY FOR CANADA.

The Chicago Bridge and Iron Works, which has developed a prominent type of steel water tank for municipal, factory and railroad service, has built and is now operating a new plant at **Bridgeburg, Ontario.** This company began twenty years ago to construct for small towns and cities the hemispherical bottom type of tank, and since then has built a great number of tanks in every province in Canada and in every state in the United States.

About ten years ago Mr. George T. Horton, now president of the Chicago Bridge and Iron Works, designed and patented the elliptical bottom tank intended at first only for locomotive service. This tank, as shown by the cut above, has a large diameter and shallow depth, thus giving, as nearly as possible, the absolutely uniform pressure that is so desirable for all kinds of water service. Its special feature is the large steel riser pipe riveted directly to the tank bottom. This construction eliminates the leaky expansion joint and wooden frost casing, common to all other types of tank, and makes an all-steel structure which will last indefinitely. The large riser pipe is built from three to six feet in diameter, depending upon the climate. The success of the design is well illustrated by the municipal tank at Moose Jaw, shown herewith, which has never been put out of service by the coldest weather.



Grand Trunk Pacific Railway; Capacity, 50,000 Gallons; Height, 20 Feet to Bottom.

The tank bottom is practically flat where the riser is attached. It is, therefore, flexible and is in itself an ideal expansion joint, as is testified by the large number of high tanks of this design now in successful service. One in particular, a 200,000 gallon tank, 175 feet to the bottom, shows how well the expansion is taken care of. This elliptical bottom is now widely used for municipal and sprinkler as well as for locomotive service.

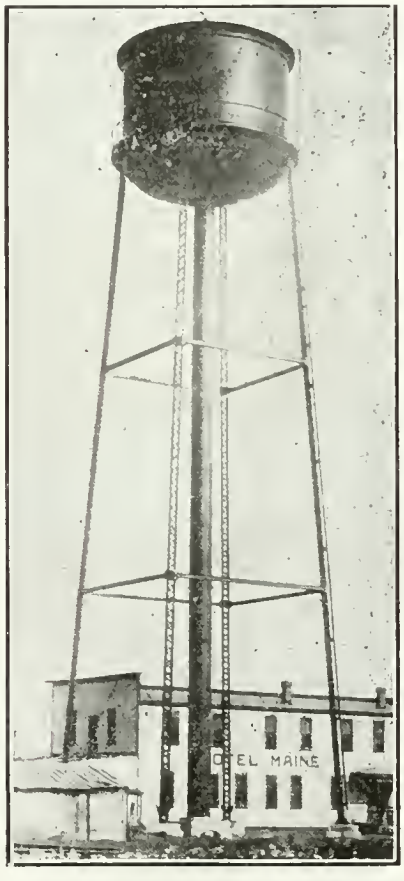
The large riser, besides doing away with wooden frost casing and expansion joints, serves as a settling basin. The inlet and outlet pipes extend up into the large riser several feet so as to be above any possible accumulation of sediment. A washout valve, operated from the outside, is installed at the bottom, so the tank can be cleaned without emptying or interrupting its service.

The self-cleaning feature of these tanks proved so important that Mr. Horton went a step farther. He designed and patented for railroads using extremely muddy water a conical bottomed tank with a large riser. This tank differs from the elliptical type only in that the bottom makes an angle of not less than forty-five degrees with the vertical so that the sediment has no chance to stop on its way to the settling basin.

How well these tanks are liked by the railroads is shown by the fact that they are in use on 85 railroads in numbers from 1 to 150 tanks per railroad.

Three years ago the Chicago Bridge and Iron Works' all-steel locomotive ser-

Edmonton, Alberta; Capacity, 75,000 Gallons; Height, 81 Feet to Top.



Capacity, 100,000 Gallons; Height, 111 Feet to Top; Moose Jaw, Saskatchewan.

Standard Elliptical Bottom Design; Capacity, 200,000 Gallons; Height, 175 Feet to Bottom.

vice tank was introduced on the Canadian railways when the Grand Trunk Pacific built a tank for experimental purposes at Scott, Sask. This tank proved so satisfactory that steel tanks were adopted as the standard for the entire system. Twenty-six tanks of the design shown herewith are now being installed at different points west of Winnipeg by the Chicago Bridge and Iron Works.

The elliptical or conical bottom tanks when installed at terminal points, or points where much water is used, do not require any heating even in Canada. Where but little water is used and steam is available a steam jet introduced into the tank near the bottom is a very satisfactory method for preventing an undue amount of ice.

Two years ago, when the Chicago Bridge and Iron Works tank was adopted as a standard on the Transcontinental Railway between Superior Junction and Cochrane, Ontario, the question of heating isolated tanks where no steam supply was available came up for consideration. Mr. Horton then suggested the method described below, which the Government engineers later adopted, and which has since been adopted by other railroads and other tank manufacturers.

The method used is very simple and consists of raising the bottom of the large riser a few feet, and installing a stove in the small room provided. The stove pipe extends up through the centre of the tank and out through the roof. The inside of the large riser at the bottom is lined with brick so as to prevent the heat from radiating.

The company has in operation, besides its original plant at Chicago, and its new shop at **Bridgeburg,** a plant at Greenville, Pa., in the Pittsburg district.

The mines branch of the Canadian Department of Mines has installed at Ottawa a modern laboratory for the purpose of experimental concentration and metallurgical tests with Canadian ores and minerals. The laboratory appears to be already well-equipped with both standard size machinery and small-scale apparatus, and an experimental roasting and sintering plant is to be added shortly. The plant will be operated free of all charges, including assays necessary for test purposes, on Canadian ores and reports of tests will be incorporated in the publications of the Mines Branch. Under ordinary conditions tests will be made by the Mines Branch officials, but arrangements may be made whereby engineers or other competent persons may supervise their own experiments.

During the month of May last the railways of the United States, according to the Bureau of Railway Economics, received for their services to the public an average of $8,230,000 a day; it cost to run their trains and for other expenses of operation, $5,920,000 a day; their taxes were $341,500 a day; their operating income, $1,972,322 a day for the 220,897 miles of line reporting, or at the rate of $8.93 for each mile of line for each day. Thus for every six dollars of their earnings which remained available for rentals, interest on bonds, appropriations for betterments, improvements and new construction, and for dividends, the railways had to pay more than one dollar in taxes. All of these amounts are substantially greater than the similar returns for May, 1912. They are from the summary of the earnings and expenses compiled by the Bureau of Railway Economics from the monthly reports of the steam railways of the United States to the Interstate Commerce Commission. They include over 95 per cent. of the mileage and earnings of all the railways of the country.

THE FINANCING OF MUNICIPAL WORKS.

Comparison of Canadian, British and South African Methods.

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The subject of loans required for the execution of municipal works, is one with which Canadian municipalities have been openly confronted with in the course of the present season. A few observations bearing with special significance upon Western Canadian municipalities, may be considered opportune, they being chosen. Firstly, because much attention has been directed to the amount of money required by them; secondly, because the conditions are unique in the history of British municipalities, and thirdly, because the precedure observed in relation to obtaining money for new works is somewhat different to that obtaining in other parts of the empire.

In England the growth of towns has been steady and practically uniform, during the last fifty years. Some towns have grown much quicker than others, but the average increase of urban population was about 15 per cent. between the years 1891 and 1901, and about 11 per cent. in the next decennium.

Some boroughs round London had grown about 26 per cent. in the years 1901-1911; this was due to immigration from the central parts to the suburbs owing to improved transportation facilities.

The following probably represents the largest increases in England and Wales during the last census period.

	Population.	Increase per cent.
Croydon	169,500	26.6
Rhondda	152,780	34.3
Swansea	114,663	21.3
Huddersfield	107,821	13.4
Cardiff	182,259	10.9
Sheffield	454,632	11.1
Belfast, Ireland	385,000	10.4

When Sir Robert Rawlinson was commissioned by the government to investigate the sanitary condition of Lancashire towns, in the forties or thereabouts, public health works were most inadequate and unsatisfactory. Sir Robert initiated great schemes to provide work for masses of men who were out of employment owing to the depression which then prevailed.

From that time to the present, English municipal authorities have gradually carried out such works. The growth of the population was steady, very few towns have had any exceptional development, and there has been no difficulty in undertaking schemes which would be ample for a generation ahead. Water supplies, sewerage schemes, street railways, electric light, gasworks, and other municipal works have therefore been provided without imposing an undue burden on the ratepayers. The only public work of importance which was difficult to carry out with a degree of assurance of success was that of the purification of sewage.

In South Africa, the conditions are different, for apart from Capetown district, Port Elizabeth, East London, Durban, Pretoria and Johannesburg, the population of the British and Dutch element has not grown to any extraordinary extent. The above towns during the ten years ending 1911 have grown considerably, but not in anything like the same manner as Western Canadian cities. Johannesburg is about 30

years old, but the other South African cities are much older and all have had time to carry out many municipal works, but there is much left to be done.

With regard to Canadian expansion, it may be instructive to analyse and compare the census returns for the 1911 decenium. The increase in population in Canada was 32 per cent. as compared with 11 per cent. in England and Wales. The province of Saskatchewan had increased 439.48 per cent.; Alberta, 413.08 per cent.; British Columbia, 119.68 per cent.; Manitoba, 78.52 per cent.; Ontario, 15.58 per cent.; and Quebec, 21.46 per cent.

The urban population in Canada had grown 62.25 per cent. as compared with 11 per cent. in England and Wales.

If we analyse the returns still further we find that the increase in a few of the cities were as follows:—Regina, 1243.40 per cent.; Moose Jaw, 787.23 per cent.; Edmonton, 848.21 per cent.; Vancouver, 51.35 per cent.; Fort William, 354.11 per cent.; Toronto, 80.99 per cent.; Saskatoon, 105.23 per cent.; Calgary, 893.72 per cent.; Medicine Hat, 257.20 per cent.; Winnipeg, 221.29 per cent.; Ottawa, 45.27 per cent.; Montreal, 75.73 per cent.

It may be interesting to know that Toronto and Belfast have about the same population but the rate of increase was as 8 is to 1. Montreal and Sheffield are somewhat similar in the number of inhabitants, yet the growth of Montreal was nearly seven times as great as in Sheffield. Winnipeg in 1911 was about three-fourths the size of Cardiff, but the expansion of the former was about 21 times as much as the latter.

Unfortunately, comparative figures are not at present available to contrast the other Canadian cities mentioned, but there is no doubt that their growth has been enormous as compared with English standards. It is palpable that in the West, the development of villages into towns will show an abnormal percentage of increase, but even if such cases are excluded, the expansion was far in excess of what ordinarily occurs in other countries.

The influx of people into Western Canada during the last five years was even greater than in the decenium 1901-1911. For instance, the writer when investigating the question of water supply of Regina, found that the annual increment for five years ending 1912 was about 36 per cent. compound. It is, of course, possible that this rate of increase has been equalled or even exceeded in other cities.

The extension of railways, the great development of the agricultural industry and the immigration of people, demand the creation of new towns and villages to provide for the commercial and social requirements of the inhabitants generally.

The enormous growth of the existing towns and the ever-increasing number of new villages, some of which develop very quickly, give rise to sanitary works, better means of locomotion, more efficient lighting, cheap power, and the many other civic requirements of modern times.

It will be acknowledged that the best policy and the only efficient administration for municipal authorities to undertake, is to carry out the necessary public works as the towns grow, and not to allow the works to accumulate in such a way as to be difficult to be overtaken. It is far cheaper and more satisfactory to carry out sanitary works in advance of the actual requirements, rather than to neglect keeping abreast of the times, and wait until a disastrous epidemic of some disease has broken out, which will not only need eradicating, but also the execution of the essential precautionary works, after causing sufferings and losses which cannot be reckoned in dollars and cents.

The influx of people into Canada, therefore, imposes an important and difficult duty on the municipal authorities, which cannot be safely ignored. That the majority of the authorities are endeavoring, within the statutory limits of their borrowing powers, to meet the requirements is proved by the calls for capital.

While English municipalities have had fully fifty years to carry out such works, the Canadian cities and especially, the Western ones, are called upon to undertake the same in about ten years. The difficulty is enhanced by the exceptional growth, for engineers find it almost impossible to estimate the future with the same confidence as they can in other parts of the world.

This difficulty is not inherent to city works, for banking corporations have frequently erected buildings which were soon found to be inadequate; railway companies have built railways and structures only to find that it was necessary to enlarge the same almost before completion; governments are guilty of similar delinquency, and business men who erected what others called "white elephants," have had to face similar conditions and exigencies.

Such, then, is the almost universal development of municipal enterprises in Canada. It is small wonder that criticisms have been levelled at civic authorities, both by investors who are not thoroughly familiar with Canadian expansion, and by people who are disappointed to find that public utilities are not developed as in England. The problem is to find the money needed. The financial aspect of this question is probably more interesting than the incomplete description of the conditions which now prevail.

The monetary requirements of a Canadian city is controlled by the total assessable value of the properties, for the power to borrow is usually limited to twenty per cent. of such value.

The next question to be dealt with will be the procedure observed when seeking loans for new works.

In England and Wales, there are the borough councils, which consist of the mayor, aldermen and councillors. The mayor is elected from among the aldermen and councillors for one year, sometimes he is elected from outside the council. The aldermen are elected from among the councillors for a term of six years, and the councillors are elected by the ratepayers for a term of three years. The urban district councils consist of the chairman and councillors.

There is usually a plethora of candidates for these honorary offices, and in the majority of towns the members have held office for many years. In the boroughs the aldermen add more permanency to the membership and policy. There is much to be said in favor of aldermen and also against the institution. Aldermen act like a ballast to a ship, so long as they are sensible and progressive, but there is a tendency sometimes, for aldermen to adhere to obsolete ideas and ignore up-to-date requirements on the plea of economy.

When any English municipal authority has decided to carry out any new scheme, the engineer prepares plans, estimates and specifications, and when these have received the approval of the council, the clerk is authorized to forward a copy of the same with an application to borrow the necessary amount of money, to the Local Government Board, which is a large government department controlling almost everything associated with civic affairs.

In due time an engineering inspector holds an official enquiry in the particular town, when the clerk, mayor, aldermen and engineer place full particulars of the town's indebtedness, population, assessment, borrowing powers, necessity for the works involved, and so on. When they have presented the case the inspector calls for evidence in opposition—if any—and at the close of the enquiry he proceeds to the site to make a personal inspection. The inspector reports to the board and that body sanctions or disapproves of the schemes,

or it may consider it necessary that a poll of the ratepayers should be taken, before giving any opinion or decision.

If the scheme receives the sanction of the Local Government Board, and it has authorized the period of repayment, the council is at liberty to approach the public works loan commissioner, or any other financial concern for offers or terms.

The Local Government Board, or the L.G.B., as it is known among the officials, is a restraining factor in the control of expenditure of public funds. The borrowing powers of the councils is usually limited to twice the rateable value, which in England is based upon the rack-rent of the properties, and not on the actual values.

The councils can undertake any new work, after its authorization by the Local Government Board at any time of the year, and float so much of the loan as is necessary or deemed expedient at the most propitious moment.

The Local Government Board is a slow moving department, often much criticised, but it is acknowledged to be an excellent organization, free from political influence, and possesses great powers to force recalitrant councils to execute any necessary works. Such powers, however, are very rarely exercised. It can, nevertheless, restrain too ambitious councils in their expenditure of moneys on doubtful schemes, or when their borrowing powers are nearly exhausted. It is somewhat conservative in its methods and adaptation to new development; bacteriological treatment of sewage and reinforced concrete structures, are instances of new methods to which it was for some time not prepared to give its sanction, except for short period loans. It will not consent to radical changes without ample proofs that they are essential in the interest of the public.

Under the English method the town authorities can take the fullest advantage of the financial fluctuations and thus ensure obtaining money on the most economical terms, which must be repaid in the period prescribed by the Local Government Board.

In South Africa, the procedure is different. The council having decided to undertake certain works for which preliminary plans, specifications and estimates have been prepared, calls a ratepayers' meeting and submits the proposals. If the ratepayers present are unanimous in favor, then the works are authorized, but if a certain number rise and demand a poll, then a plebiscite of the ratepayers is taken and the schemes are either agreed to or rejected. No formidable by-laws are necessary. If the schemes are approved by the ratepayers, the council can go on the money market at any time and thus take full advantage of the financial situation. Municipal schemes are decided upon at any time, and it is rare that any of them are suspended, altered, or turned down by new members because the policy is sufficiently established by the constitution of the council. Occasionally a scheme becomes the matter of an election contest, and the decision affords a guidance to the council in that particular case.

In Canada the procedure is different to both the foregoing examples.

The council usually decides what shall be undertaken in any year, so far as is possible. Of course, some schemes require more than one year for their execution, but the council of one year does not often settle what may be done in the next year, because the members are elected for two years and it is quite possible under such conditions to find a large proportion of new members elected at any time. Aldermen are usually busy men, engaged in businesses which calls for their close attention, whilst civic administration also demands a great amount of time which many aldermen can ill-afford. The result is found in the appointment of city commissioners, or the election of controllers, who devote their whole time to civic business, and thus relieve the aldermen of some of the administration.

The new council takes office in January each year, and some time is necessary to get the organization into working order. The aldermen call for reports, plans, etc., of works to be carried out during the year, some of which have sometimes, been considered in the previous year, in which case, if the new council acquiesces, there is a certain ecenomy of time. In due course the council decides to undertake many schemes, by-laws have to be prepared and read twice at the meetings. Then the by-laws, which recite in full various particulars and different legal phraseology, are published. The poll of the ratepayers is necessary and this is taken in ordinary course, and on the result depends whether and which schemes are to be carried out.

When the routine has been carefully observed, then the by-laws are read a third time, and advertisements are issued for bids, the most acceptable of which are selected.

All this means time, if any preliminary consideration by the council of the preceding year has taken place it permits of more expedition, provided the present council agree to such proposals.

The above procedure has to be strictly observed, otherwise the work is null and void, and the correct formalities have to be gone through and more time absorbed. As this routine must be followed by every council at about the same time, it is evident that the work is complete from March to May each year.

In Saskatchewan, the authority of the commissioner of public health is necessary before any schemes relating to public health can be submitted to the ratepayers for their approval.

In Canada, therefore, the town authorities are on the market for money about the same time, with the result that the aggregate amount appears enormous. The occasion may, however, be most inopportune, owing to financial stringency, caused by political events, abnormal industrial requirements, and perhaps by popular momentary wave of preference for securities of other countries or class. It is well known, that there is a fashion in investments as in other mundane matters, and this induces a fluctuation in the value of Canadian municipal loans, etc.

The almost simultaneous demand of many Canadian cities for money, is not to be commended. It does not usually occur in any other part of the world. It constitutes a flood of investments which cause financial indigestion and takes times to overcome.

There is a need for a greater continuity of municipal policy which can probably be attained by a longer period of election, say for three years instead of two as at present. Then fewer men will retire each year and councils will have a more established programme. If the present procedure is essential for the safeguarding of public interest, then it is a question whether the election should not be held at another time so as to permit the aldermen organizing their plans earlier. This, however, will not remove the disability due to the demand for money at practically the same time.

The character of the loan is a matter deserving of careful consideration. Instead of selling debentures required for various works in one class, they would possibly yield better average returns if those required for waterworks, electric works, street railways, and other reproductive works were disposed of individually. This is the usual practice in England and South Africa. Moreover, it is worthy of consideration whether ordinary debentures are as saleable as stock.

Many cities find it profitable to obtain funds by selling stocks of $500 and upwards.

Reverting again to the matter of procedure, it would appear that something more elastic on the one hand and more rigid on the other is necessary. This may seem paradoxical, but it is not so. The procedure should be sufficiently elastic to enable the councils framing their public works programme so as to permit them taking advantage of the financial fluctuations. It should also enable the councils to decide what works should be carried out and what money is required and come on the market at any time of the year, so that not too many of the Canadian authorities will do so simultaneously. It should be elastic enough to allow the councils to submit proposals to the ratepayers, at any time of the year, if such a procedure is really necessary. The ratepayers have elected their representatives and they might be given more freedom of action in this respect.

The procedure should also be rigid so as to protect the ratepayers and investors alike. One section of the ratepayers may have sufficient influence to force a scheme which might not be essential to the general public as another one might be. Some ambitious new aldermen may want a scheme delayed so that his may have a chance. The investor also wants safeguarding, for he is usually away from the place where the money is required. At present he has documentary evidence of the city officials supplemented in some cases by the government official. It would seem that the procedure could be made more rigid by adapting the English Local Government Board method, to suit Canadian conditions. To adopt the Local Government Board plan would no doubt be too drastic, and perhaps too great a restraint on the enterprising western Canadian councils. But to the British investor, (for most of the money comes from Great Britain), some independent and impartial investigation and sanction is desirable.

The Board of Railway Commissioners of Canada is reputed to give satisfaction to the public. The Public Utility Commissioners of Manitoba and Quebec are also said to fulfil their functions impartially and have done good work. Would it not be an advantage if similar organizations were instituted to facilitate and regulate municipal loan schemes? The fact that all municipal schemes were considered, investigated and sanctioned by such boards would doubtless have a great influence on the opinions of financiers, for it would be a satisfaction to them as well as to the ratepayers to know that all schemes have to be sanctioned or rejected by independent official authorities, who shall be absolutely free from political control. If such boards were constituted the town authorities would be able to prepare and submit any scheme at any time, and having got the necessary sanction of the board, with the period of repayment fixed, the councils could then arrange to secure the funds at the most opportune moment and on the most favorable terms. The present cumbersome procedure would then be unnecessary as there would be every safeguard in the interest of the ratepayers.

With the establishment of such boards, and a revision of the constitution of the town authorities, so as to secure a greater continuity of policy, Canadian authorities would be in a better position to obtain capital and to better arrange their programme of public works. Schemes could then be dealt with individually instead of collectively at any period of the year.

In conclusion it may be instructive to describe German municipal procedure. The city council consists of deputies elected by the ratepayers for three years; they appoint the Ober-burgermeister and a Vice-burgermeister at salaries for twelve years, and a number of stadräte or councillors, some of whom are salaried and correspond to our city commissioners. The burgermeisters and stadräte have a right to vote in council. When the council of deputies and stadräte presided over by the burgermeister has decided to embark on any scheme, the same is remitted to the burgermeisters and stadräte in charge of the branch controlling that particular work. The ober-burgermeister, vice-burgermeister and stadräte first settle all details in conference—called the magistrate collegium—and a report is presented to the council of deputies, when they finally decide the matter. The money is obtained either from an "operating fund" or by loan; but if it involves a large amount it ultimately means a loan. This is arranged with financial houses and the work proceeds. It is maintained that the ratepayers having elected their representatives it is left to them to use their judgment as to what is advisable to be done in the interest of the citizens. The government has certain powers of restraining municipal authorities, where it is felt that injudicious expenditures are incurred, otherwise the city authorities have complete independence in the administration of civic affairs.

ROCK SALT IN BRITISH COLUMBIA.

An extensive bed of rock salt has been discovered on the Skeena River, about 45 miles from Prince Rupert. Five holes have been drilled, about a mile apart, and salt has been struck in every case at depths varying from 50 to 250 feet. About eight tons of salt has been raised. The product is absolutely pure and of the best quality.

The Halifax Power Co. is planning to develop two sites on the Indian River, 18 miles west of Halifax. The upper station will include two units of 1,200 K.V.A. each. One operates on 90 ft. head from the Indian River watershed and the other on 160 ft. head from the North-East River watershed; the latter water is carried over to the Indian River by means of a long pipe line. The lower station will include two units of 1,200 K.V.A. operating on 90 ft. head; in this station the step-up transformers and high-tension gear will be placed. These developments will render 5,600 H.P. available in Halifax, which will be carried over a duplicate transmission line by two separate routes. Transmission will be at 33,000 volts. It is the intention of the company to sell this power for lighting and industrial requirements in Halifax. Plans are well under way for the upper development, one transmission line and receiving station, and it is expected that this portion of the work will be proceeded with immediately.

The exhibit of Canadian Allis-Chalmers, Limited, at the convention of the Canadian Association of Stationary Engineers held at Owen Sound, included a perfect working model of 36" size Squire's trap. Water was supplied to it by a small centrifugal pump driven by an electrical motor and a great deal of interest was taken in its operation.

Announcement is made by the B. F. Sturtevant Company, of Boston, that the plant which they have purchased at Galt, Ontario, is in such a condition that they can begin almost at once the manufacturing and assembling of their more important lines. Fans, blowers, planing mill exhausters, propeller fans, heating and ventilating apparatus, fuel economizers, mechanical draft, steam turbines, vertical engines, generating sets and stokers will be built for Canadian business and also for export to England, Australia and other countries. The manufacturing, engineering and sales will be handled by men trained by the Boston company. Arrangements have been made providing for growth up to ten acres of plant.

COAST TO COAST.

Montreal, Que.—The claims of ship owners, confirmed to a certain extent by records, that the level of the river and great lakes is being constantly lowered, principally by drainage operations, is about to be subjected to a practical test which should prove convincing to the most skeptical. According to information obtained to-day, the gauges between Port Arthur and Quebec, which are to be used in making the test, are now all in position by a special commission consisting of Prof. Haskell, of Cornell University, V. W. Forneret, chief engineer of the ship-channel and W. J. Stewart, chief hydrographer to the marine department. As the United States minister of war did not grant the application made by the Chicago drainage authorities last year for permission to increase the quantity of water they are entitled to take from Lake Michigan, the results of the tests are awaited with interest in shipping circles.

Victoria, B.C.—"The most important thing which the forestry convention did when it met at Winnipeg recently, was to pass a resolution urging upon the various provincial governments the importance of making provision for the teaching of forestry in the new universities."

That is the opinion of Mr. H. G. McMillan, the chief forester of the provincial government, who has just returned to the city after making an extensive visit of the forestry station in the interior, in company with Mr. O. W. Price, consulting forester to the government, who is here in connection with his engagement to assist in the establishment of the new department.

"What the future will demand in this province is forestry engineering and the university must provide the men and the methods. We have to develop trained forest rangers and make a study of forest engineering, for by the present look of things it appears inevitable that the logging of the future will be done by machinery. That I think was the most important thing the convention did, at all events so far as this province is concerned. There were two notable subjects discussed, namely, the extension of the civil service idea as applied to forestry and the encouragement of tree planting on the prairies. The prominence given to the last mentioned subject is perhaps best explained by stating that the convention took place in Winnipeg, where tree planting is a business.

"Since attending the convention I have been making a round of the interior stations, including Vernon, Cranbrook, Nelson, Kamloops and Vancouver and I must say that everything appears to be in good shape. The fire period is now upon us; the vegetation is extremely dry in places and the danger imminent. It will require the very closest application to business to prevent losses. Pretty good work is being done all along the line in the making of permanent improvements. You must understand that our trouble does not end at this season with merely telling people that they must not light fires. Fires will exist and it is our business to keep as close to them as possible in order to prevent them from spreading over large areas. Communication is our best weapon in this work and during the past few months we have been perfecting as far as possible our system of communication."

Quebec, Que.—After many complaints of the poor condition of the road, leading from the city to Lake Beauport, the Hon. J. E. Caron, Minister of Roads and the Hon. C. Delage, Speaker of the Legislative Assembly, have gone over the road with a view of securing some improvement. Lake Beauport is a beautiful spot, but the wretched roads prevent the extensive use of carriages or motors.

Vancouver, B.C.—For the purpose of taking up the question of a municipally owned power plant, Ald. McSpadden and Ald. McMaster were appointed by Mayor Baxter to act on a joint committee of representatives from the municipalities in Greater Vancouver.

The latest of numerous resolutions from ratepayers' associations, urging civic action towards a municipal power plant, came before the city council recently, from Kerrisdale Ratepayers' Association. It suggested a committee to gather information as to the operation of such a plant and the profits that might be derived from it, from cities which had made the experiment. Ald. Crowe favored a similar commission to that taking care of the sewerage system. He later, proposed the motion that the mayor appoint two delegates to a joint committee. Ald. McSpadden was chosen as chairman of the British Columbia Electric committee of the council.

At the last meeting of the city council, when a similar resolution came in from a ratepayers' association, it was referred to Mayor Baxter, who had intimated that the government was making a survey and a record of the water powers of the province. It was said that Mayor Baxter might look out for one for Vancouver.

Calgary, Alta.—Ald. M. C. Costello has signified the intention of proposing that the city take steps to investigate the question of filtering the water so that it will be pure and clean all the year around.

"Though the medical health officer tells us that even when the water is muddy the bacteriological count is very low, it seems to me that it is a bad thing to have muddy water at all. It must make a bad impression on visitors who come here and bad impressions are bad advertising. When we were in Saskatoon at the convention of the union of Canadian municipalities we had an oportunity to look over the filtration plant of that city and it struck us as being a most excellent scheme.

"A filtration scheme is greatly needed in Calgary, I think," he continued. "There is nothing like getting pure water. Though I hardly think there is any danger from the muddy water we have at times, it is my opinion that we should take no chances. The clearer and purer the water is, the better. The dirt should be taken out. Dirty water does not look pure and visitors to the city who turn the tap and are rewarded by a flow of dirty water, carry away a bad impression. It would pay the city in a great many ways to establish a filtration plant.

"In Saskatoon they have a small plant of small capacity, but Calgary would need one five or six times as large. Calgary needs eight or ten millions of gallons of water per day, while they get along in Saskatoon on one-fifth of that.

"I believe the very best possible system should be installed, if the scheme is viewed favorably. What that system is would have to be found out. Sand, charcoal, gravel, etc., are used in such systems."

Calgary, Alta.—City Water Engineer A. Ellison Fawkes reported to Commissioner A. G. Graves that the survey which the city is running to determine the cost of a pipe line for a mountain water supply has now been completed to within two miles of the present intake on the Elbow River. Mr. Fawkes estimates that it will require about two weeks more for the survey gang to get down to the present city reservoir, when the survey will be complete.

The work of compiling the data to secure estimates of the cost of the line is already under way and when finished will be most voluminous and complete.

"It will require two or three weeks longer after the survey is finished," said Mr. Fawkes, "to complete the estimates. Then we can take up the question of whether the city desires to go into the scheme proposed by Dr. Ings and take water from the tail race of the power plant he proposes. If the city does that, it will not have to build a dam. If it decides not to, a dam will have to be built. The difference in cost would be about $300,000."

Mr. Fawkes already has figures practically complete on the alternative cost of establishing Calgary's future water supply on a pumping and filtration basis instead of running the pipe line to the city forty-four miles from the Rocky Mountains. His preliminary figures on the pumping plant and filtration plant show that such a scheme would cost less than a million dollars, speaking in round numbers. The pipe line scheme will cost much more than a million, but the cost of maintenance in years to come would not be so great. These figures are on a forty million gallon per day basis.

Toronto, Ont.—Concrete bridge construction, while progress may be made in the future, has passed into stages of standard methods and is no longer experimental in so far as assured results are concerned, states F. A. McLean, in his annual report on highway improvement in Ontario for 1912. Past discussion has centred around the relative values of broken stone and gravel; wet and dry mixtures; methods of mixing, types of reinforcement and other details which now belong to settled practice.

Whatever specification is determined upon, however, should be carried out with intelligence, and in good faith. To this end, capable inspectors are necessary. Carefully drawn plans and specifications are of little value if their interpretation is left to men who have no proper knowledge of the properties of Portland cement and its use. Inspectors should be selected by the engineer, and should be carefully instructed before being placed on the work. Inspectors appointed by Boards of Works and councils, because of their influence, can rarely be expected to develop the skill, interest and enthusiasm that properly belong to the position and which are essential to best results. The writer has in the past found young engineering students of the second or third year to be in many respects well qualified, while the experience and training is of much value to them and ultimately to the public.

Better results could in many cases be had, were engineers to give more attention to form-work. Too frequently this is left to the rule-of-thumb methods of the foreman or contractor; whereas it is of vital importance that forms of adequate strength and of exact dimensions be provided if the strength and beauty of the structure is not to be jeopardized. Economy and perfect results will be greatly facilitated by detailed drawings for well-designed centres and forms.

Victoria, B.C.—Experiments will be made, under the direction of Water Commissioner Rust, to purify the water in Beaver Lake, which at present, owing to the presence of vegetable growth, is possessed of an offensive odor and color. An effort to precipitate the algae permeating the water, to the presence of which is ascribed the trouble, will be made by Assistant Engineer Foreman and City Analyst Birch. Recently they visited Beaver Lake and made arrangements to undertake the experiments. It is proposed to treat the water with sulphate of copper, bags of this substance to be pulled through the water. The chemical action consequent upon the introduction of the sulphate into the water, will, it is expected, precipitate the vegetable substances and thus clear the water.

The city has not yet been able to secure a full supply of clean sand for the renewing of the filter beds at Beaver Lake, but a small quantity has been secured and the filters can be used to some extent. It is expected, however, that the filter beds will be cleaned and renewed, when this method of cleaning the water from Elk and Beaver Lakes will be in full working order.

With these improvements, the supply from Elk Lake will be much more palatable, and can be mixed with the supply from Goldstream without any deterioration in the water supplied to consumers.

Toronto, Ont.—A special telegram received here from Boston, says efforts are being made by the Canadian Northern Railway to gain a terminal at Portland, Maine.

It is believed here that this step is only preliminary to an attempt to bring its lines into Boston in order to take advantage of the opportunity that the Grand Trunk failed to accept.

A company has already been organized and has obtained a charter to construct a railway from Portland to South Portland and to erect whatever terminal facilities may be needed there. This location offers the only available ground for a terminal at the Maine seaport and would make it possible for a transcontinental line to acquire a Portland entry to tidewater at comparatively low cost.

It is no secret that for some time the Canadian Northern Railway has long desired to enter Portland. Its effort to gain a terminal on United States territory and a share in New England trade led them to take steps toward acquiring rights to build south through Canada from Quebec and into the State of Maine.

Montreal, Que.—According to A. P. Davis, the contractor for the sub-structure of the Quebec bridge the work will be completed by November 15th. The St. Lawrence Bridge Company, which has the contract for the superstructure, will then commence. Mr. Davis expressed the opinion that it will take another four years to complete the bridge, and that it will not be ready for operation until 1917.

Toronto, Ont.—The International Joint Commission at Washington, which is making an investigation to determine what would be the most practicable level at which the Lake of the Woods should be maintained to best serve the interests of navigation, agriculture, power development, and fishing in that region between Canada and the United States, has sent out requests for certain information, the notices having been distributed widespread through the State of Minnesota. The Commission seeks information upon the following matters: The regulation, if any, of such secondary controlling works as exist in both Canada and the United States constructed for the floating of timber to the Lake of the Woods or tributary waters. When such works were installed, and the authority for them, the areas controlled by timber interests, and the extent to which timber has yearly been taken off such lands, and generally all information that would enable a concise report as to the progress of denudation, as well as any work, if any, in the way of reforestation. Data as to operations of all corporations engaged within the watershed of these boundary waters with the history of such corporations, conservation of the fisheries, and the possibilities of the future development of the region for tourist traffic.

Col. Geo. W. Goethals, chairman of the Isthmian Canal Commission and Chief Engineer of the Panama Canal, has consented to accept the honorary presidency of the International Engineering Congress, and will preside in person over the general sessions to be held in San Francisco, September 20-25, 1915.

PERSONAL.

HON. DR. ROCHE, Minister of the Interior, will begin a western tour of investigation about August 15th for the study of irrigation developments and necessities.

ARTHUR J. CANTIN, formerly sales engineer with the German Clancey and Grindley Company, Limited, of Edmonton, Alta., has been appointed superintendent of the Electric Light and Power Department of the town of Melville, Sask.

STANLEY LIGHTFOOT has taken over the Toronto business of Lloyd, Blackmore and Company, Ottawa, patent attorneys. The business will be owned by Mr. Lightfoot and conducted under his own name. The same office will be maintained in the Lumsden building.

L. C. GRAY, Ph.D., of Wisconsin University, and at present engaged in research work at the Carnegie Institute at Washington, has been appointed to a professorship at the University of Saskatchewan, Saskatoon. The research work of the institution will be in his charge.

The following members of the staff of the Faculty of Applied Science and Engineering, University of Toronto, have attained the rank of assistant professor in the department indicated: C. R. Young, structural engineering; W. M. Treadgold, surveying; J. R. Cockburn, drawing; M. C. Boswell, organic chemistry, and E. G. R. Ardagh, chemistry.

COMING MEETINGS.

ONTARIO MUNICIPAL ASSOCIATION.—Annual Meeting to be held in Toronto, August 28th and 29th. Secretary-treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.

THE NEW ENGLAND WATERWORKS ASSOCIATION.—Annual Convention to be held in Philadelphia, Pa., September 10th, 11th and 12th, 1913. Secretary, William Kent, Narragansett Pier, R.I.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Third Annual Meeting in Regina, September 18th, 19th and 20th. General Secretary, Major Lorne Drum, Ottawa; Local Secretary, R. H. Murray, C.E., Regina.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.C.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, Lo21 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—First Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

POWER DERIVED FROM REFUSE.

Those who have not followed the more recent developments in the disposal of city refuse, will find something instructive in a paper read by E. H. Foster before the American Waterworks Association at Minneapolis, Minn., in June. They will be surprised to learn that in a number of places part, if not all, of the steam used in driving steam pumps at waterworks pumping stations is derived from burning waste material. As a result of the development in the incinerator method of disposing of mixed refuse in England and in continental cities, several plants have been installed in this country, and, in all probability, the older and less sanitary methods hitherto in vogue will gradually give way to this more modern method, particularly as our cities increase in size.

Having produced the effect of destroying refuse in a sanitary and inoffensive manner, the question of how best to utilize this heat is answered by combining a steam boiler with the furnace and producing steam at any desired pressure. Steam so produced is available for running engines to produce electricity, but, as a rule, the amount which could be produced is but a small proportion of the total amount consumed by the community, also, the operation of the destructor does not lend itself to the requirements of peak loads which are incident to all lighting and power stations. A pumping load, however, is ideal for a destructor because of its uniformity and constancy, and it is in this direction that a municipality has its greatest opportunity for conserving this energy.

It would hardly be expected that the exact amount of steam available from the destructor would coincide with the exact amount of steam required at the pumping station, but the almost invariable condition is that the destructor steam is somewhat less than required by the pumps. Therefore, the difference is made up by auxiliary boilers.

The steam may be passed direct from the destructor to the steam range of the pumping station or converted into electricity and used to drive motor-driven pumps. Instances where steam from a destructor is used directly for driving pumps are found at Montgomery, Alt.; Westmount, Que., and Savannah, Ga., while instances where the power is first converted into electricity and the current used to drive motor-driven pumps to furnish the water are found at Milwaukee, Wis., and Savannah, Ga.

RUST-PROOF COATING FOR IRON OR STEEL.

This new rust-proof coating is a paint that is applied to the surface of the article to be coated and is then baked. The ingredients are mixed in the following proportions: Linseed oil, 25 parts; calcium resinate, 36 parts; manganese borate, ½ part; lead acetate, 1 part; naphtha, 37½ parts; artificial graphite, 25 parts. These are mixed and applied to the metal by brushing or dipping or any other method. The article is then baked at 300° F. for 1 hour and 40 minutes. The coating is stated to be highly lustrous and resistant to corrosion. No other form of graphite gives satisfactory results.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for smal fee.

19900—July 25—Approving location C.P.R. station at Corwhin, E. ½ Lot 21, Con. 19, Tp. Puslinch, Co. Wellington, Ont.; provided whenever it develops that traffic on highway is blocked for more than five minutes at any one time by reason of location hereby approved, Board shall be at liberty to relocate said station.

19901—July 25—Authorizing rural municipality of Webb, No. 138, Sask., at its own expense, to construct and maintain crossings over C.P.R. at Antelope, Gull Lake and Seward, Saskatchewan.

19902—July 25—Authorizing G.T.P. Ry. to carry traffic on portion of main line east of Prince Rupert, B.C., between Beament, mileage 195, and Morricetown, mileage 205; provided trains be operated over said portion at a speed not exceeding twenty-five (25) miles an hour.

19903—July 23—Authorizing T., H. & B. Ry. to construct interlocking plant where it crosses Hamilton St. Ry., on Barton St. East, Hamilton, Ont.

19904—July 24—Authorizing C.L.O. & W. Ry. (C.P.R.) to construct across William St., town of Cobourg, Ont. (West Riding), at mileage 120.34 from Glen Tay, by means of a bridge.

19905—July 25—Directing that, within ninety (90) days from date of this Order, C.P.R. install improved type of illuminated electric bell at crossing of highway at mileage 0.91 from St. Martin's Jct., Que., and thereafter maintain bell at its own expense; 20 per cent. of cost of installing bell to be paid out of the Railway Grade-Crosing Fund, remainder by railway company.

19906—July 22—Directing that signboards be erected and maintained at crossings on farm of Charles Sherriff, Huntingdon, Que., crossed by G.T.R. and N.Y.C. & H.R.R., and words printed thereon in large white letters to effect that such crossings are not to be blocked, and crossings must not be obstructed for a longer period than 5 minutes at any one time; this Order becomes effective within ten days from its date, and that railway company be liable to penalty of one hundred dollars for each violation of or failure to comply with provisions of this Order.

19907—July 25—Directing that, within 60 days from date of this Order, Pere Marquette Ry. install and put in working order an improved type of automatic electric bell at crossing of highway one and three-quarter miles west of Kingsville, Ont., and shall thereafter maintain bell at its own expense; 20 per cent. of cost of installing bell to be paid out of the Railway Grade-Crossing Fund, remainder by railway company.

19908—July 25—Approving location of C.P.R. station at North Appin, Tp. of Ekfrid, Co. Middlesex, Ont.

19909—July 26—Approving change in location plan of Campbellford, Lake Ont. and Western Ry. (C.P.R.) so as to include extra land required for station grounds in Lot 29, and 30, Con. 2, Tp. of Pickering, County of Ontario, Province of Ontario, and approving location of station known as "Cherrywood" on same property. (Mileage 175.39.)

19910—July 26—19911—July 28—Authorizing Dominion Atlantic Railway to operate its trains over bridges over Sissiboo River, County of Digby, N.S., and over Gaspereaux River, at Horton Landing, in the County of Kings, N.S.

19912—July 25—Directing the Campbellford, Lake Ont. and Western (C.P.R.) to construct suitable farm crossing for J. D. Howden, of Whitby, Ont., where it crosses his farm in Lot 24, Con. 2, Tp. of Whitby, Co. Whitby, Ont.

19913—July 28—Authorizing G.T.P. Ry. to construct an extension of its elevator tracks across road allowance, in its station grows in Town of Biggar, Sask.

19914—July 28—Authorizing C.P.R. to construct with its second track (double track) across fourteen highways on its Broadview Subdivision, Manitoba Division. Mileage 8.75 to 18.25.

19915—July 29—Authorizing C.P.R. to construct a spur for John MacGregor Company at mileage 45.16 from Aroostook Junction, Edmundston Subdivision into Lot 2, Parish of St. Basil, Co. of Madawaska, N.B.

19916—July 24—Re protection of G.T.R. crossing over Yonge street, 1.5 miles south of Aurora, Ont., mileage 28.66. Side road to be diverted into Yonge street. Land to be deeded to the township by the G.T.R. Work to be performed by the Tp. of King. Electric bell to be installed at crossing of Yonge street within sixty days; 20 per cent. from Ry. Grade Crossing Fund.

19917—July 26—Approving location of C.P.R. station on Lot 6898, Group 1, West Kootenay Dist., at Canyon, B.C., near mileage 63, Sirdar Subdivision.

19918—July 28—Approving plan "A" showing details of interlocking plant of C.N.O. Ry. and C.N. Montreal Tunnel and Terminal Co. with Jacques Cartier and Union Railway Company, near Jacques Cartier Junction, Province of Quebec.

19919—July 31—Directing G.T.R. to construct a siding to connect with existing siding for Greenfield Conduit Company, Limited, and others who may wish to use same in the rear of Broadview avenue, Toronto, Ont.

19920—July 24—Amending Order No. 19348 of May 16, 1913, re cattle pass on C.N.O. Ry. for John Fletcher and John Wilson the following clause: "That, in respect of the cattle pass to be constructed for the said John Wilson, the railway company be not responsible for the drainage."

19921—July 25—Authorizing C.P.R. to construct spur for Revelstoke Saw Mill Co., Ltd., across Fifth avenue and Block 123, in Town of Swift Current, Sask.

19922—July 28—Amending Order 19856, dated July 12, 1913, directing Brockville, Westport and N.W. Ry. Co. to construct a cattle pass for D. H. Grey and C. S. Grey by adding following clause: "The said cattle pass to be constructed and completed within sixty days from the date of this Order."

19923—July 28—Authorizing C.P.R. to construct spur for the Saskatchewan Motor Co., Limited, Regina, Sask.

19924—July 26—Authorizing G.T.R. to construct sidings to premises of Alabastine Hard Mortar, Limited, the York Sand and Gravel, Limited, and the York Sandstone and Brick Co., Limited, Tp. of Scarboro, Co. of York, Ont.

19925—July 31—Dismissing application of G. C. Cummings, of Lyn, Ont., to compel G.T.R. to construct a subway between Lyn and Brockville, on Lot 21, Con. 1, Tp. of Elizabethtown, mileage 127.77 from Montreal.

19926—July 31—Approving agreement dated July 29, 1913, providing for proposed new viaduct and plans and profiles referred to in agreement and dated April 25, 1913, agreement made between the City of Toronto, the railway companies (C.P.R. and G.T.R.), Toronto Harbour Commissioners. Work to be completed within three years from July 29, 1913.

19927—July 31—Amending Order No. 19288, of May 12, 1913, re compensation to be paid W. B. Fee by G.B. and S. Ry. (C.P.R.) by adding after the word "diversion" in the fifth line of the operative part of the Order the following words: "Mr. W. B. Fee to be paid whatever damages he is entitled to for the land, for severance and all other damages flowing directly from that cause."

19928—July 30—Authorizing the Vancouver, Victoria and Eastern (G.N.R.) to take certain lands in the District of New Westminster, B.C., and to construct bridge over its tracks on the line of the North road, with roadway and sidewalks. Municipalities of New Westminster, Burnaby, Port Moody and Coquitlam represented.

19929—July 29—Authorizing G.T.R. to construct sidings for Harris Abattoir Company, Limited, north of St. Clair avenue, Toronto, Ont., crossing Symes road.

19930—July 29—Approving location of G.T.P. station at mileage 428.5, Prince Rupert East, Lot 3338, Cariboo District, B.C.

19931—July 29—Approving location of Campbellford, Lake Ontario and Western Ry. (C.P.R.) station at Grafton, in Lot 23, Con. A, Tp. of Haldimand (West Riding), Ontario.

19932—July 29—Authorizing C.P.R. to construct with its double tracks across highway diversion at mileage 84.99 from Moose Jaw, Swift Current Subdivision. Present road allowance to be diverted.

19933—July 29—Approving location of C.P.R. station on the N.E. quarter of Sec. 10, Tp. 8, Rge. 30, West 2nd, Sask.

19934—July 28—Authorizing C.P.R. to construct diversion of highway and cross same at mileage 77.91 from Moose Jaw on Swift Current Subdivision. Present road allowance to be diverted.

19935—July 28—Approving revised location of C.P.R. from mileage 65.94 to 68.04 and construction of additional double track between mileage 65.94 and 69.24 (zero of said mileage being at Broadview, Sask.) and to construct across three highways.

19936—July 31—Directing that C.P.R. make connection with C.N.R. spur to Government Elevator at Port Arthur, Ont., within thirty days, cost to be paid by Board of Grain Commissioners, also to be used by G.T.P.

19937—August 5—Approving G.T.P. Standard Freight Mileage Tariff C.R.C. No. 18, to apply between stations in Alberta and British Columbia, between and including Thornton, Alberta, and mileage 1189, British Columbia.

19938—July 30—Approving By-law No. 40, Hull Electric Ry., covering rules and regulations for the government of employees of the Hull Electric Company.

19939—July 19—Approving revised location C.L.O. and W. Ry. in Lot 23, Con. A, Tp. of Brighton, and authorizing the applicant company to take from the G.T.R. the extra land required for right-of-way.

19940—July 30—Authorizing the C.P.R. to construct, maintain and operate a branch line of railway or spur for the Regina Storage and Forwarding Co., Regina, from a point on the existing spur in Block 137, thence across Lots 1, 2 and 3, Block 137, City of Regina.

19941—July 29—Approving revised location C.P.R. from a point in Sec. 21 at mileage 66.7, thence to a point in Sec. 7 at mileage 69.6 from Moose Jaw on the applicant company's Swift Current Subdivision.

19942—July 30—Authorizing C.P.R. to construct spur for De-Laval Dairy Supply Co., Limited, Peterboro, Ont.

19943—July 29—Approving location Edmonton, Dunvegan and British Columbia Ry. Co. through Tps. 71-72, Ranges 1-4, West of the Fifth Meridian, from mileage 128.44 to mileage 156.11.

19944—July 30—Authorizing G.T.R. to construct, maintain and operate a branch line through the premises of the Toronto Structural Steel Co., Limited, Western Ontario.

19945—August 2—Amending Order No. 15090, dated October 11, 1911, which authorized City of Hamilton to construct a subway on T.H. and B. at Birch avenue, by striking out the words applicant company and substituting T.H. and B. Ry.

19946—July 31—Authorizing C.P.R. until August 1, 1913, to operate its trains over crossing G.T.R. at Tecumseh street, Toronto.

19947—July 29—Authorizing Kingston and Pembroke Ry. to construct spur for the Chandler Jones Lumber Co., in the Tp. of Palmerston, Ont.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Bassano, Alta., sewage disposal works	Aug. 15.	July 17.	86
Brampton, Ont., clock tower	Aug. 18.	Aug. 7.	80
Cayuga, Ont., macadam road	Sept. 16.	Aug. 7.	88
Cobalt, Ont., municipal building	Aug. 15.	July 24.	86
Dorchester, N.B., construction of wharf	Aug. 18.	July 31	78
Kamloops, B.C., drill hall	Aug. 16.	Aug. 7.	80
Kerrisdale, B.C., incinerator	Aug. 18.	July 24.	80
New Westminster, B.C., registry office	Aug. 19.	Aug. 7.	82
Ottawa, Ont., steel steamer	Aug. 28.	July 24.	80
Peterborough, Ont., pavements	Aug. 20.	Aug. 7.	86
Peterborough, Ont., bridge	Aug. 20.	Aug. 7.	88
Poupore, Que., training pier and revetment wall	Sept. 2.	Aug. 7.	80
Prince Albert, Sask., drill hall	Aug. 25.	Aug. 7.	82
Toronto, Ont., Toronto harbor works	Aug. 25.	July 17.	84
Toronto, Ont., construction of a sewer	Aug. 19.	July 31.	84
Toronto, Ont., harbor works	Sept. 2.	Aug. 7.	86
Vancouver, B.C., wharf	Aug. 21.	July 17.	80
Welland, Ont., Severn section	Aug. 25.	Aug. 7.	86
Winnipeg, Man., drill hall	Sept. 3.	Aug. 7.	82

RAILWAYS—STEAM AND ELECTRIC.

+—Hope, B.C.—MACARTHUR BROS. COMPANY, engineers and contractors, New York City, has just been been awarded the contract for the construction of thirty-eight miles of railroad by the Kettle Valley Railroad Company jointly with the Great Northern Railroad Company. This work is located in the Coquehalla Canyon, British Columbia, and it is estimated that the cost of construction will exceed $2,000,000. The work consists of considerable heavy rock work and several small tunnels. Mr. F. C. Hitchcock, vice-president and general manager of MacArthur Brothers Company, is in charge of this work and has established headquarters at **Hope, British Columbia,** where he intends to sublet a portion of the work at once.

▲—St. Malo, Que.—Tenders will be received up till the 2nd of September, 1913, for the erection of locomotive and car shops. Plans and specifications may be obtained from Mr. Gordon Grant, Chief Engineer, Ottawa; Mr. A. E. Doucet, District Engineer, Quebec, and the Commissioner of the Transcontinental Railway, Ottawa. P. E. Ryan, Secretary.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—The Mineral Rubber Company has made a demand on the city commissioners that it be allowed to do 15,000 yards more paving, but it is not likely the demand will be complied with. The subject was considered at the meeting of the commissioners recently. When the paving contracts were awarded last year the Mineral Rubber Company was given 100,000 yards, but when the contracts were let certain streets were allotted to the company, the paving on which was 15,000 less than the award. The company consented to the council reducing its award to 85,000 yards when the contracts came to be drawn up. Like all the other companies to which contracts were given, with the exception of the Crown Paving Company, the Mineral Rubber Company failed to complete its contract, and was, therefore, subject to having its contract for what was left over cancelled. The commissioners, however, saw fit not to cancel it, but allowed the company to go on and finish up this season. Commissioner Samis stated at the meeting that he did not consider it advisable to do any paving except by the city plant this year. The matter was left to Commissioner Samis and the city solicitor.

Canora, North Saskatchewan.—Tenders will be received up till August 18th, 1913, for the construction of two reinforced concrete bridge abutments for a bridge over the Whitsand River. Plans and specifications may be obtained from A. J. McPherson, chairman, Board of Highway Commissioners, Regina, Sask.

Chatham, N.B.—The Department of Public Works, Ottawa, has stopped all work on the new bridge across the Miramichi River from Newcastle to a point below Nelson. This action has been taken as a consequence of not complying with the regulations which affect the building of bridges or wharves on navigable rivers. The construction will begin again when the plans are furnished and approved by the Department of Public Works, at Ottawa.

+—Jacksonville, Fla.—The DOLARWAY PAVING COMPANY have been awarded the contract for the construction of 26,141 square yards of pavements.

Kamsack, North Saskatchewan.—Tenders will be received up till August 18th, 1913, for the construction of two reinforced concrete bridge abutments for a bridge over the Assiniboine River. Plans and specifications may be obtained from A. J. McPherson, chairman, Board of Highway Commissioners, Regina, Sask.

+—London, Ont.—The City Council has awarded Messrs. BAIN & ROSS the contract for the substructure of the Wharncliffe Road bridge.

London, Ont.—Tenders will be received up till August 18th, 1913, for the construction of approximately 5,430 square yards of reinforced concrete pavements with 4,230 lineal feet of cement curb. Plans and specifications may be obtained from W. N. Ashplant, City Engineer.

Moose Jaw, Sask.—Work is proceeding rapidly on the big bridge which is being built for the Canadian Northern Railway across the South Hill Ravine, and it will be completed in a very short space of time. Already more than half of the bridge has been completed and one of the piers has been erected for the bridge, which will give the company entrance into the central portion of the town, and the pile-driver is now on the north side of the river. There is a large amount of trestle work and bridging to be done between South Hill and the point where the roadbed will strike the level, about Fairford Street East, but this will not take long, now that an active start has been commenced. Reports say the company will start work next week on a station in South Hill.

Osgoode, Ont.—Tenders will be received up till August 18th, 1913, for the building of a concrete bridge opposite Lot 22, Concession 7. Plans and specifications may be obtained from Chas. Macnab, County Clerk, Court House, Ottawa.

Ottawa, Ont.—Tenders will be received up till the 6th of September, 1913, for the construction of a substructure of a bridge at Smith Falls. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, Secretary.

Preeceville, North Saskatchewan.—Tenders will be received up till August 18th, 1913, for the construction of two

Tarvia

Preserves Roads
Prevents Dust~

Beaurepaire Road, Beaconsfield, Quebec. New macadam road treated with two coats of "Tarvia B."

A New Principle in Road Building

IT has long been recognized by engineers that one of the greatest causes of the destruction of macadam roads by traffic has been the internal movement caused by the passage of heavy loads. The endless shifting and creeping of the lower courses of stone causes a grinding and pulverization which destroys the stone and breaks the bond.

To reduce this internal movement engineers have buried the larger stone under successive layers of finer stone. This fine stone forms dust more rapidly but the dust serves to protect the foundation of the road by acting as a cushion. Modern traffic makes the use of such dust cushions quite impracticable, for the automobiles not only stir up the dust but they create entirely new conditions by scouring the surface of the road and breaking the bond with the backward thrust of their driving wheels.

The possibility of making roads automobile-proof by using Tarvia as a binder from top to bottom of the wearing-course during the construction of the road has now been satisfactorily demonstrated. The Tarvia fills the voids and forms a tough, durable matrix in which the stone cannot shift or grind. Consequently it has become possible to use large stone in a much greater proportion of the construction. The fine screenings and stone chips are used only on the surface as a finishing coat

Traffic wearing away the surface strikes the layer of large stone in the Tarvia matrix and makes little or no impression upon it. The large stone pulverizes but slowly and cannot be torn loose by automobile wheels. It does not change contour, sheds water instantly, is free from dust, costs but a trifle more to build than ordinary macadam, costs much less to maintain.

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reinforced concrete bridge abutments for a bridge over the Assiniboine River. Plans and specifications may be obtained from A. J. McPherson chairman, Board of Highway Commissioners, Regina, Sask.

Regina, Sask.—Tenders will be received up till August 23rd, 1913, for the construction of grade, North Sections 21 and 22, Township 33, Range 19, West Third Meridian. Plans and specifications may be obtained from A. J. McPherson, chairman of the Board of Highway Commissioners.

Rosthern, Sask.—The Town Council has accepted an offer of 87½ per cent. and accrued interest for $10,000 sidewalk debentures from the Imperial Bank of Canada. In view of the condition of the money market the price is considered fair.

+—**Russell, Man.**—Mr. O. DANNELS, Bredenbury, has been awarded the contract for the construction of cement sidewalks here.

+—**Sandwich, Ont.**—The City Council has awarded Mr. THOS. CHICK, Windsor, the contract for the construction of 16,000 square yards of concrete pavement. The contract price is $26,000.

Saskatoon, Sask.—Work will be commenced on the new traffic bridge across the South Saskatchewan River, being erected by the Provincial Government and the city at a cost of $398,000.

+—**Springfield, Ill.**—The DOLARWAY PAVING COMPANY have been awarded the contract for the construction of 1,216 square yards of pavements.

St. Jean, Que.—The municipal council has awarded Messrs. BARABE & JACQUES, Deschailons, the contract for the construction of a bridge over the Duchem River. The contract price is $17,500.

Victoria, N.S.—Tenders will be received up till August 23rd, 1913, for the following bridges and culverts: Road Jersey Cove to Smokey, 23.2 miles, 90 culverts. Road Lower Middle River to Inverness, County Line, 13.7 miles, 72 culverts. Road Baddeck to Inverness County Line, via Nyanza, 16.6 miles, 105 culverts. Road Baddeck to Englishtown, 18.0 miles, 95 culverts. Plans and specifications may be obtained from Road Commissioner, Halifax, N.S., and also at the offices of the following: John G. Morrison, Esq., Englishtown, N.S.; M. D. McAskill, Esq., Baddeck, N.S.; A. K. MacKenzie, Esq., Nyanza, N.S.; David A. MacRae, Esq., Middle River, N.S. E. H. Armstrong, Commissioner of Public Works and Mines.

+—**Winnipeg, Man.**—The City Council has awarded Messrs. ALLOWAY & CHAMPION and the CANADA MINERAL RUBBER COMPANY equal contracts for supplying refined asphalt. The UNION OIL COMPANY, Chicago, the contract for supplying fluxing oil. The contract price is $20 per ton.

LIGHT, HEAT AND POWER.

Aurora, Ont.—The ratepayers of the town have passed a by-law calling for an expenditure of $16,000 for the purchase and installation of electrical machinery and apparatus.

+—**Carlyle, Sask.**—The John Galt Engineering Company have awarded the following contracts in connection with the $20,000 extension of the waterworks in order to supply the Canadian Northern Railway, and $10,000 for electric light and power works: Power house and reservoir and erection of compressor, BENNET DEBNAM COMPANY, Calgary, pumps, CALEDONIAN IRON WORKS, Calgary; generators, GENERAL SUPPLY COMPANY, Calgary; meters, PACKARD ELECTRIC COMPANY, Winnipeg; poles, McKINNON COMPANY, Calgary; line material, NORTHERN ELECTRIC COMPANY, Winnipeg; wire, E. F. PHILLIPS COMPANY, Winnipeg; transformer, CANADIAN MALONEY COMPANY, Winnipeg; street lighting equipment, N. E. F. PRINGLE, Winnipeg; wiring line, E. SMITH, Melville Sask.

Hamilton, Ont.—Tenders will be received up till August 28th, 1913, for the installation of a joint underground conduit system for the Hamilton Hydro-Electric, the Dominion Power and Transmission Company and the telegraph companies. Plans and specifications may be obtained from the Hamilton Hydro-Electric Department. E. I. Sifton, Consulting Engineer.

Medicine Hat, Alta.—Electric wiring in the business portion of the city of Medicine Hat is becoming inadequate, and the work has been commenced on the alteration of part of the distribution system. It is proposed to place these wires on 45-ft. poles in order to avoid danger from contact with telephone and fire alarm wires.

+—**Winnipeg, Man.**—The City Council has awarded the FORT GARRY CONSTRUCTION COMPANY the contract for the new terminal power station for the light and power department. The contract price is $35,000.

GARBAGE, SEWAGE AND WATER.

Fort William, Ont.—The report on sewage disposal in the township of Neebing, adjoining this city, has been completed by Engineer William C. Sample, and will be presented at the August meeting of the council of the municipality. This report deals with a scheme for adequate drainage for the site of some five hundred houses to be erected.

Medicine Hat, Alta.—During the month the water distribution system of Moose Jaw has been extended by 6,413 feet of 6-inch and 213 feet of 8-inch pipe. In all, 27 new 6-inch valves were installed and 62 new connections made. In addition to this, the work of connecting the new main from the standpipe to the new power house was completed and a temporary connection to the pump was finished. In connection with this some 624 feet of 8-inch pipe were laid between the well and the end of the 20-inch main.

Port Arthur, Ont.—The council of the corporation intends to construct sewer and water mains on Secord Street from Pearl Street northwards to Armory Building, and intends to specially assess a part of the cost upon the land abutting directly on the work. The estimated cost of the construction of the sewer is $300 and of the water main $220.

+—**Regina, Sask.**—The City Council has awarded the CANADIAN IRON CORPORATION, Fort William, the contract for supplying 4,000 cast-iron pipe to be used for waterworks construction.

+—**The Pas, Man.**—The Town Council has awarded the HURST ENGINEERING AND CONSTRUCTION COMPANY, Winnipeg, the contract for sewer pipe. The contract price is $76,920.

Toronto, Ont.—Tenders will be received up till August 26th, 1913, for the supply and erection of three motor-driven centrifugal sewage pumps, automatically controlled. Plans and specifications may be obtained from R. C. Harris, Commission of Works, City Hall, Toronto. H. C. Hocken, Mayor.

Victoria, B.C.—The following tenders have been received in connection with the Sooke water supply. These were referred to the Water Commissioner and Consulting Engineer Meredith. For the concrete pipe line of 27½ miles long from Sooke Lake to Humpback Reservoir: M. P. Cotton & Company, $2.38 a foot, $342,720; Ross Nichols & Company, $2.38 a foot, $342,720; Pacific Lock Joint Pipe Company, $2.29 a foot, $329,760; Graff Construction Company, Limited, Seattle, $214 a foot $308,160; Arthur S. Bent, $2.38 a foot, $342,720; Reinforced Concrete Pipe Company, Limited, $3.25 a foot, $468,000. For riveted steel pipe for the pressure line, ten and quarter miles long: Cumming & Kiehl, $529,730.50, divided into sectional bids for excavation, pipe-laying, filling, concrete piers, riveted steel pipe of 5-16 of an inch, and also of ⅜ of an inch in thickness, construction of gate-house, and other oddments. McDonald, Godson & Company, $444,988; Jones & Rant, Limited, $398,263; Andrew Grey & Company, $477,296. There were also four tenders for the steel trestles, the figures varying according to the class of material to be used, and tenders also for various minor materials required in the prosecution of the contract. In connection with the concrete pipe the Union Contracting Company wrote withdrawing a bid, and stating they did not wish to tender. Only two of the contractors who bid on the original specification in December, 1911, are again in the field after business.

INDUSTRIAL WORKS.

Cascades Point, Que.—Tenders will be received up till August 20th 1913, for rebuilding head of Guard Pier, lower entrance, Soulanges Canal. Plans and specifications may be obtained from the Chief Engineer of the Department of Railways and Canals, Ottawa, and also at the office of the Superintending Engineer, Quebec Canals, Birks Building, Montreal. L. K. Jones, Assistant Deputy-Minister and Secretary.

Gravelburg, Ont.—Tenders will be received up till the 25th of August, 1913, for the interior fittings of a post-office. Plans and specifications may be obtained from H. T. Mollard, Regina, and the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

48 in CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire Machine Banded

WOOD STAVE PIPE

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RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

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MANNESMANN TUBES

Six Hundred Authorities Are Using Mannesmann Tubes

in Great Britain in varying quantities up to 15 miles; in Canada, to 17 miles.

Seven hundred miles of weldless steel spigot and faucet tubes —quite apart from flanged tubes and lapwelded spigot and faucet tubes—are in use in the United Kingdom, as well as large quantities in Canada, Australia, South Africa, South America, India, China, New Zealand and Europe.

We are constantly adding new customers to our list, and, what is of even greater significance, more frequently still receiving repeat orders.

Solid drawn tubes are used in places where it is impossible to use cast-iron pipes or lapwelded tubes, as well as in places where the conditions are more normal.

In the past five years the sale of Mannesmann weldless steel spigot and faucet tubes (home trade alone) increased one thousand per cent., and during the last financial year reached the figure of about 5,000 tons, equal to 15,000 tons of cast-iron, in addition to a large export business.

MANNESMANN TUBE CO. LIMITED

59 Victoria Square, MONTREAL

BOOKLETS ON REQUEST

Guelph, Ont.—The city has disposed of $8,396 of waterworks debentures, and expect to sell $72,448 more directly.

Levis, Que.—A contract has been let by the Transcontinental Railway Commission for a considerable amount of dredging in connection with the new car ferry dock at Levis.

+—Montreal, Que.—The Dominion Government has awarded the J. T. SCHELL COMPANY, Alexandria, Ont., the contract for the interior fittings of postal station "B."

Ottawa, Ont.—Tenders will be received up till the 18th of August, 1913, for the cutting of dead timber in Alberta. Plans and specifications may be obtained from the Department of the Interior, Ottawa. L. Pereira, Secretary.

Ottawa, Ont.—The Cabinet Council has awarded the following contracts: To the PACIFIC DREDGING COMPANY at Pitt River, B.C., $158,220; to BROLEY & MARTIN, New Westminster, B.C., for completion of the jetty at Steveston, B.C., $83,500; to PIERSON U. BAR COMPANY, for greenhouses and hot water heating in connection with experimental farm, $19,447. The Government has also passed an order-in-council purchasing from Hugo Carstairs a site in Winnipeg for a postal station, $35,000.

Quebec, Que.—Tenders will be received up till the 25th of August, 1913, for the installation of hot water heating apparatus in the citadel armory. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

+—Sault Ste. Marie, Ont.—The Dominion Government has awarded the SOO DREDGING AND CONSTRUCTION COMPANY the contract for dredging. The contract price is $162,000.

South Vancouver, B.C.—Sonth Vancouver is discussing the question of indnstrial sites and the prospects of a municipality-owned gas plant.

St. Malo, P.Q.—Tenders will be received up till September 2nd, 1913, for the construction and erection, complete, of a locomotive and car shop repair plant. Plans and specifications may be obtained from Mr. Gordon Grant, Chief Engineer, Ottawa, and also at the office of Mr. A. E. Doucet, District Engineer, Qnebec, P.Q. P. E. Ryan, Secretary.

The Pas, Man.—Tenders will be received up till the 20th of August, 1913, for the construction of a sedimentation basin and foundations for a power house. Plans and specifications may be obtained from Murphy & Underwood, Saskatoon, and H. H. Elliott, Secretary-treasurer.

+—Toronto, Ont.—Messrs. C. W. WOOD & SONS, LIMITED, have been awarded the masonry contract on the Dominion Glass Company's factory on Dovercourt Road by Mr. J. Francis Brown, Board of Trade Building.

+—Vancouver, B.C.—The Hudson Bay Company has awarded the WHINSTONE MACADAM QUARRIES COMPANY the contract for supplying 10,000 cubic yards of crushed rock.

Victoria, B.C.—The City Commisssioners have received the following tenders for a telephone service in connection with the Sooke water supply: For the telephone service: Jones & Rant, Limited, $635 a mile, $15,875; Hinton Electric Company, $270 a mile, $18,000; Ocean Accident and Guarantee Company, through W. B. Morgan & Company, $13,425; Frank H. Folsom, $345 a mile, $8,625; P. E. Sommers, $488.50 a mile, $12,212.50. These were referred to the Water Commissioner and Consulting Engineer Meredith.

Victoria Harbor, Ont.—Tenders will be received up till September 8th, 1913, for the construction of a wharf at Victoria Harbor. Plans and specifications may be obtained from the Toronto Builders' Exchange, Toronto.

▲—Welland, Ont.—Tenders will be received up till the 27th of August, 1913, for the third section of the Welland ship canal. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, Secretary.

MISCELLANEOUS.

Albert County, N.B.—Tenders will be received up till September 2nd, 1913, for construction of an extension to the breakwater at Upper Salmon River. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, and at the offices of F. C. Goodspeed, District Engineer, Chatham, N.B.

+—Beauport, Que.—The Dominion Government has awarded Mr. CELESTIN PARENT the contract for the erection of a drill hall. The contract price is $30,000.

Brampton, Ont.—Tenders will be received up till August 18th, 1913, for the construction of a clock tower, public building. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

+—Brampton, Ont.—W. A. THORN, of Collingwood, has been awarded the contract for a drill hall. The contract price is $16,000.

+—Edmonton, Alta.—The school board has awarded Messrs. BROWN & HARGREAVES the contract for the erection of a school building. The contract price is $160,000.

+—Edmonton, Alta.—The Canadian Consolidated Rubber Company has awarded the CANADIAN STEWART COMPANY the contract for the erection of a warehouse. The contract price is $120,000.

+—Fort William, Ont.—The CANADIAN STEWART CONTRACTING COMPANY has been awarded the contract for the erection of the new Whalen building. The contract price is $450,000.

+—Fort William, Ont.—The McDonald Wholesale Company has awarded Messrs. G. W. ALEXANDER & COMPANY, Winnipeg, the contract for the erection of a large wholesale house. The contract price is $50,000.

+—Greenwood, B.C.—The Dominion Government has awarded Messrs. JOHN BEMIS & SON the contract for the construction of a public building. The contract price is $41,000.

+—Hampton, N.B.—The Dominion Government has awarded the BRITISH AMERICAN CONSTRUCTION COMPANY, LIMITED, St. John, the contract for the erection of a post-office. The TRUSSED STEEL COMPANY, Halifax, were awarded the contract for the reinforced concrete.

+—Kemptville, Ont.—The Dominion Government has awarded Mr. JOHN DILLON the contract for the erection of a drill hall. The contract price is $11,800.

+—Millbrook, Ont.—R. SHEEHY has been awarded the contract for a drill hall. It will cost $11,000.

+—Montreal, Que.—The WHITE CONSTRUCTION AND REALTY COMPANY, have been awarded the contract for the erection of a moving picture theatre. The contract price is $15,000.

+—Montreal, Que.—The Dominion Government has awarded the following contracts for the erection of Grenadier Guard armory: General contract, concrete, plastering and painting, D. G. LOOMIS & SONS; steel and metal lockers and electric not let; roofing, CAMPBELL, GILDAY COMPANY, LIMITED; heating and plumbing, HICKEY & AUBUT.

+—Montreal, Que.—The Dominion Government has awarded Mr. C. E. DEAKIE the contract for the erection of postal station "H." The contract price is $200,000. The ARGENTEUIL GRANITE COMPANY the contract for supplying the granite.

Nelson, B.C.—Tenders will be received up till August 25th, 1913, for the erection and completion of a vault for the land registry at Nelson, in the Ymir electoral district. Plans and specifications may be obtained from Mr. W. F. Teetzel, Government Agent, Nelson; J. E. Griffith, Public Works.

New Westminster, B.C.—Tenders will be received up till August 19th, 1913, for the erection and completion of addition to the Land Registry office. Plans and specifications may be obtained from S. A. Fletcher, Government Agent, New Westminster; J. Mahony, Government Agent, Vancouver, and also J. E. Griffith, Department of Public Works, Victoria, B.C.

+—North Battleford, Sask.—The Dominion Government has awarded Messrs. PIGOTT & HEALEY Picton, Ont., the contract for the erection of a drill hall.

Ottawa, Ont.—Tenders will be received up till the 25th of August, 1913, for the erection of two residences on the experimental farm. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

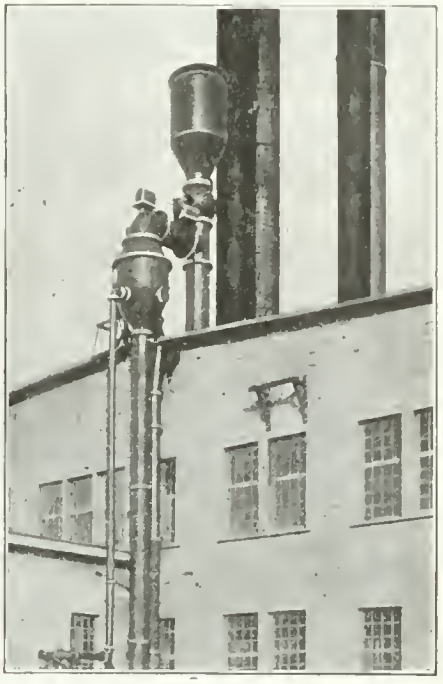
Ottawa, Ont.—The contract for the piers at Carleton Head has been awarded to ROGER MILLER, of Toronto. The price is $949,250.

Ottawa, Ont.—Tenders will be received up till 4 p.m. on August 22nd, 1913, for underground services. Plans and

CONDENSING APPARATUS

specially designed to secure

GREATER STEAM ECONOMY



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THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

The Hampton Sedimentation Tank

Used in connection with an electrolytic hypochlorite treatment, the process is **ABSOLUTELY ODORLESS** and the effluent is free from disease germs.

Nine years of operation in large and important installations in England have demonstrated that an effluent exceptionally low in suspended solids and as free from odor as the entering sewage may be obtained with The Hampton Tank.

The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction of the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

Sterilization Co.

Union Building, Clinton Street

NEWARK, N.J.

Also engineers for the electrolytic treatment of water.

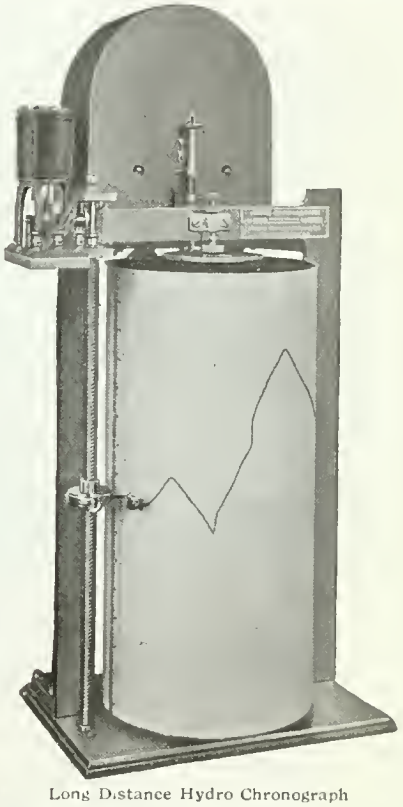
Variations in Water Head Recorded at a Distance

The Electric Hydro Chronograph

enables you to indicate and record in an office or power house the variation in level at the dam or reservoir that may be several miles away.

Designed especially for Power Plants, Surge Tanks, Municipal Water Works and Filtration Plants.

Write for Catalogue



Long Distance Hydro Chronograph

Hydro Manufacturing Company

700 Bullitt Building Philadelphia, Pa.

specifications may be obtained on application to Mr. James Johnston, Chief Electrician, Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

+—**Prince Albert, Sask.**—The Bank of Nova Scotia has awarded Mr. R. CLUNIE the contract for the erection of a new bank building.

Prince Albert, Sask.—The building permits for the month of July amounted to $171,000. For the same month last year they amounted to $300,550. This is a decrease of $129,550.

+—**Prince Rupert, B.C.**—The Premier Hotel Company has awarded Mr. C. L. WILLIAMS the contract for the erection of a five-story hotel. The contract price is $50,000.

+—**Red Deer, Alta.**—The Dominion Government has awarded Messrs. NESBITT & MILLER the contract for the erection of a drill hall. The contract price is $36,000.

+—**Red Deer, Alta.**—NESBITT & MILLER have been awarded the contract for a drill hall. The contract price is $36,000.

+—**Regina, Sask.**—The Tenn Manufacturing Company has awarded SMITH BROTHERS & WILSON the contract for the erection of an implement factory. The contract price is $40,000.

+—**Simcoe, Ont.**—The Dominion Government has awarded ROBERT E. GUNTON the contract for the erection of an armory. The contract price is $30,000.

Steelton, Ont.—Tenders will be received up till September 9th, 1913, for the construction of a public building. Plans and specifications may be obtained from Thomas R. Wilks, 612 Queen Street Sault Ste. Marie.

Toronto, Ont.—At a recent investigation into a large number of serious fires that have occurred in Toronto lately, Fire Chief Thompson recommends the expenditure of $100,000 on additional motor equipment. He recommends steam fire engines equipped with tractors for the mid-level districts. The opinion of the chief was against motorizing the whole department at once, but he recommends a partial installation of motor-drawn equipment.

Welland, Ont.—The building permits for the month of July this year amounted to $89,710. For the same month last year they amounted to $46,241. This is an increase of $43,469.

+—**Winnipeg, Man.**—The following contracts have been awarded in connection with the Manitoba Medical College: General contractors, masonry and carpentry, BLOW BROS.; iron and steel, VULCAN IRON WORKS; roofing, A. B. ORMSBY COMPANY; painting, R. CRAWFORD; heating, G. L. STEPHENSON; electrical, WM. McDONALD & WILSON.

Winnipeg, Man.—Tenders will be received up till the 25th of August, 1913, for new rifle range. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout & Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Canada.—Thos. Clarkson and W. J. Morrison, reducing valves; Alex. H. Welker, motor-winding mechanism; Thos. Clarkson and W. J. Morrison, metal wheels; Wm. Gibbs, disk-straightening and truing apparatus; John Fox, grain picklers; E. A. Bolton, steam superheaters; John C. Jackson, concrete poles; Thos. W. Brown, weather strips; Wm. P. Evans, shaft bearings; Lambertus Elfrink, fillers for caoutchouc and processes for manufacturing same; Geo. Cropper and H. E. Ritchie, suspension of motors and like road vehicles; Robt. McFarlane, windmills; Koolman and Ponndorf, hop-extracting apparatus; Harry Hudkins, plough trucks, and Woods, Gilbert and Little, dressing of stone.

United States.—Jethro Hoskyn, hammers.

Argentina.—Massey-Harris Company, Limited, harvesting machines.

Australia.—Fred. M. Bawdon, improvements in tire treads.

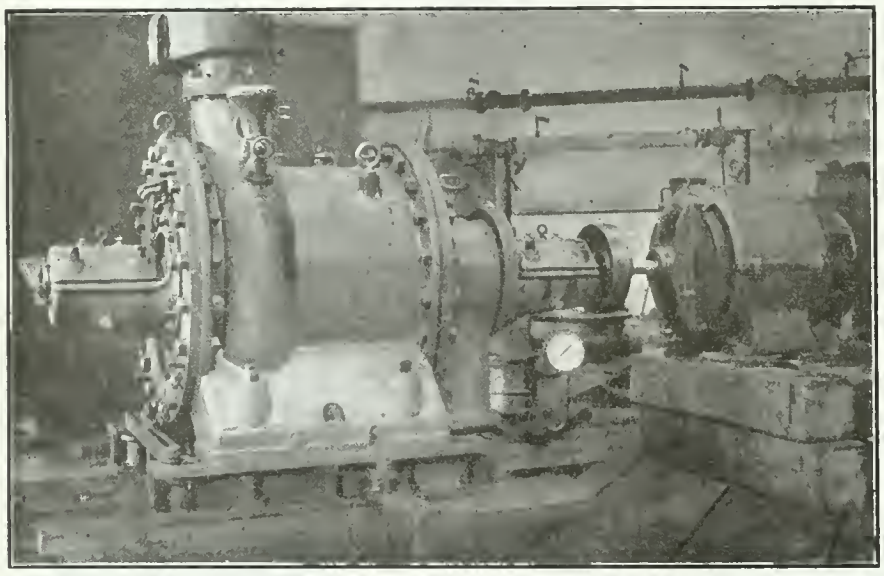


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Illustration shows 12" pump designed for direct connection to a water-turbine running at comparatively low speed. It is consequently built with four stages. Photograph was taken in the testing bay. The normal speed for domestic supply is 520 r.p.m., when the pump delivers 1,100 Imperial gallons against 200 ft. head, requiring 92 h.p. When speeded up to 590 r.p.m. the pump gives a pressure of 260 ft., with the same quantity, for fire purposes, consuming 124 h.p.

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What Motor Trucks will do for You

Would you like to know what motor trucks have done for other engineering and contracting concerns—how they use trucks?

What size and kind of body? What is the difference between motor-trucks and horse-drawn vehicles in the engineering and contracting business under exactly the same conditions?

7½ Ton Mack Automatic Dump Truck
used by the Metropolitan Coal Company for long distance heavy coal deliveries.

What the saving is in time and money, the increased area of business operations, etc.?

We shall be pleased to answer these questions for you and to furnish you data, without obligation on your part, showing what motor-trucks have done in your line.

We are Canadian Sales Agents for the Mack Truck manufactured by The International Motor Company.

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"Leading Gasoline Truck of the World"

The first Mack Truck, built in 1900, is still in active service at Tucson, Arizona.

That fact should be full of meaning for you. In order for a truck to be profitable it must last long enough to pay back the original investment with a good big profit.

The Mack has proven its reliability, economy and long life by 12 years of real service in every line of transportation.

When you buy Mack Trucks you do not buy THEORY but HISTORY.

Mack Trucks are built in 1, 1½, 2, 3, 4, 5 and 7½ tons capacity, with any load distribution and any style of body.

Let us make an analysis of your requirements—what truck equipment, the cost, and what it would do for you.

The Canadian Fairbanks-Morse Company, Limited

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CALGARY SASKATOON VANCOUVER

TENDERS CALLED FOR

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

WELLAND SHIP CANAL.

SECTION No. 3.

NOTICE TO CONTRACTORS.

SEALED TENDERS, addressed to the undersigned and marked, "Tender for Section No. 3, Welland Ship Canal," will be received at this office, until 2 p.m., on **Wednesday, August 27th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, St. Catharines, Ontario.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered bank of Canada, for the sum of $400,000.00, made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 2nd August, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—46052.

CAYUGA, ONT.

Sealed tenders will be received up to noon on the 16th day of September, 1913, by the undersigned at Cayuga, Ontario, for the construction of twenty-six and one-half miles of stone macadam road in the county of Haldimand.

The work will be let in three separate and distinct contracts, not necessarily to the same individual.

Tenderers are required to examine the localities of the work and are requested to be present at the opening of the tenders at 2 p.m., on Wednesday, the 17th day of September, 1913.

Plans and specifications may be seen at the office of the County Engineers, Messrs. Jackson and Kyd, Dunnville, or may be had from them on the payment of $10, which sum will be refunded on return of the documents.

Lowest or any tender not necessarily accepted.

T. A. SNIDER, K.C.,
County Clerk,
County of Haldimand,
Cayuga, Ont.

THE COMMISSIONERS OF THE TRANSCONTINENTAL RAILWAY.

NOTICE TO CONTRACTORS.

TENDERS FOR LOCOMOTIVE AND CAR SHOPS AT ST. MALO, P.Q.

SEALED TENDERS addressed to the undersigned, and marked on the envelope, "Tender for Shops," will be received by the Commissioners of the Transcontinental Railway at Ottawa, Ontario, until 12 o'clock noon of **Tuesday, 2nd September, 1913,** for the construction and erection complete, in accordance with the plans and specifications of the Commissioners of a Locomotive and Car Shop repair plant at St. Malo, P.Q.

The plans, details and specifications, which will include the locomotive and car shops, the yard sewerage system and drainage system, yard water system, and the yard grading and track-laying, may be seen at the office of Mr. Gordon Grant, Chief Engineer, Ottawa, Ontario, and at the office of Mr. A. E. Doucet, District Engineer, Quebec, P.Q.

Persons tendering are hereby notified that tenders must be made on the printed forms supplied by the Commissioners. These may be had on application to Mr. W. J. Press, Mechanical Engineer, Ottawa, Ontario, or to Mr. A. E. Doucet, District Engineer, Quebec, P.Q.

Each tender must be signed and sealed by all parties to the tender, and witnessed, and be accompanied by an accepted cheque on a chartered bank of Canada, payable to the order of the Commissioners of the Transcontinental Railway for the sum of ($50,000.00) Fifty Thousand Dollars.

The cheque received from the party whose tender is accepted will be deposited to the credit of the Receiver-General of Canada, as security for the due and faithful performance of the contract, according to its terms.

Cheques received from parties whose tenders are rejected will be returned within ten days after the signing of the contract.

The right is reserved to reject any or all tenders.

By order,
P. E. RYAN,
Secretary.

The Commissioners of the
Transcontinental Railway.
Dated at Ottawa, Ont., July 28th, 1913.

Newspaper inserting this advertisement without authority from the Commissioners will not be paid for it.—45825.

MAIN DRAINAGE WORKS.

Sealed tenders addressed to the Chairman of the Board of Control, City Hall, Toronto, will be received by registered post only, up to noon of Tuesday, August 26th, 1913, for the supply and erection of three motor-driven Centrifugal Sewage Pumps, automatically controlled.

Plans, specifications, forms of tender and other information may be obtained at the office of the Commissioner of Works, City Hall, Toronto.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, August 9th, 1913.

(For further Tenders see page 86.)

Consider the Cost

of always paying high insurance rates—of always running the risk of your business being stopped by disastrous fires—of always feeling the dread of possible fatal consequences to your employees should a fire suddenly occur.

The time to consider is before you build—before the plans are finished. We have a staff of engineers and inspectors who are specialists in fire-proof construction and insurance ratings. Without charge we will place our highly specialized knowledge of these matters at your, or your engineer's or architect's disposal. Our brokerage department will then be able to obtain for your structure the lowest possible insurance rate.

E. M. SELLON & CO.
LIMITED

INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

MIMICO BRAND
Vitrified, Salt-Glazed
SEWER PIPE

Excellent clay, modern machinery, up-to-date kilns and—above all—CARE in every process makes Mimico Brand the best sewer pipe in Canada.

BIG STOCK ON HAND.

Round Pipe and Square Dealings *Write for Catalogue*

The Ontario Sewer Pipe Co.
LIMITED

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Agents for Patented Vitrified Segment Block for Sewers over 24"

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Concrete Costs.

Tables and Recommendations for Estimating the Time and Cost of Labor Operations in Concrete Construction and for introducing Economical Methods of Management.

By FREDERICK W. TAYLOR, M.E., Sc.D., and SANFORD E. THOMPSON, S.B., Mem. Amer. Soc. C.E., Consulting Engineer. Small 8vo, xxii+709 pages, 82 figures. Cloth $5.00 net.

J. R. WORCESTER, CONSULTING ENGINEER, BOSTON, MASS., writes:—"I find this book of great interest and usefulness."

SECOND EDITION, Revised and Enlarged.
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Concrete, Plain and Reinforced.

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In this edition is included the developments in the construction of reinforced concrete since the issue of the first edition.

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Covers in a systematic manner, those principles of mechanics underlying the design of reinforced concrete.

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In three parts. Part I—STRESSES IN SIMPLE STRUCTURE. 8vo, xii+326 pages, illustrated with cuts throughout the text. Cloth, $3.00 net.
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Part III—DESIGN. (In preparation.)

TENDERS CALLED FOR

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

TRENT CANAL.

PORT SEVERN SECTION—SEVERN DIVISION.

NOTICE TO CONTRACTORS.

SEALED TENDERS, addressed to the undersigned and marked, "Tender for Port Severn Section—Severn Division, Trent Canal," will be received at this office until 2.00 o'clock p.m., on **Monday, August 25th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after July 26th at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa; at the office of the Superintending Engineer, Trent Canal, Peterborough, Ont.; at the office of the District Engineer, Public Works Department, Midland, Ont., and at the office of the Postmaster, Orillia, Ont.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labour, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered Bank of Canada, for the sum of $10,000, made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 29th July, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—45677.

SEALED TENDERS addressed to the undersigned, and endorsed, "Tender for East Pier, Eastern Entrance, Toronto Harbour, Ont.," will be received at this office until 4.00 p.m., on **Tuesday, September 2nd, 1913,** for the reconstruction of part of superstructure of East Pier of Eastern Entrance to Toronto Harbour, in the County of York and Province of Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and H. J. Lamb, Esq., District Engineer, Windsor, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering declines to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, August 1, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—43525.

(For further tenders see page 84).

Agent Wanted

We are open to negotiate with a reliable firm to act as agent for Canadian business.

W. H. ALLEN, SON & CO.
LIMITED
Queen's Engineering Works
BEDFORD - - ENGLAND

Engineers and Builders of
STEAM, HYDRAULIC, AND
D.C. ELECTRIC MACHINERY

(See Advertisement on Page 103.)

Address firm's representative:
A. LEO MIEVILLE,
c/o Box 92, *Canadian Engineer,*
62 CHURCH STREET, TORONTO.

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES—IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

At The Toronto Exposition
Visit BUFFALO PITTS CO. Exhibit

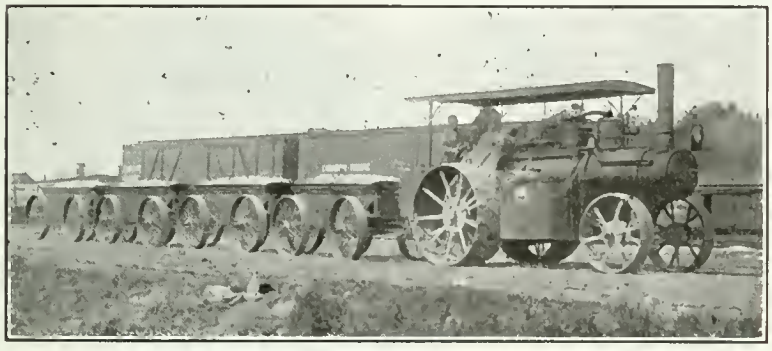
You cannot appreciate the development in Traction Engines until you have seen and investigated the

BUFFALO PITTS CO.
ROAD LOCOMOTIVE.

It has two road speeds. Traction platform and gearing on separate mountings. No strain on boiler. More power for weight than is found in any other Traction Engine.

BUFFALO PITTS CO. Road Locomotive at Road Work

Illustrations Show Outfits used in Building Roads in Northern Ontario



A BUFFALO PITTS CO. HAULAGE TRAIN AT WORK IN CANADA

This patented Reversible type of Road Car steers either way by simply throwing a lever.

No other car like it.

Makes the car efficient in places where others are useless. So strong the train will not pull in two. So simple a boy can operate. The greatest time saver of the age.

All Types of Buffalo Pitts Cars Can be Coupled in One Train

3½ yds. Patent Reversible Car Stone Spreading and Bottom **Dump Styles,** 5-ton size. Forged Steel Frame, steel wheels with special bronze bushings, special steel axles. 54-inch wheels with 8-inch tires. (Illustrated above.)

6½ to 8 yds.—10-Ton Wooden Frame Car. Same features of construction as described in 5-ton size.

6-Ton Patent Reversible Freight Car, Convertible, equipped with different bodies for brick, cement, asphaltum, oil in barrels, pipe, timbers or any kind of material. (As illustrated.)

Write for Art Catalogue and Full Particulars

BUFFALO PITTS CO.

Haulage Outfits of Efficiency and Durability

BUFFALO, N.Y.

Branch Houses and Agencies in All Leading Centers

SECOND-HAND MACHINERY

Second Hand Contractors' Machinery

Why not use second hand equipment on the next job? We have a large stock of machinery ready for delivery

Nearly Good as New

Get the details on these items:—

1—24" x 24¼" x 30" "Ingersoll-Sergeant" compressor, Class A
1—20" x 20¼" x 24" "Ingersoll-Sergeant" compressor, Class A
1—14" x 14½" x 18" "Ingersoll-Sergeant" compressor, Class A
1—No. 2½ "Smith" concrete mixer
1—No. 5 "Gates" gyratory crusher, style K
1—30" x 14" "Buchanan" crushing roll
1—35 H.P. "Farquhar" combined engine and boiler
2—No. 15 "Morris" centrifugal pumps with engines

L. F. SEYFERTS' SONS, Inc.
437 NORTH THIRD ST., PHILADELPHIA, U.S.A.

Contractors' Machinery For Sale

Selling Agents for M. Beatty & Sons

We have in stock the following second-hand equipment for immediate delivery, at prices that will save you money on your next contract.

Get further details and prices.

1—No. 21 Ransome concrete mixer.
1—Ideal automatic concrete mixer.
5—6ft. Ransome concrete carts.
13—5ft. Sterling Concrete carts.
1—No. 2 Austin rotary stone crusher.
1—8"x 10"x 8" steam driven air compressor.
1—9"x 10" belt driven air compressor.
1—6" belt driven centrifugal pump.
1—20-ton Tribloc chain hoist.
1—14 H.P. vertical boiler on wheels.

H. W. PETRIE, Limited Front Street W. TORONTO, Ont.

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

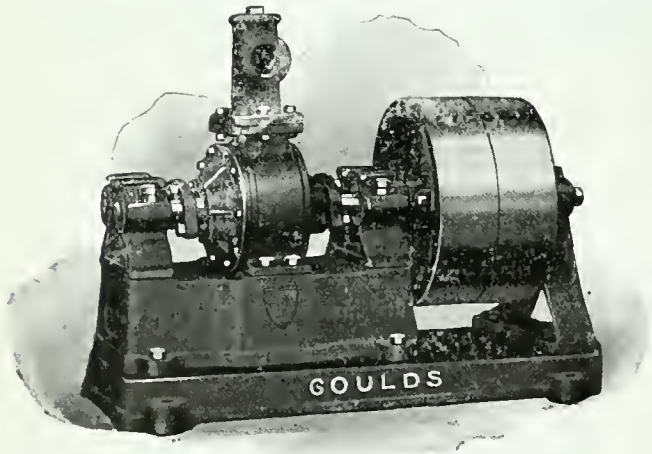
FOR SALE at a snap: 60-H.P. Cowan and Co. engine and 80-H.P. Cowan and Co. boiler. Write for particulars, J. F. Barnard and Son, Spencerville, Ont.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade were received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.: A Vancouver firm desire to dispose of a modern stiff-mud shale brick plant and a 50-acre shale deposit near Vancouver, and invite inquiries from interested parties in Great Britain.

NEW ROTARY POWER PUMP.

A new type of rotary power pump has just been developed by the Goulds Manufacturing Company, Seneca Falls, N.Y., This pump differs from the rest of the line of pumps of the same capacity in that gear-style cams have been substituted

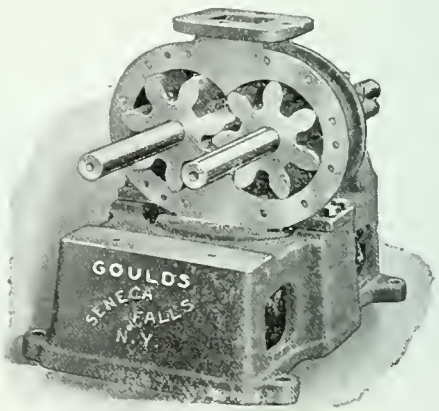


The Goulds Rotary Pump.

for the three-toed cams used in the remainder of the line (as shown by one of the illustrations), and the gears on the end of the cam shafts have been eliminated.

Two sizes are built. No. 1 has a capacity of 25 to 50 gallons per minute at 225 to 450 revolutions, and No. 2 has a capacity of 50 to 100 gallons per minute at 225 to 450 revolutions. Both pumps are suitable for pressures up to 100 pounds, or 230 feet elevation.

They are mounted on a cast-iron bedplate, fitted with an outboard bearing and tight and loose pulleys for belt-drive. The suction connection is made within the base, directly beneath the case, and is reached through hand-holes in the base. No. 1 has two discharge openings, one tapped for



Section Showing Unique Design of this New Type.

pipe and the other threaded for hose couplings. No. 2 has three discharge openings, two fitted the same as No. 1, and the third fitted with an interchangeable blank flange.

The suction is 3-inch on No. 1 and 4-inch on No. 2. The discharges are for 1½ and 2-inch pipe or hose, respectively.

The Goulds line of pumps are for sale in Canada by the Canadian Fairbanks-Morse Company, Limited.

NEW INCORPORATIONS.

Windsor, Ont.—Swedish Crucible Steel Company of Canada, $100,000. N. L. Olson, C. E. Blandfield, both of Detroit. A. J. W. Nixon, Felafield, W. Cadwell, O. E. Cadwell, Limited, $800,000.

Winnipeg, Man.—Acme Welding and Engineering Company, Limited, $10,000. S. J. Tufts, F. Evans, A. Styles. Smith Grain Company, $40,000. M. K. Smith, M. H. Smith, M. A. Smith. Strome-Bravender Company, $150,000. U. S. Strome, W. C. Bravender, A. Paling. Selkirk Development Company, $500,000. C. W. N. Kennedy, F. A. Gemmel, A. J. Norquay. Sterling Manufacturing Company, $20,000. R. E. Emery, Guelph, Ont.; A. C. Ferguson, A. E. Dilts.

CANADA Portland CEMENT

SOME men ask for so many bags of "cement"—

Others, more careful, say they want "Portland Cement"—

But the man who does the best work insists upon getting "Canada" Portland Cement—

And he looks to see that every bag bears this label

To specify Canada Portland Cement, is to introduce an additional safety factor into your calculations. Architects, contractors and engineers know the value of "making assurance doubly sure."

Canada Cement Company Limited

Head Office, - - - - MONTREAL

Sales Offices at

MONTREAL TORONTO CALGARY WINNIPEG

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

GRADUATE ENGINEER, five years' experience in railroad work, including heavy concrete work, steel and timber bridge construction, and heavy earth work. Box 68, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

ENGINEER WANTED.—For erection of refrigerating, pumping and power plants with a Western Canadian Company, some commercial and drawing experience preferred. Must invest One Thousand Dollars ($1,000.00). Box No. 98, *The Canadian Engineer*, Toronto, Ontario.

MAN, (40), with university and technical education, engineering experience, both office and field, desires employment with Civil Engineer, or would become articled to Dominion Land Surveyor. Can report immediately. Presently residing in Winnipeg, will go anywhere. Box 100, *The Canadian Engineer*, 820 Union Bank Bldg., Winnipeg.

MECHANICAL ENGINEER—Experienced Designer, Cost Estimator and Salesman, Works Supervision, all kinds of steam engines, boilers, hydraulic pumps, air machinery and mining plants, seeks position with Consulting Engineer, Contractor, Manufacturers or agency business. Highest references, some capital. Box 102, *The Canadian Engineer*, Toronto.

MECHANICAL AND ELECTRICAL ENGINEER, with large workshop experience and university training, desires position on sales staff of manufacturing concern. Will accept position as engineer or draughtsman in the meantime if no vacancy on the sales staff is available. References given if required. Apply Box 106, *The Canadian Engineer*, Toronto.

ELECTRICAL AND MECHANICAL ENGINEER, married, 7 years power house, 10 years general contracting experience, accustomed to control, has superintended many complete installations in different countries, desires responsible position, any locality. Box 108, *The Canadian Engineer*, Toronto.

SUPERINTENDENT SEEKS re-appointment on heavy work, experienced in big plant, steam shovel work, rock, hardpan, concrete, etc. Highest references. Box 110, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Notice is hereby given in regard to Canadian patents 100,707, 100,980 and 129,756, steam turbines, and 135,000, 135,001, 136,321 and 137,222, classifiers, that Canadian Allis-Chalmers, Limited, Toronto, owner of rights under said patents, is prepared to supply devices covered by these patents.

NOTICE.—Any one desiring to obtain the invention covered by Canadian patent No. 134660, granted on October 8th, 1911, to Jules Blanc, for process and apparatus for destroying rats by purified sulphur dioxide, may do so upon application to the undersigned who are prepared to supply all reasonable demands on the part of the public for the invention, and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, 53 Queen Street, Ottawa; Russel S. Smart, resident.

NOTICE.—Any one desiring to obtain the invention covered by Canadian patent No. 127846, granted on August 30th, 1910, to Alexander Albert Holle, for fluid turbines, may do so upon application to the undersigned who are prepared to supply all reasonable demands on the part of the public for the invention, and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, 53 Queen Street, Ottawa; Russel S. Smart, resident.

HAYES' DERAILS

Derailing devices and operating mechanisms for derails made according to the well-known HAYES' designs.

The undersigned are prepared to furnish the above devices at moderate cost under Canadian Letters Patent 106,831 and 106,832.

All communications regarding these should be addressed to

Canadian Hart Wheels Limited,
HAMILTON, ONT.

NEW INCORPORATIONS.

Berlin, Ont.—Berlin Industrial Centre, $40,000. A. Millar, H. J. Sims, W. H. Gregory.

Sarnia, Ont.—Harrow Canners, $40,000. A. T. Gahan, M. E. Oxenham, N. L. LeSoeur.

Tillsonburg, Ont.—Universal Paint and Varnish Remover Company, $50,000. J. H. Teall, G. W. Tillson, W. H. Bennett.

Elora, Ont.—John C. Mundell and Company, $300,000 (furniture dealers). J. C. Mundell, J. A. Mundell, both of Elora, J. S. Allan, Guelph.

Hamilton, Ont.—Saskatchewan Farm Land and Development Company, $250,000. C. W. Linnenbank, L. Bercowitz, C. S. Walters. Goodwin Park, $40,000. G. W. Tinlin, F. H. Jory, G. A. Tinlin. Hamilton Tailors, $40,000. M. Silverman, S. C. Harris, L. Silverman. Strathearn Park, $40,000. J. B. Weir, A. B. Crearer, Mrs. E. M. Weir.

THE FOUNDATION COMPANY
LIMITED

MONTREAL
Bank of Ottawa Building

VANCOUVER
Dominion Trust Building

Bridge piers damaged by ice and scour, which we are replacing on deeper and more solid foundations

OUR SCOPE:

Bridge Piers
Docks
Dams
Mine Shafts
Pneumatic
Caissons
and
Heavy Building
Foundations

OUR PLANT:

Equipment
is Complete
Our
Organization
Thorough
Enabling us
To Undertake
Difficult Work
At Short Notice

MARKET CONDITIONS

Montreal, August 9th, 1913.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ¼ base; tire steel, $2.30 for 1 x ¼ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are: Queen's Head, $4.35; Colborne Crown, $4.25; Apollo, 10¼ oz., $4.25. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¼ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX,, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 4o-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 73½ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black and 63½ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, August 13th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double hitted, $6 to $10; single hitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Brick.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.h., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 5c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 5c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.34; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	13.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, August 12th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.35; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound.

Volume 25. Toronto, August 21, 1913

Contents of this issue on page 341

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

THE NEW WELLAND SHIP CANAL

THE THIRD AND GREATEST WATERWAY TO JOIN LAKES ERIE AND ONTARIO—ITS GENERAL DESIGN AND COURSE—HISTORICAL NOTES RELATING TO OLD WELLAND CANALS.

AMONG the big engineering undertakings started during the present season there are few that excel in size the structure which is to replace the canal which connects Lakes Erie and Ontario. The Welland Canal now in use has, since its construction, been known as the "new" canal, in distinction from the original waterway which is now historically referred to as the "old" canal, the work under contemplation therefore constituting the third. The original and present canals followed a route from Port Colborne across the Niagara peninsula, practically paralleling each other at the northern end, entering Lake Ontario at Port Dalhousie. The original canal was commenced in 1824, and completed in 1833, the line following very closely certain water courses, to facilitate construction, making the length 27½ miles. This canal contained 27 locks, 24 of which were 150 by 26½ ft., and the other three, 200, 230 and 270 by 45 ft., respectively. The depth of water on the sills was 10¼ ft., with a total lift of 326¾ ft. The initial construction of these locks gave a depth of 8 ft., the increase of 10¼ ft. being a subsequent change. The present canal was commenced in 1872, and completed in 1887. The route at the northerly end was slightly changed to the east near St. Catharines, the canal coming out into Lake Ontario at the same point as the original one. The locks are 26 in number, 270 by 45 ft., with a depth of 14 ft. over the sills.

The route to be followed by the proposed canal, beginning at the southern terminus, i.e., at Port Colborne, is the same as that of the present canal as far as Thorold, from which point it will deviate to connect with a harbor which will be constructed at the Lake Ontario end, some three miles east of the present Port Dalhousie outlet, this diverging portion being about eight miles in length, and passing in almost a straight line through Merritton to the lake. The section of the existing canal between Thorold and Merritton will, therefore, be abandoned, but it is the intention to use the portion of the present canal between that point and Port Dalhousie as an auxiliary.

The present canal is made up of twenty-five locks each 270 ft. by 45 ft. with some 14 ft. of water over the sills. The total length of this canal is 26¾ miles.

The new canal will have seven locks each of 42½ ft. lift, 80 ft. width, and sufficiently long to accommodate a vessel of the length of 800 ft. It will be 25 miles from lake to lake and will cope with a difference of level of 325½ ft. between them. The minimum depth of water over the miter sills of each lock will be 30 ft. The bottom of the canal will be 200 ft. in width, and although the depth will ultimately reach 30 ft., the present excavation will stop when 25 ft. is reached, further deepening being looked after when occasion arises by dredging out the reaches to the required depth, according to design The lock walls will be 82 ft. high above the top of the gate sills, and including the necessary foundation work required below this level two of the locks will have walls 100 ft. high. The lock gates will be of the single-leaf type, swinging on a hinge at one side of the lock and resting in a notch cut in the opposite wall, a single leaf thus spanning the whole width of the lock chamber. The gate at the foot of each lock will be 83 ft. high and 88 ft. long, and will weigh about 1,100 tons. The valves and culverts in the walls will be of large dimensions and will permit of the lock being filled in less than eight minutes. This will mean that the time of passage through the canal will be reduced much below that required at present. The time of lockage of the present canal is from 10 to 20 minutes per lock. In the new canal there will be 18 fewer locks, and the saving in locking time will be in the neighborhood of three hours.

Port Colborne Development.

In Fig. 1 will be noted a proposed new breakwater off Port Colborne, to prevent a disturbance of harbor water, with which the present conditions have to contend, as the present breakwater is insufficient in effect owing to size and location. The new breakwater will consist of an immense rubble mound of stone from the excavation north of Port Colborne, and will terminate in a timber-and-concrete headblock located some 2,000 ft. farther out in the lake than the present breakwater.

The outer harbor at Port Colborne has now a 22-ft. depth of water at ordinary stages of the lake, which is as much as is available at most of the other lake ports and in the channels connecting the lakes at the present time. The deepening of this portion of the harbor may be left for a few years until the connecting channels in the lakes allow deeper navigation. The inner harbor will be excavated to the new depth proposed, and the old locks and regulating weir now in the centre of the village will be entirely removed.

From Port Colborne to Humberstone the rock cut will be deepened and widened on the west side, and just below Humberstone a new cut will be made across the

point now forming Ramey's Bend, materially straightening the canal. The excavation from this cut will be principally rock, and will form suitable material for the breakwater in Port Colborne harbor.

A guard lock will be built in the rock cutting a short distance below Humberstone, and when this new cutting is ready for navigation a regulating weir will be built across the abandoned portion of the present canal, which will be used as a by-pass to furnish water to the canal. This lock and regulating weir will control the elevation of the summit level of the canal, which it is proposed to keep at the level of extreme low water in Lake Erie, viz., 568 ft. above sea level.

The Welland River Crossing.

From Ramey's Bend to Welland the present canal will be enlarged by an extended excavation along the western bank. It crosses the Welland River by an aqueduct at Welland, as indicated in Fig. 1, but in the new structure it is proposed to raise the level of the river to that of the summit level of the canal by means of a dam across the river at Port Robinson. This dam will be provided with a large overflow and regulating weir, which will control the elevation of the summit level, allowing any surplus water to overflow into the old Welland River and pass out into the Niagara River at Chippawa, as at present. A sufficient quantity of water will be allowed to run constantly to keep the river clean.

The present aqueduct at Welland will be dredged out, as well as the bank between the canal and the river. The river will be utilized between Welland and Port Robinson instead of the present canal, being somewhat more direct and entailing considerably less excavation. At Port Robinson a cut will be made through the present bank between the canal and the river, enabling vessels to re-enter the canal prism. Between Port Robinson and Allanburg what is known as the "Deep Cut," which has a maximum depth of 66 ft., will be enlarged by cutting a slice off the western bank.

In raising the Welland River above Welland some 1,600 acres of low land adjoining the river will be flooded. This land is not of any great value, as it is flooded every spring by the river overflow, limiting its agricultural value to pasturage only. The township of Wainfleet, adjoining the Welland River on the south side, consists principally of low-lying ground which drains into the Welland River, and to prevent damage to this land on account of the raising of the river it will be necessary to open up most of the ditches from the point of their present entrance to the river, to the intended high-water mark.

Turning the Welland River into the canal will pollute the waters which are at present used by the towns of Welland, Thorold and Merritton and the city of St. Catharines for domestic purposes. This may necessitate the construction of extensive filtering plants, although

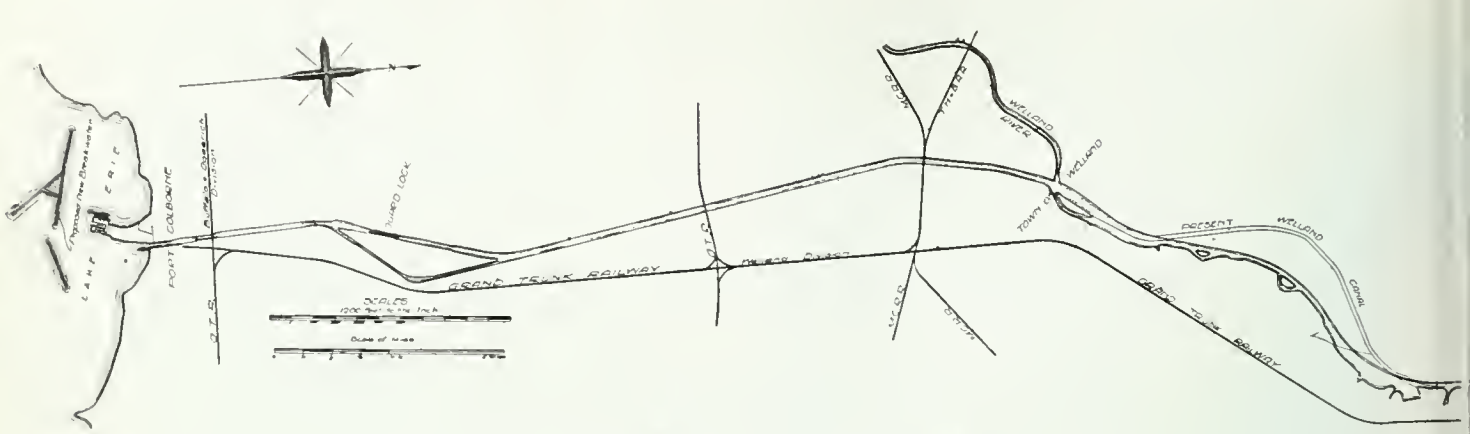


Fig. 1.—Course of New Welland Ship Canal, 25 Miles in Length.

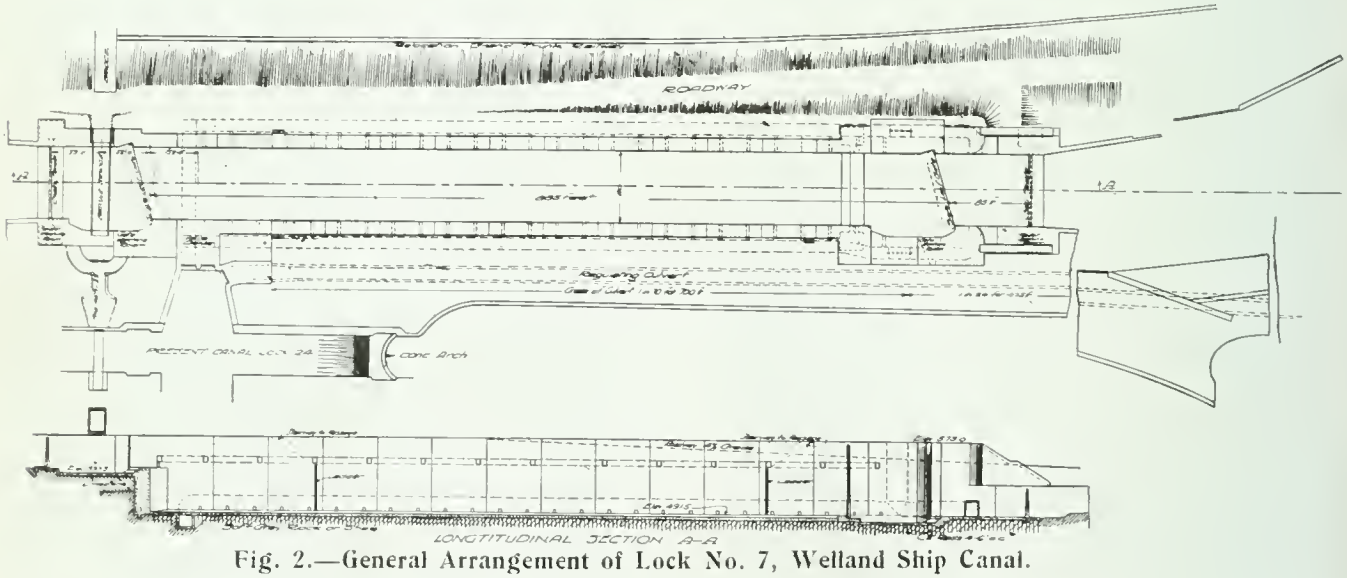


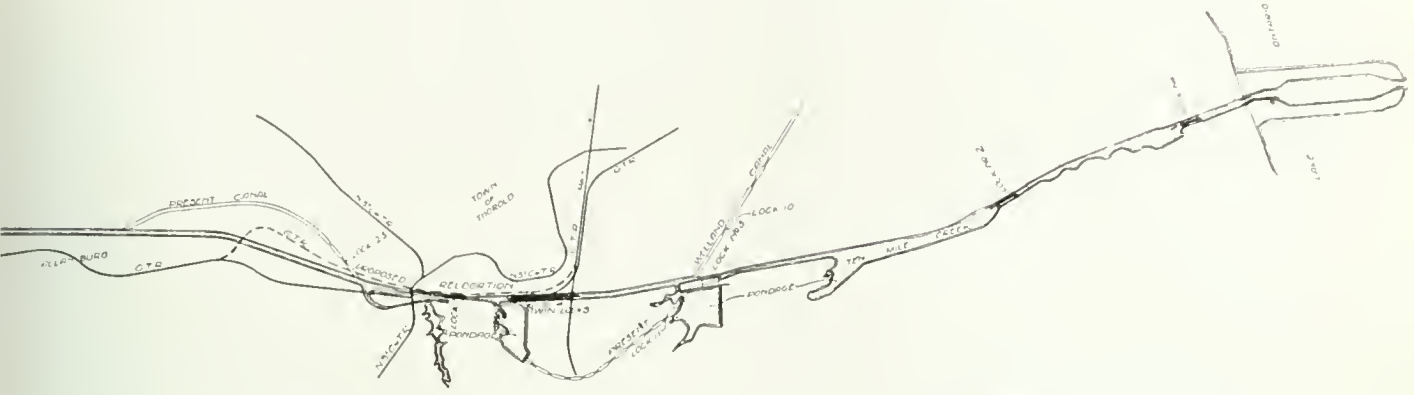
Fig. 2.—General Arrangement of Lock No. 7, Welland Ship Canal.

this scheme is not looked upon with favor by those interested. An alternative scheme to lay a pipe line from Lake Erie to the reservoirs of the different municipalities, through which clean water would be continuously pumped, is under consideration and appears to be the most feasible scheme available.

Allanburg is now the junction of the present and old

dumping ground, and the old canal will become more self-contained, as at present the entrance works are situated at an inconvenient distance from the remainder of the canal.

If it is desired to continue navigation on the old canal, entrance may be had to it through lock 25 of the present canal (a little south of the town of Thorold) when



It is Equipped With Seven Lift Locks, Each 800 Feet in Length, With 46½ Feet Lift.

Welland Canals, and the water required for the latter, which is quite considerable, on account of the numerous power developments along it, is taken into the canal through a weir at this point.

In connection with the construction of the new canal, it is proposed to close the present old canal entirely between Allanburg and Marlatt's Bridge, near Thorold, first building a new weir at the head of lock 25 of the present canal, to supply the above mentioned water. A dam will then be thrown across the old canal at Allanburg, and the old bed of the canal between the dam and Marlatt's Bridge will be utilized as a dumping ground in which to place the material removed from the above water in widening the deep cut. This will form a very convenient

the new canal is completed, by making a short cut through the bank separating the two waterways.

New Lock No. 7.

Between this point and Thorold will be located a pair of twin guard locks, just at the southerly limits of the town, and a short distance north of them will be located lock 7, the head of this lock being directly opposite the head of lock 24 on the present canal. Fig. 2 shows its general design. The portion of the present canal between locks 25 and 24, together with a pond of about 27 acres, formed by flooding the upper valley of the Ten Mile Creek, will be utilized as a regulating basin from which water to fill lock 7 will be drawn. This method of drawing water from a side pond, instead of directly from the canal above, avoids the formation of objectionable currents and surges in the canal and locks, and is the method adopted for filling all of the locks.

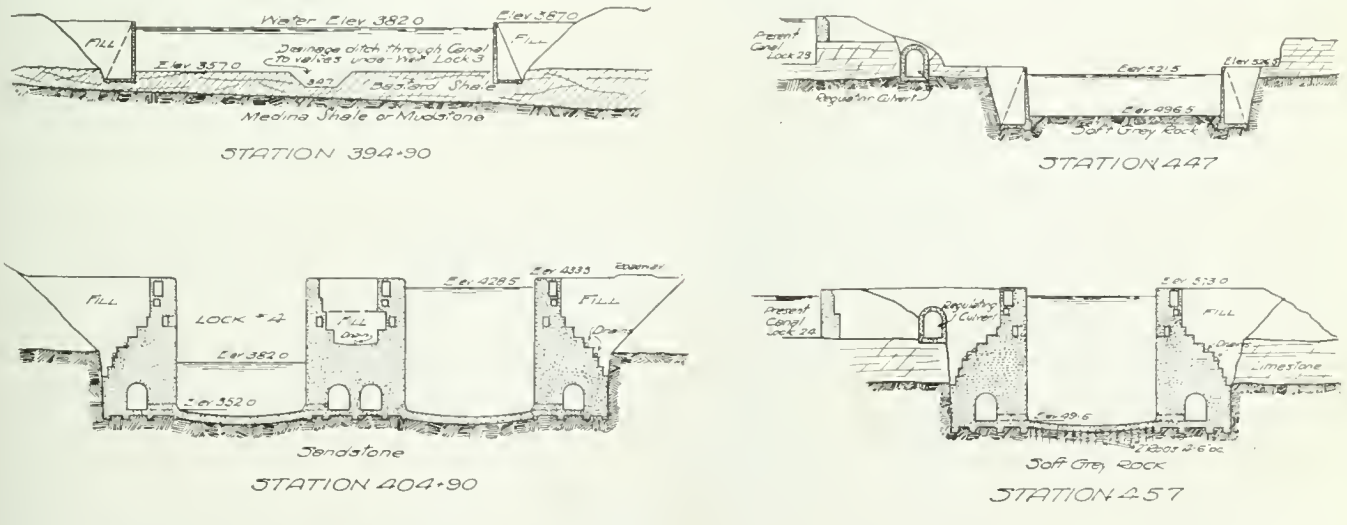


Fig. 3.—Typical Cross-Section of Earth-Works at Various Points.

Below lock 7 will be a short reach of canal, with an adjacent pondage or regulating basin having a surface

area of about 84 acres (see Fig. 1), and immediately below will be located twin locks 6, 5 and 4 in flight. These three locks will overcome a descent of 139½ ft. One flight will be used for down bound vessels and the adjoining flight for up bound, a double flight being required to save long delays in the passage of vessels through the canal.

The main line of the G.T.R. between St. Catharines and Niagara Falls will cross over the foot of twin locks 4, by means of two short bascule lift bridges.

The Port Dalhousie-Welland branch of the G.T.R. is situated just where the new locks are to be built, and it will be necessary to divert it some distance to the west. The diverted line will bear the same relation to the new canal as the present line does to the present canal, following upon the west side of the locks, but remaining on the west side of the canal for some distance above the present lock 25, when it will cross the new canal by means of a bascule lift bridge.

From lock 4 the proposed waterway will run northwards, following in part the bed of the Ten Mile Creek until it crosses the present canal at the foot of lock 11, at an elevation of 382 ft. above sea level. This is the level of the present canal at that point, and small vessels may, if desired, use the Port Dalhousie entrance, as at present, as far as lock 11. (See Fig. 1.)

Lock 3 will be located immediately north of the present canal, and at its head on the east side will be situated an equalizing basin or pondage with an area of 150 acres. Below lock 3 a heavy cut will be required through the village of Homer to a point where the bed of Ten Mile Creek is again reached, and below this point lock 2 will be built, as shown. It was difficult to find a location for this lock on account of the lack of rock for a foundation, but eventually a suitable foundation was found at this site. The canal at the head of lock 2 will be at an elevation of 335½ ft. above sea level and will flood about 200 acres of land along Ten Mile Creek. Below lock 2 the canal will follow the bed of the creek to the lake, lock 1 being situated just below the Lake Road. The pond at the head of lock 1 will cover an area of 107 acres.

Some typical cross-sections of several locks are shown in Fig. 3.

The Entrance Into Lake Ontario.

The outer entrance piers in Lake Ontario will be placed about a mile and a half from shore, where the depth of water is 30 ft. A wide channel will be dredged from these piers to lock 1. The sides of this channel will be protected near the shore end by reinforced concrete cribs, with concrete superstructures, alongside which vessels may lie. This arrangement is illustrated in Fig. 1. From the shore line of the lake to the outer entrance piers an embankment about 500 ft. wide will be formed on either side of the channel, from material excavated from the canal between the lake and Thorold. For the purpose of conveying this material from the different contracts to the lake, the Department of Railways and Canals will build a double track railway along the west side of the canal from the foot of the flight locks near Merritton to the lake, and temporary trestles will be built out in the lake on either side of the harbor, from which to start the dumps. The railway will also be utilized to haul crushed stone from the site of the flight locks to locks 1, 2 and 3, for making concrete. The contractor for the rock excavation from the site of the flight locks will, under his contract, be obliged to crush a sufficient quantity of the good rock taken from his excavation to supply all the crushed stone required for making all the concrete for the different locks and structures.

The construction of the new canal is under the direction of the Department of Railways and Canals. It will cost approximately fifty million dollars. The engineer in charge of the entire construction is Mr. J. L. Weller, M. Can. Soc. C.E.

The contract for the first section of the work, a length of about three miles, including lock 1, and the pier works at the Lake Ontario entrance, was awarded early in July to the Dominion Dredging Company, Limited, Ottawa, the contract price being about $3,500,000. Other sections are following closely, and contracts for them will be awarded before the close of August.

MONEL METAL.

A synopsis is given by R. H. Gaines in Chemical News, of the methods of manufacture of this new alloy, the reduction of which has now been so perfected as to give a product of very uniform composition, different analyses of different varieties only varying betyeen the limits: Nickel, 67.55 to 69.54 per cent.; copper, 26.25 to 27.53 per cent.; carbon, 0.17 to 0.44 per cent., and iron, 2.07 to 3.33 per cent. In forged or rolled metal the manganese varies from 1.26 to 1.82 per cent., and the silicon from 0 to 0.37 per cent., while in cast metal the manganese varies from 0.09 to 0.49 per cent., and the silicon from 1.08 to 1.41 per cent. Variations in mechanical properties have little relation to variations in composition. Carbon appears to strengthen the alloy; iron hardens, whitens, and increases the strength, but appears to reduce the elastic limit. Silicon and manganese do not materially affect the physical properties, but manganese may correct the action of sulphur, which is probably present. The alloy resembles nickel in color, it machines well, and takes a high polish and retains it indefinitely. It melts at 1,360° C.; has a specific gravity of 8.87 and a hardness number of 20 to 27 on the Shore scale. It is magnetic and absorbs carbon, which can exist in it both free and combined. Compared with nickel and copper its mechanical properties are:—

	Copper, rolled.	Nikel, rolled.	Monel metal. Cast.	Rolled.	Annealed.
Tensile strength, pounds per square inch	34,000	75,500	85,000	100,000	110,000
Elastic limit, pounds per square inch	18,000	21,000	40,000	50,000	80,000
Elongation, per cent. in 2 inches	52	43.9	25	30	25
Contraction, per cent.	57	57	25	50	50
Modulus of elasticity.	....	.....	22,000,000 to 23,000,000		

Monel metal resists corrosion by sea-water, superheated steam, and chemical solutions about as well as Parson's manganese bronze, phosphor bronze, and Tobin bronze. There is no difficulty in forging and rolling it, but on account of its high melting-point and power of dissolving gases special precautions are needed in making sand castings, somewhat similar to those necessary for making steel castings. These uses are suggested: pump cylinders for sea-water, propellers, rudders, mining screens, valves, and plumbing fixtures subject to corrosive influences. Sheets of monel metal are largely used in America for roofing purposes.

THE DETERMINATION OF INTERNAL TEMPERATURE RANGE IN CONCRETE ARCH BRIDGES

BULLETIN No. 30 of the Iowa State College, engineering experiment station, contains a treatment of this subject by Messrs. C. S. Nichols, assistant director of the station, and C. B. McCullough, assistant engineer, Iowa Highway Commission. The experimental data from which their conclusions were deduced, relates to observations on a number of concrete structures, taken by themselves and others during the past four years. The report contains the results in detail, while only the introduction and the conclusions arrived at are published herein.

The use of the arch in bridge construction dates back over two thousand years, although it was not until the latter part of the nineteenth century that reinforced concrete was used for such structures. The invention of this type of construction is generally conceded to Joseph Monier, of Paris, the date of the building of his first arch bridge usually being given as 1867. In the year 1894 F. Von Emperger introduced the "Melan" system of reinforced concrete arch construction into this country, and built the first reinforced concrete bridges of considerable span. Edwin Thatcher was also a pioneer in this work, building bridges as early as this date.

While it is thus seen that the use of reinforced concrete in arch bridges is of comparatively recent date, yet the growing sentiment in favor of it, because of its peculiar esthetic value, is so great as to warrant the belief that this type of structure as a highway bridge will not be replaced by staticly determinate structures, at least not within the lifetime of the present generation of bridge builders.

One of the main arguments used against the adoption of this type of construction is our present limited knowledge of the actual internal forces for which the structure should be designed. Particularly is this true of the range of internal temperature. The immediate necessity for an investigation of this temperature range in arch bridges was therefore manifested in two ways:

(1) There is at present a very great diversity of practice among our western bridge companies in allowing for internal temperature variation in their arch bridge design. It has been ascertained, from good authority, that several of the prominent construction companies of the West are designing their structures to withstand temperature variations of from 15 degrees to 30 degrees F. each way from normal. Others are allowing a fixed percentage of the dead load stresses, this generally being, in highway construction, from 10% to 20 %, while analysis according to the elastic theory for the range to be expected in this latitude gave temperature stresses (in the case of one arch) as high as 206% of the dead load stresses at the crown, and 123% of the dead load stresses at the spring time.

One of the prominent concrete engineers of the east wrote: "We allow, in this latitude, (New York) or anywhere in the northern states, a range of 40 degrees in temperature, or 20 degrees each way from the mean. This may or may not be sufficient."

(2) There are scarcely any available experimental data on the range of temperature in concrete having a direct bearing upon the design of reinforced concrete arch bridges. The replies to a large number of letters sent out prior to the beginning of the tests, brought out very strikingly the fact that, while there were considerable available data and many theories concerning the expansion and contraction in concrete, yet very little was known concerning the actual internal variation of temperature in concrete structures.

Conclusions.—From the results, the writers draw the following conclusions:

I. The yearly range in temperature in a reinforced concrete arch structure, typical of the highway arch construction in this State, is, in this latitude, not far from 80 degrees F.

II. The relation between the depth of concrete covering at any point and the yearly temperature range may be obtained from a curve plotted from the results obtained on bridges under test. The curve that most nearly passes through the centre of the results can be represented by the equation

$$y = 90 - \frac{53}{100} x$$

wherein y = the yearly temperature range in degrees Fahrenheit, and

x = the distance from the nearest exposed surface in inches.

However, the effect of the different factors, such as the presence of a water surface, direction of prevailing winds, etc., so modify the results that the writers prefer to state their conclusions as in I., giving an average value for points throughout a structure of this type.

III. The amount of direct sunlight modifies somewhat the actual temperature in the concrete for a considerable distance into the interior of the mass, although, on account of the meagre nature of the data gathered, no definite conclusion can be stated.

IV. The data seem to show that in structures of this type the minimum temperatures are attained in time intervals anywhere from less than one day to four days after the atmospheric minimum. This interval depends upon the position of the portion of the structure considered, and is roughly proportional to the distance from the nearest exposed face.

V. Because of the high temperature in the concrete when it attains its set, and the effect of atmospheric temperature upon this maximum, other conditions being equal, the pouring of an arch ring at a temperature near the atmospheric mean annual operates to materially lower the stresses in the ring induced by temperature variation.

VI. When uninfluenced by other factors than atmospheric variation, the rise and fall of an arch ring agree quite closely with theory.

VII. The shrinkage of concrete, if unrestrained by reinforcing, amounts, in 100 days after placing, to about 4/1000 per cent. This induces bending stresses analogous to those produced by a temperature drop, but these are so modified by the initial stresses due to shrinkage that the chief effect is to cause a high compression in the steel on the compression side of the bending. When, due to other forces acting on the structure, a high compressive stress in the steel is encountered, the effect of this shrinkage should be carefully studied.

VIII. To render an arch ring structurally safe, provision should be made, in this latitude (Iowa) for stresses induced by a temperature variation of at least 40 degrees F. each way from an assumed temperature of no stress. Particular circumstances may demand that a greater variation be used for drop in temperature to prevent the appearance of cracks. This will always remain largely a matter of judgment with the designing engineer.

A MAINTENANCE-OF-WAY DEPARTMENT RAILROAD TESTING PLANT.*

By B. B. Milner.

SOME time ago the writer was asked to assist a maintenance-of-way engineer in the investigation of a problem which involved a study of track design and the stresses imposed upon its various members. Consultation with several men of recognized experience and authority, as well as an investigation of all experimental work performed in this connection, and a search through the literature of the subject, revealed the fact that dependable data upon which to base definite conclusions upon various points raised were lacking.

The same revelation was made by Mr. O. E. Selby, bridge engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway, in a paper, entitled "A Study of the Stresses Existing in Track Superstructure and Rational Design Based Thereon," which was published in Bulletin No. 80, American Railway Engineering and Maintenance-of-Way Association, October, 1906. This paper elaborated upon the statement that "railroad track has grown in strength as heavier loads have made increased strength necessary, but such growth has been entirely along empirical lines, and not one single detail of track superstructure bears marks of engineering design."

Mr. Selby, after careful consideration of such factors as rail loading and stress therein, tie bending, bearing of tie upon the ballast, depth of ballast and its bearing upon the subgrade, developed the track design shown in Fig. 1. The sizes on the drawing are for 60,000-pound axle loads. The principal sizes for 50,000-pound loads, using various weights of rail, are given in Table I.

Table I.

Rail	80 pounds	90 pounds	100 pounds	Rail with Sec. Mod. 20
Axle load	50,000	50,000	50,000	60,000
Size of ties	7″x 8″x 8½′	7″x 8″x 8½′	7″x 8″x 8½′	7″x 9″x 8½′
Spacing of ties	16½″	18″	20″	20″
No. of ties 33-foot rail	24	22	20	20
Depth of ballast	14″ stone	16″ stone	18″ stone	12″ stone 12″ gravel
Width of roadbed	21′	21′	22′	24′

From this table it is at once seen that the number of ties per 33-foot rail, as well as the depth of ballast, is much greater than that found in standard track to-day, and, since the figures in the table are the result of a careful consideration of the strength of the materials involved,

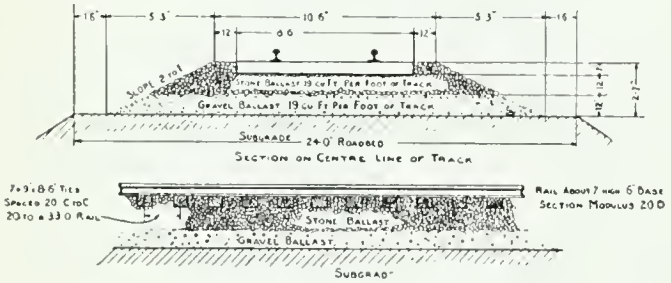


Fig. 1.—Track Superstructure for 60,000 lb. Axle Loads.

it is not surprising that the question of strengthening our present standard tracks is becoming such a live one, especially with our heavier trunk lines.

*Abstract from paper as presented to the Franklin Institute and published in the Journal of the Institute for August, 1913.

The depth of ballast, computed by Mr. Selby, was obtained from formulæ for the thickness of ballast necessary to produce equal distribution of axle loads on the surface of subgrade beneath the ballast, for which Mr. Thomas H. Johnson, consulting engineer of the Pennsylvania Lines West of Pittsburgh, was responsible. Mr. Johnson deduced these formulæ after studying a report, made by Railroad Director Schubert, of Berlin, in 1899, of observations extending over a period of over three years, on the action of ties actually in track. This report was translated and published by Mr. W. C. Cushing, chief engineer, maintenance-of-way, Pennsylvania Lines, and appeared in Bulletin No. 76 of the American Engineering and Maintenance-of-way Association, June, 1906.

In Mr. Johnson's formulæ the two following premises are made:—

1. "That the width of distribution of the load is equal, for stone ballast, to the width of the tie plus the depth of the ballast, and, for gravel ballast, to the width of the tie plus half the depth of the ballast."

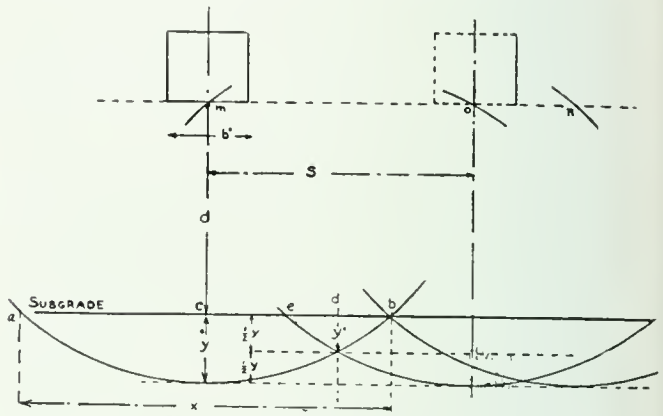


Fig. 2.—Width of Load Distribution Graphically Expressed.

From Fig. 2 this premise may algebraically be expressed thus:—

For gravel, $x = b' + \frac{1}{2} d'$.....(1)

For stone, $x = b' + d'$.....(2)

where x is the width of ballast pyramid carrying the load.

2. "That the intensities of pressure within that width are proportional to ordinates to an arc of a circle whose radius and chord are equal to the width of distribution of the load."

The deduction of the formulæ is as follows:—

If the circular arcs be considered as approximate parabolas, the intensities of pressure may be assumed to be proportional to the ordinates of the curves. The area of the parabolic segment = $\frac{2}{3}xy$, hence the mean ordinate = $\frac{2}{3}y$, or the mean pressure = $\frac{2}{3}$ the maximum.

The pressure at b is o, hence, to obtain an approximately uniform distribution of pressure over the surface of the subgrade, the tie-spacing S must be such that the curves overlap and have a common ordinate y′ equal to $\frac{1}{2}y$. This will obtain when db = $\frac{1}{4}$ cb; eb = $\frac{1}{4}$ ab or mo = $\frac{3}{4}$ mn.

Hence, the tie-spacing $S = \frac{3}{4}x$.

Therefore, from (1), for gravel, $S = \frac{3}{4}(b' + \frac{1}{2} d')$ and from (2), for stone $S = \frac{3}{4}(b' + d')$ from which the required ballast depths d′ are obtained by transposition:

For gravel, $d' = 8/3\ (S - \frac{3}{4} b')$

For stone, $d' = 4/3\ (S - \frac{3}{4} b')$

both of which give values of d′ much greater than exist in practice.

The question whether, in order to strengthen our tracks for the increased loads imposed, the number of ties or the depth of ballast, or both, should be increased, is one upon which opinions vary widely among those concerned. The following is here presented in this connection.

Fig. 3 shows a diagrammatic section of the ordinary standard main line track, in which 7-inch by 8-inch ties are spaced 22 inches apart, or 18 per 33-foot rail, and laid upon 6 inches of ballast. The slopes of the ballast pyramids, transmitting the load from bottom of tie to subgrade, are determined in accordance with Mr. Johnson's premises for the distribution of pressure at the bottom of stone ballast. It will be noted that the width of the base of the ballast pyramid under each tie is 14 inches and the width of the strip of subgrade unloaded and lying between adjacent ties is 8 inches. As shown by Director Schubert's experiments, and in line with the experience of all trackmen, the subgrade line, originally straight, will be disturbed, as AB in Fig. 4, the amount of disturbance being proportional to the weakness of the subgrade and to the ratio of the area of subgrade between the loaded ballast pyramids and that of subgrade beneath the ballast through which the load is transmitted.

By changing the tie-spacing to 20 inches, or 20 per 33-foot rail, as shown dotted in Fig. 3, the ratio of loaded to unloaded width of subgrade at the 6-inch depth of ballast becomes 14/6 instead of 14/8, an increase of 33⅓ per cent. The subgrade is more nearly confined, a condition which, of course, materially increases its carrying capacity. Maintaining the 22-inch tie-spacing and increasing the depth of ballast from 6 inches to 8 inches changes the ratio of loaded to unloaded width of subgrade from 14/8 to 16/6, an increase of approximately 52½ per cent.; while the combination of the decreased tie-spacing and increased ballast depth increases the original ratio from 14/8 to 16/4, or approximately 128.6 per cent.

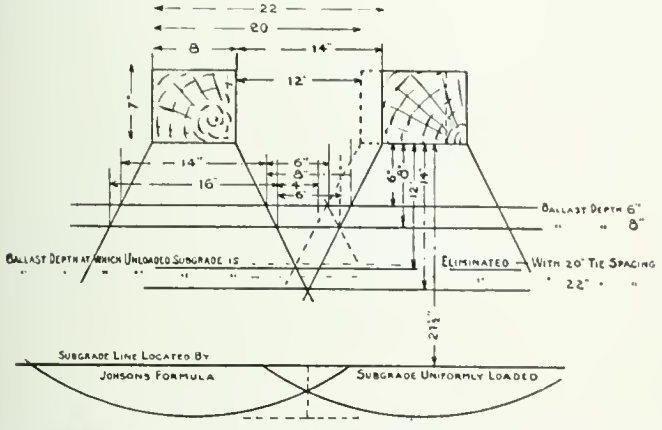


Fig. 3.—Section of Standard Main Line Track.

In the diagrammatic plan of track shown in Fig. 5 it is assumed that the rail load is spread by the tie 18 inches on each side of the rail centres, or, for an 8-inch tie, over an area of 36 times 8 = 288 square inches of the lower face of the tie under each rail, and over somewhat less than the 36 + 6 times 8 + 6, or 588 square inches of the subgrade. The corresponding area of unloaded subgrade is 42 times 8, or 336 square inches, and the ratio of loaded to unloaded subgrade areas is 588/336. Decreasing the tie-spacing to 20 inches will increase this ratio to 558/252, or 33⅓ per cent., while combining with this decrease, an increase of ballast depth of 2 inches, will increase the ratio to 588/168, or 100 per cent.

Fig. 5 also shows that with 18 ties per 33-foot rail the unloaded area of subgrade between adjacent ties becomes zero when the depth of ballast is increased from 6 inches to 14 inches, while with 20 ties per 33-foot rail it becomes zero with a ballast depth of 12 inches.

According to Johnson's formula for stone ballast, uniform distribution of subgrade loading will be obtained with 21⅓ inches of ballast for 18 ties per 33-foot rail and with 18⅔ inches of ballast for 20 ties per 33-foot rail.

Any consideration of the relief to be expected from decreasing the tie-spacing, increasing the depth of ballast or otherwise, should take into account the cost, and in this connection Table II. is presented.

From this table it is seen that a reduction of tie-spacing from 22 inches to 20 inches increases the ratio of width of loaded to unloaded subgrade by 33⅓ per cent. at a cost of $464, $928, and $1,856 per mile for single, double, and four-track lines respectively, while an increase of ballast depth of two inches (from 6 inches to 8 inches) increases this ratio by 52½ per cent. at the respective cost of $256.90, $507.23, and $1,006.51 per inch additional inches of additional ballast. Whether the first or the second or a combination of both is best is therefore somewhat of an open question.

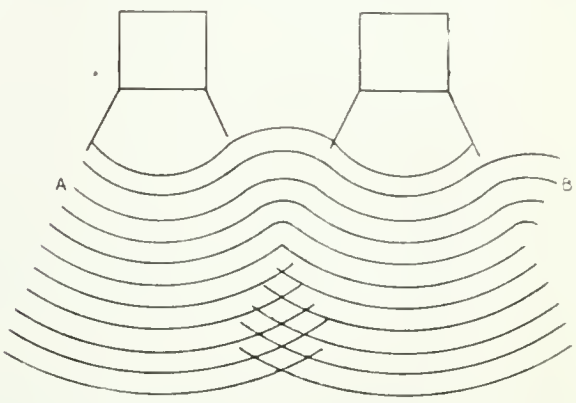


Fig. 4.—Lines of Distortion of Ballast Under Loaded Ties

Some individuals and committees have recently recommended a ballast depth greatly in excess of previously existing standards and still greater than the ballast depths actually obtaining even on our densely travelled lines, without qualification dependent upon either the subgrades or the characteristics of the imposed loads.

Table II.

Statement Showing Comparative Cost of Increasing Number of Ties per Rail Length (33 Feet) from 18 to 20 and Cost per Inch Depth of Putting Additional Ballast Under Standard Track of One of Our Larger Lines.

Ties per mile spaced	Single track.	Double track.	Four-track.
18 per rail length	2,880	5,760	11,520
20 per rail length	3,200	6,400	12,800
Additional ties	320	640	1,280

Cost per tie:

1 tie	$0.90	Volume of 1 tie, 3.3 cu. ft.
2 plates	.28	Cost of ballast, 75cts. per cu. yd.
8 spikes	.11	Cost of laying ballast, 40 cents per cubic yard.
	$1.29	Total cost of ballast in track, $1.15 per cubic yard.

Credit account ballast displaced	$0.14		
Net cost per tie	$1.15		
Labor placing tie in track	.30		
Cost per tie in track	$1.45		
Cost of additional ties in track.	$464*	$928*	$1,856*
Full width of ballast base.....	164½"	324½"	644½"
Cubic yards per square inch section per mile equals 1.35			
Cubic yards ballast required...	223.39	441.07	875.23
Cost of required ballast in track, at $1.15	$256.90	$507.23	$1,006.51

To the writer it appears that the design of railroad track must be approached in the same way as the design of any mechanical parts. As a foundation it should be treated like any other foundation, and a study of its requirements, purposes, construction, and maintenance should be made. It must be designed to carry loads of certain individual magnitude, density and speed, etc., and must do this upon subgrade of given conditions. With a sufficient amount of the right kind of data, it should be possible to combine the knowledge of the loads to be imposed with that of the subgrade conditions, and prescribe the most efficient and economical track construction, which, if it cannot be immediately provided, can be approached from year to year in connection with regular track maintenance work. Subgrade conditions vary materially within short distances, but with these conditions properly charted it should be a very easy matter, in bringing the condition of the track up to a desired standard, to concentrate effort upon those sections which are farthest from that standard and which will be located from tabulated or charted data or from the frequency of service failure.

Opinions of maintenance men vary greatly upon a majority of questions relating to track and track superstructure design, and practically none of these opinions is supported by such conclusive test or experience as will make early agreement or reconciliation possible. In the maintenance-of-way department dependable data are not being collected as in the motive power department, in which department much money has been, and is continually being, profitably spent to settle questions pertaining to the design and operation of both locomotives and cars, many of which questions are of less importance than some of those relating to track construction.

The writers upon maintenance-of-way subjects will have served a useful purpose if they succeed in focusing attention upon the comparative deficiency of experimental work in this field, for as soon as this deficiency is realized then work will be inaugurated which will, in a few years, elevate the science of track construction to its proper level. The condition of our tracks is now lagging behind requirements, and we cannot consistently hope for a better state of affairs unless some move along scientific lines is soon inaugurated. In the meantime, locomotive and car designers must "mark time," so far as increased loads and speeds are concerned.

*Does not include labor cost of respacing present ties to make the insertion of additional ties possible, nor the cost of distributing the ties and ballast to point where placed in track.

While some investigations should necessarily be made under regular service, many can, nevertheless, be (and a few have been) carried out upon an experimental track of significant proportions. An experimental track was constructed a comparatively short time ago by the Prussian State Railroads at Oranienburg, Germany, and is being used to determine experimentally the best construction. Dr. H. K. Hatt, of Purdue University, who visited this installation a few years ago, reported:

"It consists of an oval track two miles in circumference over which runs a train consisting of electric locomotive and cars. At about every fifty feet two vertical rail ends were sunk in the ground on each side of the track and clips riveted onto them to serve as a reference

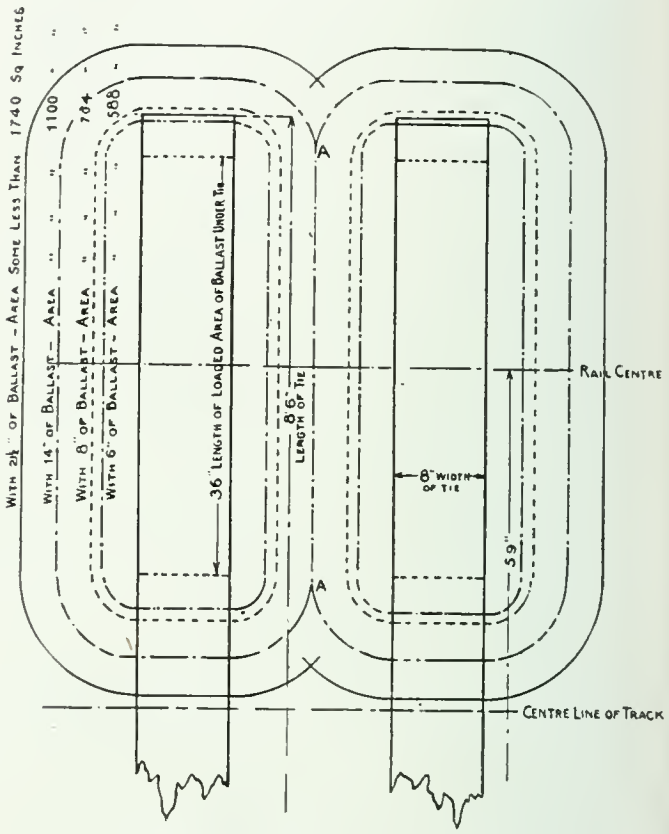

With 21½" of Ballast – Area Some Less Than 1740 Sq Inches
With 14" of Ballast – Area 1100 "
With 8" of Ballast – Area 704 "
With 6" of Ballast – Area 588 "
36" Length of Loaded Area of Ballast Under Tie
8'6" Length of Tie
8" Width of Tie
59"
A
A
Rail Centre
Centre Line of Track

Fig. 5.—Sketch of Track Plan.

7" x 8" x 8' 6" ties spaced; 22" or 18" per 33' rail. Showing outlines and areas of loaded sections of subgrade with 6", 8", 14" and 21½" of ballast under the ties.

line, for measurement of track deformation. The service is considered as severe in one year as eight years on the main line. The cost of the roadbed and equipment is stated to have been $40,000.

"About a year before my visit the first track had become worn out and a new track consisting mainly of steel and beech ties had been set under service.

"Some of the elements which were being experimented with at Oranienburg may be listed as follows: Prussian standard steel ties with side ribs have been down one year in different forms of ballast. The evidences of derailment of cars were visible, but the steel ties were not sprung. The modern double steel tie was used at the joints. Various forms of anchorage of rails to ties were under experimentation. These anchors are found more necessary in steel ties than in the case of wood. The

various forms of anchors seemed all to be effective, although the track as a whole had not been down long enough to give final results.

"The scarf joint appeared to be unsuccessful, inasmuch as the inner edge of the scarf sheared off at the edge, due to the wave motion in the rail. The records of traffic passing over this experimental track show that in 369 working days the number of kilometre tons was about six million. In the months of January, February, March and April, in 1909, there were nearly seven million kilometre tons. The locomotive weighed 59½ tons and would pull a train of from 240 to 375 tons. The speed of the train was 60 kilometres per hour."

The loads imposed upon this experimental track are insignificant in comparison with those which, for the results obtained to be of service, would have to be placed upon such a track in this country.

The writer would suggest that an experimental track be designed and constructed in the form of a figure 8, so that one loop could be operated while the other was being prepared for test. On this track, properly enclosed by fencing, etc., a motor, hauling any desired combination of cars, loaded with any desired axle loads, could be controlled from the office of an engineer of maintenance-of-way tests located in the centre of either of the loops, and in this way any combination of rails, fastenings, ties, joints, ballast, frogs, switches, signals, and safety devices could be tested. The value of an ability, by this method, to rapidly test rails of different steels, under more scientific conditions, must be apparent when the amount of work done in settling rail questions during the last ten years is considered.

CANADIAN PETROLEUM.

The petroleum industry in Canada has been marked during the past four years by a rapidly decreasing output, the production in 1911 being only a little more than one-third that of 1907, according to statistics contained in the annual report on mineral production of Canada, by John McLeish, B.A. The total production of crude petroleum in 1911 was 291,092 barrels of 35 imperial gallons each, valued at $357,073 or an average of $1.22½ per barrel, as compared with a production of 315,895 barrels valued at $388,550, or an average of $1.23 per barrel in 1910, and 420,755 barrels valued at $559,604, or an average of $1.33 per barrel in 1909. With the exception of 86,139 gallon in 1911, 51,975 gallons in 1910, and 3,328 gallons in 1909, produced in New Brunswick, the output was entirely from the Ontario oil fields.

The above statistics of production are based on the claims made for the bounty paid by the Dominion Government, which was first provided for in 1904 by an Act passed by the Dominion Government authorizing the payment of a bounty of 1½ cents per gallon on crude petroleum produced from wells in Canada. The bounty was continued during 1910 under the "Petroleum Bounty Act, 1909," which provides for the payment of bounty on crude petroleum produced from oil-shales mined in Canada, as well as on oil from wells in Canada. Payments are made on claims submitted by the producers of crude oil to the Minister of Trade and Commerce. These claims have to be substantiated as to quantity by the certificate of the receiving stations, tanking companies refiners or other purchasers, as well as by the supervising officers of the Department of Trade and Commerce.

The bounty paid on the crude petroleum produced gives, therefore, as accurate a basis as is available for a reliable statement of the annual production.

A FEW COMPARATIVE COSTS IN ROAD AND PAVEMENT WORK.

By Fred. L. Macpherson, A. M. Inst. C.E.
Municipal Engineer, Burnaby, B.C.

ALTHOUGH the cost of roads and pavements naturally varies greatly in each city, or district, depending on local conditions, labor and materials, a comparison of the average prices obtaining in the vicinity of Burnaby, B.C., may be interesting.

Macadam Road.—Initial cost, 80 cents per sq. yd.; annual cost of oiling, .02 cent per sq. yd.; average annual cost of maintenance during the first three years of life, 11 cents per sq. yd.; cost applied over three years, $1.19 per sq. yd.; cost of scarifying and resurfacing usually necessary at the end of three years, 32 cents per sq. yd.

This means that in the fourth year of its existence an ordinary macadam road under average conditions has cost $1.50 per sq. yd., and even then it is far from being a permanent structure, being still susceptible to patching, scraping, oiling and resurfacing continually, thus increasing the cost of the road until, at the end of the fifth year or so, the macadam road has cost as much, if not more than, the initial cost of a bituminous pavement for which a usual five years' guarantee is given, and which is likely to last twice that time with comparatively little maintenance cost.

Further figures may be conclusive evidence of the extravagant construction of ordinary macadam roads. During the last three years there has been spent on our two principal highways, Douglas Road, 6¼ miles in length, $110,000, and Kingsway, 4¼ miles in length, $60,000. The latter is now being reconstructed at a total estimated cost of $400,000, for which the maintenance (except the cost of cleaning) of the actual pavement will cost the municipality practically nothing during the next ten years. Had this road not been paved, the repairing, resurfacing, oiling, etc., during that time would have cost $50,000—a very conservative estimate. Unless for purely residential streets, where it best fulfils its purpose, the ordinary macadam road should be a thing of the past. The present policy of borrowing money for 40 years for building roads with an average life of three years, and maintaining such roads out of revenue expenditure, seems to be radically wrong. An ordinary macadam road, far from being an asset, is nothing short of a burden, under such conditions.

The average cost of other pavements dealt with are:

Concrete pavements	$2.00 per sq. yd.
Hassam pavements, thickness, 6 ins.	2.25 per sq. yd.
Granitoid pavements, thickness, 7 ins.	2.65 per sq. yd.
Brick on city streets on 6-in. concrete	3.75 per sq. yd.
Brick on rural roads on 4-in. concrete	2.75 per sq. yd.
Dolarway pavement	2.20 per sq. yd.
Bituminous pavements—	
On concrete base	2.60 per sq. yd.
On old macadam base	1.25 per sq. yd.
On new macadam base	1.80 per sq. yd.

Based on an average cost of $25,000 per mile, 100 miles of bituminous pavements built on existing macadam or gravel roads in Burnaby would cost $2,500,000. While the initial cost of such work seems alarming, the investment should be a sound one if spread over a period of about five years, inasmuch as the work would be per-

manent, the average annual cost of maintenance, say, $50,000, at the end of that period would be practically eliminated and the needs of every district amply served.

Although on first consideration such an undertaking would appear to be stupendous and financially impossible for any ordinary municipality, the issues at stake are so serious, and the necessities so imperative as not only to deserve mature consideration but also to demand prompt action. Permanent initial construction is the proper policy for any municipal or government authorities to adopt. Municipal bodies are active in the permanent road policy, but unfortunately the action is not concerted enough and the results are therefore disappointing and ineffective.

The proper administration of highways is a prominent feature of road economics which has not had the earnest consideration locally which its great importance deserves. In view of the increasingly urgent demands for the opening up of new roads for settlers, and the improvement of existing residential roads, a municipality should not altogether be saddled with either the construction or the maintenance of through highways. Such roads and the roads to which they link up should be under a highway commission, composed of engineers and representatives of some more permanent public bodies, such as is in vogue in England and in portions of Eastern Canada and United States. The adoption of such an administration would assuredly make for uniformity and continuity of construction, and result in a more even and equitable assessment of expenditures involved.

The provincial governments appear to be alive to the situation and have adopted progressive permanent measures in their road construction policy. Financial assistance is now given chiefly for permanent work, and, locally, Burnaby and South Vancouver have reason to be greatful for the material assistance received in the permanent paving of Kingsway.

There are many other interesting and important features associated with the question of semi-permanent and permanent roads and pavements, but the above remarks may serve to prove that progress towards the better highway and the better street, in which we are all so intimately interested, must be along lines that are utilatarian, logical and aesthetic, and further, that the wish for a more permanent highway will be visionary until the need for it is created and its claims urged upon the powers that be.

The total value of the sales of sewer pipe in 1911 statistics as contained in the annual report on Mineral Production of Canada by John McLeish, B.A., was $812,716, as compared with a value of $774,110 in 1910, and a value of $645,722 in 1909. Nearly 50 per cent. of the production in 1911 was made in Ontario. Following is a list of firms that reported production of sewer pipe in 1911: Standard Drain Pipe Company, St. Johns, Que., and New Glasgow, N.S.; Ontario Sewer Pipe Company, Toronto, Ont.; Dominion Sewer Pipe Company, Toronto, Ont.; Hamilton and Toronto Sewer Pipe Company, Limited, Hamilton, Ont.; Clayburn Company, Limited, B.C.; British Columbia Pottery Company, Victoria, B.C. The imports of drain pipe and sewer pipe during the calendar year 1911 were valued at $382,029, of which $338,644 worth was imported from the United States, $44,278 from Great Britain, and $7 from other countries. The production of drain tile as reported was not as large in 1911 as in 1910 or 1909. The total sales in 1911 were valued at $339,812, as against $370,008 in 1910, and $408,440 in 1909.

FOREST DEVELOPMENT AND PRESERVATION.*

By R. H. Campbell, Esq., Director of Forestry, Ottawa.

IN considering the forest and its development, it is necessary to have clearly fixed in our minds the fact that the forest is a living thing, and that it grows and develops according to natural laws. In order to understand the forest, therefore, it is necessary to study the habits of life of the tree. The four great requirements for tree life are water, light, air and soil. The tree carries on its functions of life and growth very much in the same way as animals do. One of the great differences, however, is that the tree is in a fixed position and therefore cannot go to find its food or requirements where they may be. It is therefore necessary for it to adapt itself to the conditions as they exist where it is located. We will look at the materials which the tree requires for its growth, and then consider some of the adaptations that are necessary so that the tree may make use of them.

Water is the most important constituent for the use of the tree. The tree is continually drawing up from the earth through its roots, large quantities of water which pass up from the trunk and are exhaled from its leaves. In order to keep the tree in a healthy condition this flow of water must be kept constant, and the more freely the water passes through the tree the more vigorous will be its growth. We see this very clearly by following different characteristics of the tree growth in different portions of the Dominion. On the coast of British Columbia, in a moist climate, the growth of the tree is very vigorous and we have the immense Douglas firs and cedars that form one of the most magnificent forests in Canada. In the forests of the Selkirk Mountains in the central part of British Columbia where the rainfall is still heavy, there is a vigorous growth of white pine, cedar and fir. In the dry belt in the province of British Columbia, the mountains which receive the most of the precipitation are covered with a dense forest of lodgepole pine and fir, but in the lower portion of the dry district, where the rainfall is scanty, the forest thins out and there is a scattered growth of yellow pine. In the prairie country the Rocky Mountains carry a stand of lodgepole pine, Englemann's spruce and fir, which is more or less of a mountainous character, and therefore not so large in size as the forests of the Selkirk Mountains or the coast of British Columbia. The reason for this is that ascending the mountains or going northward in latitude the soil is cold for a longer period during the year, and this has a considerable effect on the rate of growth of the trees.

The trees are not directly affected by the lowness of the temperature, as some specimens of trees are found growing in the barren lands to the north, away beyond the general line of tree growth. The effect of the cold is, however, to keep the ground frozen for a great portion of the year, and therefore to prevent the tree from obtaining a supply of water with the result that is cannot continue its functions. In the muskegs of the north country the trees are very slow in growth and stunted. This is partly the result of the fact that the ground is kept very cold by the covering of moss, and therefore the growth is slow, but it is also partly due to the fact that there is considerable acid in the water of the muskegs and consequently

*Read at the Seventh Annual Meeting of the Association of Dominion Land Surveyors, Ottawa, March 5th, 1913.

the tree cannot make use of the water as it could if it were pure. The method by which the water passes from the outside of the rootlets to the inside is a physical one dependent on chemical composition. If the water outside is a stronger solution than that inside the root, the water will not pass in and consequently the tree cannot get the use of it.

As you reach the northern latitudes or the alpine elevations of the mountains, the tree growth becomes more stunted until finally it lies almost like a mat on the surface of the earth, as illustrated by the view of the white barked pine at an altitude of 6,000 feet on the Porcupine Hills in Alberta. This flattening out of the growth is partly due to the fact that the water supply is not sufficient, and that it is difficult to get the water pumped up if the tree grows to a greater height than the ordinary level, and partly to the fact that the drying wind increases so largely the transpiration that the supply of water cannot be obtained quickly enough in a soil which is so cold for such a great part of the year.

To counterbalance the great extent of the tree above ground, it is necessary also that the root should extend deep and wide in the earth in order that the tree may not be overthrown by the wind. The growth of the tree in this manner is not, however, the most satisfactory for producing lumber, as the lumber produced will be knotty and will have a very small proportion of clear stuff. In order to produce the best quality of lumber the tree should be grown in a close stand. Where the trees have been sown close together and are reaching upward toward the light, each one tries to get its crown where it can get the most light. As a result the trees grow rapidly upward and the inside branches dry off and gradually drop from the tree, leaving a long, clear trunk. Many of the trees in such a stand will finally become suppressed by the more vigorous ones and will gradually die out completely. In the forests of Europe such trees would be taken out by a thinning process, but in this country the market conditions do not make such thinnings possible, although in a district like the Cypress Hills, of Alberta, where there is no other timber within one hundred miles, there seems to be reason why thinning might be done profitably.

The soil has considerable influence on the growth of trees. We find that on the light, sandy soils the pine will grow readily, particularly the red pine and the jack pine. As a rule, however, trees will grow best in a fairly good soil, and the forest floor covered by leaves and debris from the trees finally forms a bed of humus which provides excellent nourishment for tree growth. The province of Ontario is now taking active steps to replant pine on some of the sandy areas in the western part of the province, which have been entirely denuded and left bare of trees or any other useful growth.

In order to meet the different conditions as explained above, the tree has to arrange various adaptations. Sometimes the tree is in a location where water can be obtained plentifully, and in such case it is arranged that water will pass through the tree rapidly and escape. Such trees usually have broad leaves with thin coverings and numerous openings called stomata from which the moisture may escape. Trees or plants growing in dry situations, on the other hand, have devices for retaining the water as long as possible. One of the clearest examples of this, is the cactus growing in the deserts of the western United States, and even in the dry districts in the southern part of the prairies. The cactus has thick leaves containing a great many water vessels, and these leaves are covered with a close covering through which water cannot pass very easily. As a consequence all the water which the plant draws up from the earth is retained in the plant with almost no loss.

While the tree draws up water from the earth, bearing a few mineral salts, its chief sustenance is the carbon drawn from the air through the leaves. The fact that the tree is largely composed of carbon can be seen in any burnt district. The carbon is supplied largely from carbon dioxide in the air. In order to carry on its process of obtaining the carbon from the air, which process is carried on by assimilation in the leaves, it is necessary that light should play upon the leaves as fully as possible. Consequently the leaves are spread out so as to catch as much light as they possibly can. This is illustrated by the broad, flat leaf of the maple, arranged upon the stem so that the broad, upper portion of the leaf should always be exposed as much as possible to the sun. In the case of the coniferous trees the leaves are small, but this deficiency is made up by their leaves being very numerous.

The stem is so arranged as to provide for the water supply from the root passing up readily, and it is a very interesting process to investigate. It is not yet clearly understood how the force is supplied which will drive up the water required for one of the giant trees on the Pacific Coast two or three hundred feet through vessels of microscopic size. Various theories in regard to the matter have been put forward, and it was thought at one time that the matter was settled by an explanation that the pulsations of the living cells of the trees resulted in a pumping process which gradually forced the water upward. This theory is not, however, accepted as final at the present time.

Each year of growth adds a distinct ring to the woody tissue of the tree. In the spring the cells of wood are large with thin walls, and late in the summer are small with thick walls, and this makes the distinction between the growths of different years. The growth of a year may be larger or smaller according to the season. The favorable season will make the ring of growth larger, and a dry season will make it considerably narrower. Trees which are suppressed will also make slower growth than those which are open to light and air.

The bark gives protection to the growing parts of the trees, and as the tree increases in size the outer bark dies and is split open by the pressure from the inside, resulting in the corrugated bark which is so characteristic of many trees. The rough bark is characteristic of the white pine, elm and many other species. The bark in other cases, like the spruce, strips off in flakes, and that of the white birch exfoliates in thin sheets.

There is added to the natural conditions which have to be considered in the growth of the trees, an artificial condition caused by fire. Fires have occurred in all our wooded districts, and the evidence of their destructive power is clear to any person who has travelled through the timbered districts. Fires make the condition more difficult inasmuch as they make it harder to carry out the protection of a forest, and that they have made the conditions for reproducing the forest more difficult than they would be naturally. Where a tract is well covered with forest trees the cutting can be done so as to favor natural production, but where a forest fire sweeps through, the conditions are changed without regard to what is to follow, and we have to try afterwards to bring about the conditions that would have been considered and provided

for if the removal of the forest had been done in a regular way. The vast stretches of forest that have been destroyed by fire mean a great loss to the capital and industry of the country, and means for combatting them are of prime importance.

The methods taken for handling the forest on better principles are:—

1. The provision of a fire patrol. We have a large number of fire rangers patrolling the forests by foot, by horse, by canoe or boat, during the dangerous season in the summer. These men put up notices warning people of the danger of fire, and instruct every person that they meet as to the necessity of taking care in the use of fire. On the Saskatchewan River, and one or two other places, we have put on a patrol boat. In such cases there are large stretches of water from which the forest can be reached and in this way a very much larger area can be patrolled than can be done in any other way. The work of the fire patrol may be illustrated by the work that is done in the portion of Manitoba north of Lake Winnipeg. This district is in charge of Mr. Jas. T. Blackford, with headquarters at Norway House. The canoe routes for the country to the north and down towards Hudson Bay all start from Norway House, and here he has an opportunity of meeting the parties that are travelling and warning them in regard to the danger of fire when they are starting out. Fire notices are posted at all the portages along the canoe routes, so that the matter is brought immediately to the attention of any parties when they go into camp. Mr. Blackford has also been successful in interesting the Indians in the matter of fire protection. He has talked to them about the matter when they are gathered for treaty payment and has induced them to promise to put out their own fires and have others do the same. Every one of the Indians who promises to do this receives a small fire ranger's badge in the shape of a maple leaf, and they are very proud of these badges and wear them all the time.

On the forest reserves where matters are more fully under control, and the line between agricultural and forest lands is permanently settled, we take further steps for fire fighting by making permanent improvements of various kinds. In a tract like the Cypress Hills, where the prairie comes immediately in contact with the forest, plowed fire guards are made so as to prevent prairie fires sweeping into the timber. Such fire guards have been found of great advantage in holding back fires. Telephone lines have been erected in order to have communication through the forest with the object of getting word about the fires out quickly and getting help in to fight them. In the forests of Europe the telephone is being largely used, and it is also being used very considerably on the forest reserves of the United States. It is one of the most useful adjuncts to the fire preventive work that can be had. The work of fire prevention in the forests is on the same principle as the work of fire prevention in the city; that is, the fire must be located quickly; notice of it must be given without delay; and help must be got to it speedily. This means the opening up of communication of all kinds—trails, roads, telephone lines, etc.

Another matter that has to be dealt with in order to meet the fire difficulty is the disposal of slash resulting from lumber operations. The condition of the forest after lumbering operations is such that the ground is covered with the debris of tops and branches forming fuel for a fierce fire and one which it is almost impossible to fight. The methods proposed for disposing of this debris is to have it piled and have it burned at a season when there is no danger of its spreading. Another method is to have the lower and upper branches of the top lopped so that the top will fall flat on the ground and rot away more quickly. This reduces the time of the danger by a few years, but until the tops rot it leaves a dangerous situation. On the whole the best method will be to pile the tops and burn them, and in Minnesota it has been found that this work can be done for 25 cents per thousand feet board measure. In Europe, all material produced by the forest is of value so that the question of the disposal of slash is not a difficult one there. It will be many years before that condition is reached in Canada.

In order to provide for replacing cut over forest by a new growth there are two main methods; one is to do the cutting so as to leave seed trees or groups of seed trees so that a supply of seed may be furnished for the reproduction of the trees. In Canada the natural reproduction is good, as a rule, and as the method of artificial reproduction is somewhat costly, the former method will be followed generally. However, in some cases the forest has been so depleted on lands that are non-agricultural that it is necessary to make arrangements for reforestation. Such a tract is that in the Spruce Woods Forest Reserve in Manitoba, and we have started a nursery there with the object of growing young trees and replanting the denuded areas from the nursery. The method used is that of establishing seed beds in the nurseries and transplanting the trees into the larger beds before they are finally ready to plant out in the forest at the age of about three years. When the trees have reached that age they are planted out in the place where they are to grow finally. In the western prairie district the trees are usually planted about four feet apart in order to give them as much protection as possible. Planting at this distance will mean that considerable thinning should be done at a later stage, and possibly by the time the trees have reached that stage thinning will be a commercial possibility. In many cases, however, the trees are planted as much as eight feet apart.

The whole object of the work that is being undertaken is to finally produce forests where there is a regular stand of clear timber producing a large quantity of wood regularly every year. The danger of not looking after the tree growth is in evidence on the bare and denuded mountain sides of many places in China where forests once flourished; on the bare, rocky hillsides in the Holy Land where a few small shrubs and grasses are gathered for fuel; and on the bare mountain sides of several districts in France where millions of dollars had to be spent for works to control the flow of torrential mountain streams and to replace the forests which have been destroyed by fire and close grazing.

The American Bar Association and the American Bankers' Association have each authorized special committees to co-operate with the management of the American Road Congress in the holding of sessions at Detroit to deal respectively with road legislation and the financing of road improvement. An effort will be made at the legislative session to bring about the formation through official channels of a national committee to codify State road laws and recommend simple and uniform legislation for each State and the elimination of the great accumulation of conflicting and confusing road laws. The finance section will endeavor to have adopted in all parts of the country simple and effective methods of road accounting and a record of such cost data as may be essential to the proper conduct of road work, and will also deal with the important subject of bond issues.

PREVENTION OF WASTE OF FLOWING OIL AND GAS.

METHODS for the prevention of the tremendous waste that usually accompanies the "coming in" of wells producing large quantities of oil or gas by natural flow fall naturally into two classes, preventive and remedial. The first have to do with keeping under control whatever gas or oil may be encountered in the process of drilling; the second relate to the capping or subduing of wells that have "gone wild." Both are dealt with fully in a bulletin prepared by R. Arnold and V. R. Garfias, and recently issued by the U.S. Bureau of Mines. Of these the preventive methods are likely to be of interest in the Canadian field, and are outlined here with that in view.

A few general conditions affecting flowing gas and oil wells are as follows:—

1. The gas from gas wells and the gas that generally accompanies the oil is not injurious to health, hence workmen may labor near the well without being harmed.

2. Owing to the usual tremendous velocity of the stream of gas, the part immediately over the casing head is like a smooth column, and may be approached with safety.

3. The sand usually expelled under tremendous force with the oil or gas often wears out the casings, but this wearing action generally takes place only throughout the uppermost 30 or 40 feet and opposite or near the place where the gas enters the well, thus leaving the main part of the entire length of the strings practically sound.

4. The great volume and tremendous pressure of the gas and oil make the use of the best fittings a necessity. Some of these, being of special sizes, are made to order.

For convenience, and in accordance with common usage, the flowing oil wells and the gas wells discussed herein are designated respectively as "gushers" and "gassers."

With the present state of our knowledge regarding the situation of the "gusher" and "gasses" strata in the developed fields, there is no excuse for the general lack of precautions taken before the depth is reached at which the flow is expected. Furthermore, if the well is being drilled in a new or prospective field, adequate precautions should be taken so as not to jeopardize in advance the possible profits of such an uncertain and expensive undertaking. The additional cost of the safety devices is insignificant in comparison with the total cost of drilling such wells and with the amount that can usually be saved if their rate of production is regulated. It may be safely stated that practically all of the great waste resulting from the unrestricted flow of gassers and gushers can be prevented easily by known means which generally are within reach.

Controlling the rate of production of the well has a direct bearing on the returns to be derived from the product. There are times when, owing to the market conditions and the transportation and storage facilities, the "bringing in" of the well might be an unwelcome event, as was strikingly shown in the case of the Lake View gusher. Experience also shows that a gasser or gusher will yield a greater total production if allowed to flow only a fraction of its capacity, the famous Huasteca No. 7 well in the Mexican oil fields affording a most remarkable example. This gusher has been flowing under perfect control for about 2½ years, yielding about 23,000 barrels per day under a pressure of about 285 pounds.

One of the most successful apparatus devised with a view to controlling whatever flow of oil or gas is encountered is the blow-out preventer, which has given general satisfaction, particularly in drilling by the rotary method.

Description of Apparatus.—The blow-out preventer is a modified type of a stuffing-box casing head, which in turn is an addition to the four-way **T**. The immediate object of the preventer is to control the flow of oil or gas between two strings of casing, and naturally its use is better adapted to drilling by the rotary method in which the circulating water keeps an open space between the inner casing and the wall of the hole. An idea of its operation may be gained by imagining a four-way **T** attached to the top of the last casing set or landed and the inner casing passing through the **T**, the flow of oil or gas between the casings being deflected to the lateral openings of the **T** by closing the annular space between the inner casing and the upper part of the **T** by means of a stuffing box. In the preventer the stuffing box can be removed or put in place by turning adjuster screws which operate slips provided with hydraulic packing that fit around the inner casing as an adaptable split valve. To the lower opening are bolted interchangeable screw flanges to fit standard casings from 6 to 12½ inches in diameter, and to the opposite opening are attached suitable guide plates to prevent the wearing of the inner parts of the apparatus by the revolving inner casing. These guide plates are made to fit casings from 8 to 2¼ inches in diameter. The lateral openings are threaded to fit pipe 6 inches in diameter. The apparatus is manufactured of cast steel and lined with babbitt metal, being tested to stand a pressure of about 2,000 pounds per square inch.

Mode of Operation.—To insure the successful operation of the preventer, careful attention must be given to all the details, such as welding the bars, fitting the small pins that secure the wrench to the screws, and providing a suitable place outside the derrick for the man who is to operate the wrenches, etc., as soon as the apparatus is put in place.

The preventer, when used, is always placed on the last string of casing set or landed, thus controlling the flow between that string and the drill pipe or casing that is being lowered. The slips should be in a position to be clamped around the drill pipe, but should not be kept too near it, in order to avoid possible damage to the hydraulic packing. If the well is being drilled with a rotary rig, the back-pressure valve inside the drill pipe will effectively prevent any flow upward through this casing, and if the standard rig is used, a heavy gate valve, which can be closed after removing the drilling tools, is placed on top of the inner casing. The only outlet left is the space between the casings, and the flow through this opening can generally be controlled by clamping the split valve of the preventer around the drill pipe and closing the gate valves on the pipes connected to the two lateral openings.

It sometimes becomes necessary to exclude from the drill hole water or gas found in an overlying sand in order to control the well or to recover or test the oil below. This end can be easily accomplished in drilling with a rotary rig by forcing muddy water to the bottom of the well through one of the lateral openings of the preventer, the pressure being regulated by closing the valve connected to the other opening. A back-pressure valve in the drill pipe will prevent the flow of the mixture through this casing. By drilling a short distance and forcing as much mud as possible into the porous sands penetrated, a

plastered wall of clay is built throughout the gas-bearing or water-bearing strata. After the entire thickness has been penetrated and the casing landed in an impervious bed, another string may be used to tap the oil sands below. The gas thus excluded can be recovered afterwards by drilling shallower wells to the upper sands.

This method can also be employed in drilling the entire thickness of a gas or oil sand under tremendous pressures, an operation that might otherwise prove troublesome. The mud can easily be removed by releasing the pressure or bailing down the water in the hole, a strainer or perforated casing being placed in the sand to prevent the wall of the well from caving when the pressure is released.

Testing of Supposed Oil or Gas Sands.—It is often advisable before drilling is continued to ascertain whether certain beds carry oil. The work involved is often accompanied by accidents and loss of time, as the material may collapse and pack around the casing, thus preventing its removal or further lowering. Many such accidents can be avoided and the required tests made by using a preventer or a stuffing-box casing head in the following manner.

After the preventer has been attached to the last casing set, a special shoe about 8 feet long is attached to the bottom of the inner casing, and this is lowered to the bottom of the hole and driven down into the formation, making a water-tight joint. The split valve of the preventer is then closed. A pump is connected to one of the lateral outlets, the valve on the other being kept closed to control the pressure in the well. Muddy water is then pumped in, and the pressure between the casings is increased in order that the formation will not cave in and "freeze" the inner casing. While the pressure is maintained the column of fluid in the inner casing is bailed out. This fluid being a representative sample of that which came from the formations passed through should show the presence of oil if any has been encountered. Great care should be exercised in bailing, as the casing may happen to be in such condition that it will not withstand the outside water pressure.

Precautions Against Fires.—Perhaps the greatest individual losses in connection with flowing oil and gas wells have been caused by conflagrations which in most instances could have been avoided by proper precautions. In such conflagrations the gas, owing to its lower flash point, is generally set on fire before the oil. Ignition may be caused by fires under boilers or in forges, by unprotected lamps, burning matches, or spontaneous combustion at the bearings of the calf wheel, bull wheel, headache post, or band wheel in the engine house. It is also claimed that the friction of pebbles striking each other or rubbing against the casing as they are expelled with great force with the gas or oil may cause sparks that will set on fire the more inflammable hydrocarbons. In certain oil fields fires caused by lightning are comparatively numerous.

The prevention of these fires depends on the proper control of the flow of gas and oil, the ventilation of the space immediately above and near the well so that no gas will accumulate, and the keeping of boiler fires, forges, lamps, burning matches, poorly insulated electric wires, etc., at such a distance or in such a position as to eliminate danger.

The most effective means employed for subduing gas or oil fires has been the use of steam discharged in great quantities and under high pressure against the lowest part of the flame. Well cappers have also been used successfully. Nature at times comes to the rescue by temporarily stopping the flow when the well "sands up." On the other hand, the flow may render human ingenuity powerless by destroying the casing and forming a veritable oil volcano, as was the case in Mexico with the famous Dos Bocas well.

UNITED STATES CEMENT PRODUCTION, 1912.

The United States Geological Survey will shortly issue a bulletin, "The Mineral Resources for 1912," which will contain the following data concerning the quantities and values of cement produced in that country during the past three years:—

Class.	1910. Quantity (barrels).	1910. Value.	1911. Quantity (barrels).	1911. Value.	1912. Quantity (barrels).	1912. Value.
Portland	76,549,951	$68,205,800	78,528,637	$66,248,817	82,438,096	$67,016,928
Natural	1,139,239	483,006	926,091	378,533	a 821,231	367,222
Puzzolan	95,951	63,286	93,230	77,786	a 91,864	77,363
Total	77,785,141	$68,752,092	79,547,958	$66,705,136	83,351,191	$67,461,513

a Shipments.

Prices.—According to reports made to the Geological Survey by the manufacturers, the average price by districts of Portland cement per barrel in 1912 in bulk at the mills ranged between 67.4 cents in the Lehigh district and $1.358 on the Pacific coast, as compared with 71.5 cents and $1.406 for the same districts in 1911. The average price for the whole country was 81.3 cents in 1912, as compared with 84.4 cents in 1911, a decrease of 3.1 cents a barrel. The average price in 1912 reached the same level as in 1909, and is the lowest point recorded for Portland cement. The lowest average price reported to the Survey was 62 cents a barrel, received at several plants in Pennsylvania, and much cement was sold as low as 65 cents, not only in the east, but in the middle west. The highest figure reported was $1.65 a barrel, reported by a California plant.

A subject which will be taken up at the contractors' session of the Road Congress, at Detroit, which should prove of special interest to road contractors is the "Protection and Upkeep of Road Equipment." An immense amount of money is lost through failure to protect and properly maintain costly road machinery and equipment. Another subject which will be presented by a trained specialist is the "Organization and Arrangement of Working Forces." It is quite a problem to place the road hands of a big force so as to avoid waste of time and money, and this subject should bring out much useful discussion. A special committee of three of the most prominent engineers and contractors identified with contract work, of which Mr. J. R. Wemlinger, secretary American Society of Engineering Contractors, is chairman, will have charge of the programme of the contractors' session.

FOUNDATION WORK ON C.P.R. BRIDGE AT MUD LAKE, ONTARIO.

THE Canadian Pacific Railway Company's low-grade freight line, now building between Toronto and Perth, Ont., crosses Mud Lake some 150 miles north-west of Toronto, and foundations for a single-track bridge at this place are now nearing completion. The bridge, when constructed, will have a length between the parapet walls of the abutments of 953 ft. 7½ ins., and an extreme height above rock foundations of 105 ft. Fig. 1 is a general diagrammatic sketch showing design. It will be supported upon four piers, two sets of pedestals of four each, for column support, and two abutments. The bridge site is some six miles from the railway station. This signifies that the entire plant as well as supplies has had to be transported over land by wagon over hilly country, and since the main plant, aside from such auxiliary plants as are ordinarily used on such work,

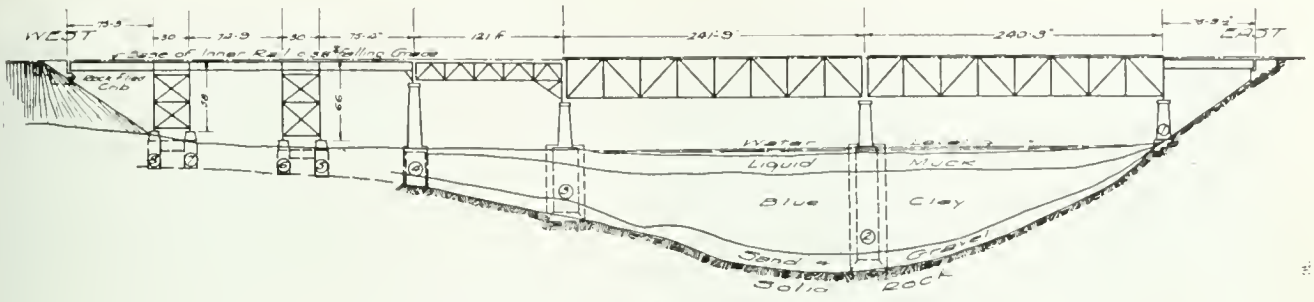


Fig. 1.—New Canadian Pacific Railway Bridge Over Mud Lake, Ont.

Fig. 2.—General View, Showing Piers No. 1, No. 3 and No. 4 Completed.

consisted of three 90-h.p. Loco boilers weighing some 20 tons each, and two air compressors of practically the same weight, the difficulty attending the installation of plant may be understood.

Geological Condition of Site.—Mud Lake lies in a pocket surrounded on three sides by high hills. It derives its name from semi-liquid ooze lying in a mass almost from the surface of the water to the hard-pan some 86 feet below it at the lowest point, which is where Pier No. 2 is located, presenting a formidable opposition to the sinking of caissons under air on account of its low bearing value both in friction and in compression, while in density it could well be classified as soft, blue clay. Despite all its depth of mud to be contended with, the route across Mud Lake chosen by the railway engineers presented to them fewer difficulties than an alternative location among the granite hills surrounding it; and besides, it enabled them to maintain that distinctive feature of the new route, i.e., its low-grade line.

Active work was begun late in March of this year and was continued night and day since then until the beginning of August.

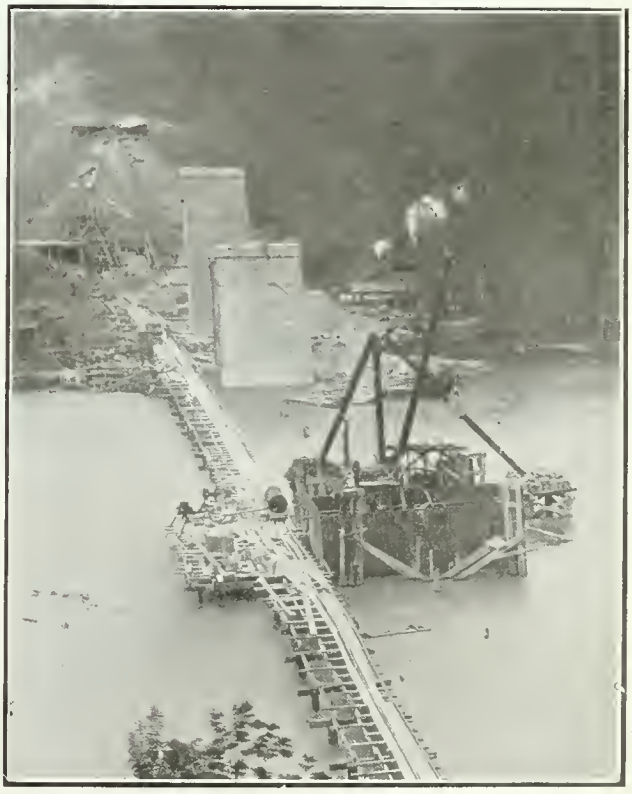


Fig. 3.—Caisson for Pier No. 2 Being Sunk.

Of the four piers, Nos. 2, 3 and 4 were sunk under air pressure; No. 2 to a depth of 103 feet 4 inches, No. 3 to a depth of 59 feet, and No. 4, 40 feet. Except for the last thirteen feet, which consisted of quicksand and

boulders running into hardpan, the materials which these piers replaced were liquid muck and solf, blue clay. The foundations for Pier No. 1 and pedestals Nos. 5, 6, 7 and 8 were sunk in open sheet-piling cofferdams.

All foundations and piers are being constructed on concrete in proportions of 1:2:4 and 1:3:5 and rest upon solid rock. Sand for the concrete is procured from a pit some two miles from the bridge site and is delivered by wagon. Stone is quarried and crushed at the bridge site.

The mixing plant consists of a one-yard steam mixer located near the west end of the bridge. The concrete is transported in dump buckets on cars over a track supported by a pile trestle reaching across the lake, and is handled into the work by means of stiff-leg derricks.

Figs. 2, 3 and 4 show general arrangement of plant, shore conditions, and progress of the work up to about three weeks ago. The massiveness of the concrete piers is well indicated.

The deepest of the two caissons sunk by pneumatic method, viz., Caisson No. 2 was 34 x 20 feet outside dimensions, provided with two dredging wells 8 ft. 8 in. by 9 ft. inside dimensions. Owing to the soft nature of the material and the despatch with which it was necessary to sink these caissons, they were sheeted and braced like an ordinary wood caisson with steel cutting edge, the walls of the working chambers being reinforced with rods. The elimination of forms thus enabled the sinking to be carried on continuously night and day.

After the caisson was dredged to a depth of 40 feet, it was deemed advisable to place the reinforced concrete deck, which was accomplished under water, being by no means an easy task, the remaining 63 feet being sunk under air. In this deck the shafting was embedded and carried to the surface above water level, on the top of which the air lock was placed.

Caisson No. 3 was the same size, only the depth being so much less makes description of its progress unnecessary.

Sinking a caisson to a depth of 103 feet 4 inches, as in the case of Pier No. 2, requiring a maximum air pressure of 47 lbs. to the square inch, is an undertaking that does not permit of methods other than those well tried and proven. Particular care was exercised for the safety of labor employed on the work. Only men with previous experience on caisson work were engaged. The time interval to which they were subjected to this excessive air pressure was forty-five minutes, and in spite of all precaution, careful attention and surgical aid, the "sand hogs" were not all the time immune from the "bends" and paralysis. A hospital lock was in commission at Mud Lake, and those afflicted during the sinking of the caissons were speedily treated by the usual air method.

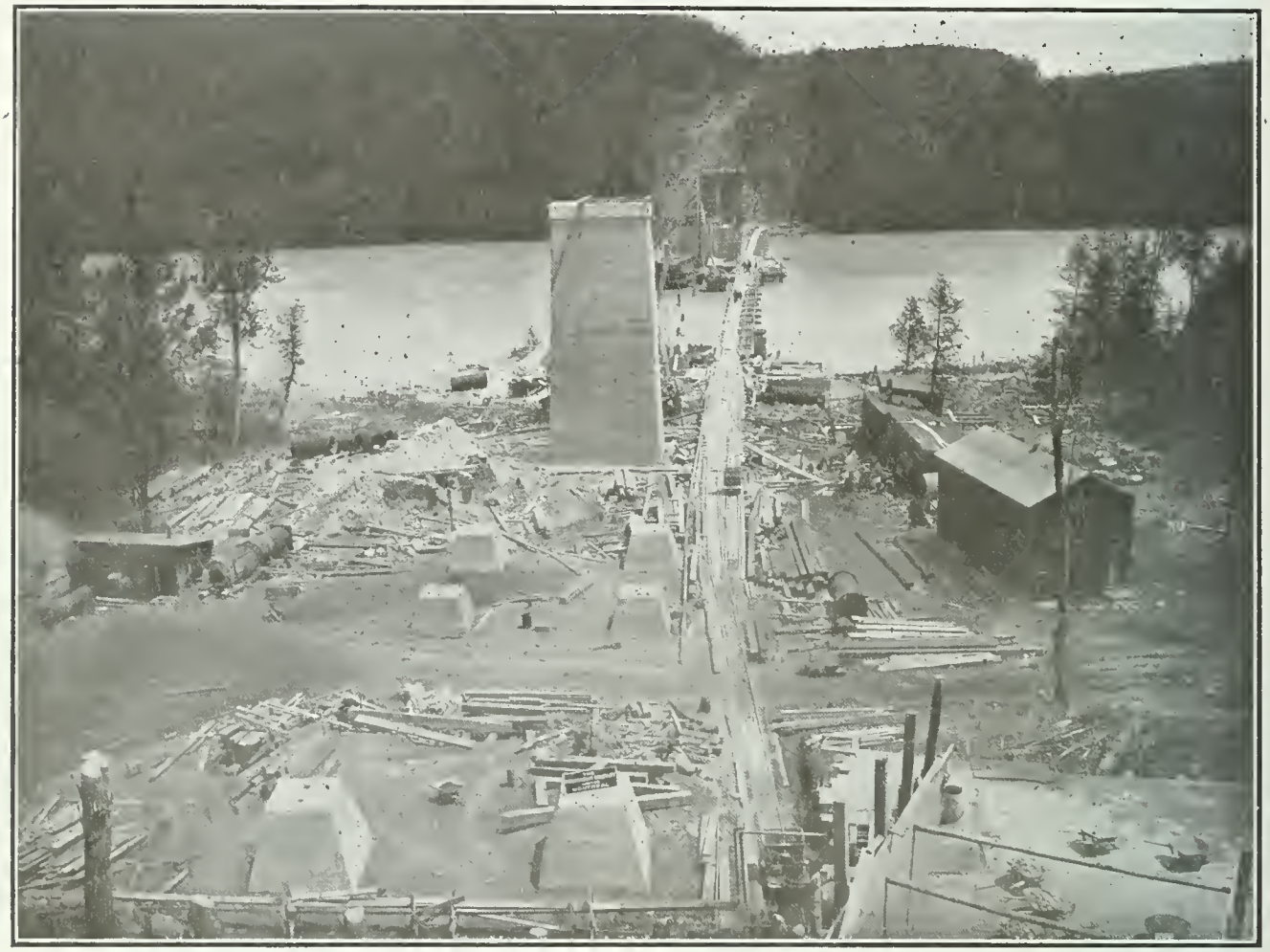


Fig. 4.—Bird's Eye View Looking East, Showing Pedestals for Steel Work, and Pier No. 4 in the Foreground.

The work at Mud Lake was carried out under the direction of C. W. P. Ramsay, Esq., engineer of construction, from design of P. B. Motley, Esq., engineer of bridges, for the Canadian Pacific Railway. The foundations for Mud Lake bridge were built by The Foundation Company, Limited, of Montreal and Vancouver, Mr. A. I. Campbell, superintendent.

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CONTENTS OF THIS ISSUE.

	PAGE
Editorial:	
Municipal Engineers and Employer	341
English for Engineers	342
Leading Articles:	
The New Welland Ship Canal	325
Monel Metal	328
The Determination of Internal Temperature in Concrete Arch Bridges	329
A Maintenance-of-Way Department Railroad Testing Plant	330
A Few Comparative Costs in Road and Pavement Work	333
Forest Development and Preservation	334
Preservation of Waste of Flowing Oil and Gas	337
Foundation Work on C.P.R. Bridge at Mud Lake, Ontario	339
Cuts in Newly-paved Streets	343
Mechanical Handling of Materials	345
The Boucanne River Viaduct	350
Coast to Coast	355
Personals	356
Coming Meetings	356
Railway Orders	75
Construction News	76
Market Conditions	92-94
Technical and Municipal Societies	94

MUNICIPAL ENGINEER AND EMPLOYER.

The uncalled-for subordination which some members of civic boards would like to see their engineers exhibit, is, to the unprejudiced and fair-minded observer, an apt illustration of the fact that engineering and its problems are but minor details, in comparison with other difficulties with which the municipal engineer is confronted. A case was recently cited in the Western press. It relates to the indignant tone of a committee meeting at which the engineer's report upon a certain phase of construction work was being read. A point, with which the engineer had apparently taken for granted that every member of the board was familiar, required further elucidation. The engineer being absent and efforts to locate him failing, an alderman abruptly declared that it was about time to call for the engineer's resignation, and for a general cleaning-up of his department (the latter being a favorite phrase among some aldermen).

Inquiry was rewarded by the information that the engineer had taken suddenly ill and was removed to a health resort. Prior to his departure his deputies were carefully instructed in the matter of their work during his absence, and the department was experiencing no cessation of activities as the result of his personal misfortune. With the promise of his medical adviser to acquaint the Board of Works of his necessary suspension of duties, the engineer had obeyed the strict instructions, thereby occasioning the debate already referred to, in which more than one alderman is quoted to have endorsed the statement, "If a man in his position (the engineer's) goes away without our instructions and without our knowing when he is coming back, it is about time to call for his resignation."

The scene changes. More recent press reports state that during the comparatively short period of twelve months, six working months of 1911 and 1912, this engineer has established a record in development and improvement work in that city which has not been equalled in any other Canadian city, his record including over 32 miles of block pavement, over 56 miles of sewers, about 95 miles of cement sidewalks, some 74 to 80 miles of streets cleared and rough-graded, 30 to 40 miles of rocking, and about 90 miles of water mains, the aggregate cost of this gigantic achievement being in the neighborhood of $8,000,000. In addition to this successful endeavor, through bringing down recommendations for greater yardages of pavements than had hitherto been attempted, and thereby inducing keener competition, he saved the city something like $130,000, as compared with the cost of the pavements which had previously been put down.

The engineer was not fired, thanks to the discrepancies in the point-carrying ability of some individuals, but his discharge was under consideration without an appearance of good grounds.

The case is just another example of the absolute lack on the part of civic councils of the elementary principles of fairness in dealing with municipal officials. Other examples have been previously given in *The Canadian Engineer*. Each example endorses the opinion that city councils have outgrown their usefulness, that the qualifications which bring about the election of many of the members are far removed from those of knowledge and ability which the responsibilities of their positions warrant, and that so long as the present method of election is entertained, these governing bodies will not measure up to a much higher standard than the one that is being

referred to here. As already mentioned time and again in this journal, the trouble lies in the city councils and the remedy is there also.

It is against such contingencies as these that some municipal engineers are obliged to carry on a single-handed strife. It is very doubtful whether the existence and powers of a professional association on their behalf, to whose consideration they might refer such occurrences as these, would have much weight, considering the idiosyncrasies of many members of present-day municipal governing bodies.

ENGLISH FOR ENGINEERS.

Much has been written at one time and another about the utility of English as part of the engineering curriculum. *The Canadian Engineer* has always held that there is a need for some training for engineers along this line, in addition to that which the high school course supplies. Perhaps this need could not be better summed up than in the following paragraph, which we take the liberty of quoting from an article by Benjamin P. Kurtz in the California Journal of Technology:

"When facts of iron and steel, of girders and trusses, are turned into a written report, they are presented no longer in their own tangible, objective medium or material, but in the new and subjective medium of words. Now, in the first place, it is to be noted that in this passage from the realm of objective reality to written representation there is ever present the dangerous chance of deflection of facts and even of their actual transformation—in a word, the danger of error. This, merely because of the sudden transition to a new and unaccustomed medium. More narrowly regarded, however, the difficulty arising here is that of accuracy of statement plus the adaptation of technical facts and information to the laws and economy of mental attention. In order to gain and hold the attention of the reader, in order to present facts in such fashion that they may be easily and thoroughly understood, and that the general proposition may be seen to be supported at every point by its details, so that there is the mutual proof of a complete harmony between parts and the whole—in order to accomplish this successful communication with another mind, it at once becomes necessary to marshal the objective facts or material in such fashion that they will find a ready, orderly and emphatic entrance into the mind of the reader. Facts without grouping dissipate the attention; poor grouping, overlapping division, insufficiently marked separation confuse the attention; diffuse, wandering connections weary the attention; neglect to distinguish between division and implication, or between fact and hypothesis, muddle the conception of the reader; tortuous and nebulous sentences befog the conception of the writer; insufficient recognition of the necessity of exemplification and illustration, and ignorance of their difference, leave the reader too much to do or undo; the very lack of knowledge of what constitutes a definition, and of the fundamental methods of expanding a logical definition, lay the entire argument open to objection or render its outlines amorphous. In two words, the necessity of being understood, not the achievement of truth; the necessity of presenting groups of facts in accordance with the habits of trained thought-attention, not the accuracy of turning one fact into one phase;—this is that new labor and skill required of the technician when he expounds his facts and thoughts to other minds in the medium of words."

This very clearly states the newer conditions to be met. We regret that the value of what Mr. Kurtz calls "expository composition" has not been as fully recognized by the engineering faculties of some of our universities as to provide for a course in English of as great a length as can reasonably be expected in their already-crowded curriculums.

CANADIAN PUBLIC HEALTH ASSOCIATION.

The third annual congress of the Canadian Public Health Association will be held in Regina, Sask., on September 18th, 19th and 20, 1913.

The following papers will be presented at the sectional meeting of engineers and architects, of which Mr. L. A. Thornton, B.A., B.Sc., city commissioner of Regina, is chairman:—

(a) "Municipal Loans and Municipal Works," R. O. Wynne-Roberts, M. Inst. C.E., M. Can. Soc. C.E., consulting engineer, Regina.

(b) "Hygiene of School Buildings," J. H. Puntin, L.R., I.B.A., architect to the Regina School Board.

(c) "Results of Water Filtration at Saskatoon," Geo. T. Clark, B.A., A. M. Can. Soc. C.E., city engineer, Saskatoon.

(d) "Sanitary Surveys of Rivers," J. R. Malek, C.E., assistant sanitary engineer, Bureau of Public Health, Regina.

(e) "Sunlight in Cities," Theo. Brockmann, Dipl. Ingr. (Berlin), city engineer's office, Regina.

(f) "The Effect of Water Filtration—Biological and Chemical," H. W. Cowan, C.E., Toronto.

(g) Paper—title to be announced later—J. Antonisen, C.E., superintendent, Brandon Municipal Railway.

(h) "Canadian Conditions Affecting the Design, Construction and Operation of Sewage Disposal Works," R. H. Murray, A. M. Inst. C.E., A. M. Can. Soc. C.E., resident sanitary engineer, Bureau of Public Health, Regina.

In addition to the above, the following papers of particular interest to engineers will be presented at the general sessions:—

"The Smoke Problem," R. N. Blackburn, Wh.Sch., chief inspector of steam boilers for Saskatchewan.

"Standards With Reference to Sewage Treatment," T. Aird Murray, M. Can. Soc. C.E., consulting engineer, Toronto, Ont.

Engineers and public health officials intending to be present at the congress should notify the local secretary, R. H. Murray, C.E., Bureau of Public Health, Regina.

LETTER TO THE EDITOR.

A Question of Stability.

Sir,—The following account of how a large brick arch is standing at the present time, with parts of its abutments entirely cut away, is a very good illustration of the remark once made by a great engineer who, in response to a query as to why a certain structure stood up replied, "By the grace of God and the force of habit,"

and for this, if for no other reason, the following description should be of interest to all engineers and contractors.

Extensive alterations are being made to a church situated on the west side of the city of New York. These alterations, in so far as they have been carried out up to the present time, consist in entirely wrecking one wing of the church, in order to make way for a new addition. The wrecked wing was separated from the main body of the church by a 28-inch brick bearing-wall, which has been left in position, except as hereinafter described. Communication between the two parts of the edifice through this wall was by means of a large opening about 18 feet wide, spanned by a four-rowlock brick arch. This arch not only carries the 28-inch wall extending for about 15 feet above the crown of the arch, but also carries a small portion of the roof of the main part of the church.

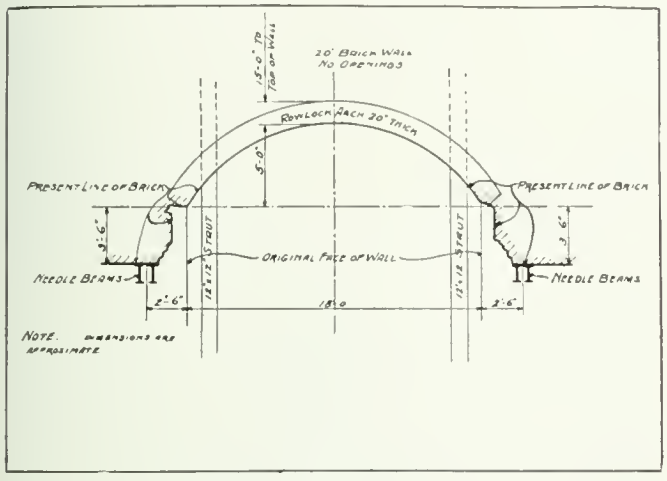


Fig. 1.

Part of the new work to be installed consists in placing steel columns in this wall, and in order to do this, the contractor has braced up part of the roof of the main building resting on the arch with long 12-in. by 12-in. strut timbers extending to the main floor of the church, has run needle beams through the wall at various points, two sets of which are shown in Fig. 1, and then has cut away the wall under the needle beams, and also under the ends of the brick arch. In Fig. 1, the original face of the wall is indicated, and the present line of the brickwork shown in a heavy line.

Why this arch stands, is something of a mystery, but the explanation, as far as any can be given, is as follows: The brickwork above the arch is acting as a false arch and, aided by the temporary struts supporting the roof, is carrying the load above, the true arch really being supported by this false arch, and the bricks of the arch are held in position solely by the adhesion of the mortar. It is a question in the writer's mind how far such a risk should be taken, with a span of this size, even with first-class brickwork. He strongly condemns this particular case, and, indeed, expects any day to pass by and find this arch in ruins. It is such work as this that, when a failure occurs, brings engineers and engineering into disrepute, although if the facts were known, it would probably be found that no engineer had anything whatever to do with this particular piece of work.

J. H. GANDOLFO,
Assoc. M. Am. Soc. C.E.

New York City, August 7, 1913.

CUTS IN NEWLY PAVED STREETS.

By James E. Barlow,
Assistant City Engineer, Cincinnati, Ohio.

THIS paper appears in the Proceedings of the American Road Builders' Association, and deals with the problem of underground services with which all cities have to contend. A cross section of a downtown city street shows car tracks, electric ducts, telephone conduits, water mains, gas mains, sewers, etc., and, of course, leading from these to the different buildings, are the necessary service branches. These all constitute a network which honeycombs pavement foundations, and it is the repair, renewal and extension of these which give rise to the problem which forms the subject of Mr. Barlow's paper.

It is a matter of common observation that an opening repaired is never as good as the original undisturbed pavement. In addition to the general disturbance of the subsoil there is usually left a slight hummock or a slight depression in the pavement which the pounding of traffic accentuates, causing a more or less endless chain of repairs. Eminent authorities have estimated that in some cities the useful life of the pavement is decreased 25 per cent. by these cuts. The reduction in the life of the pavement in a city such as Cincinnati is probably not as great as this, but nevertheless, the damage is very real. Some idea of this damage in dollars and cents may be had when one realizes that the cost of pavements, including maintenance, interest and renewals in a modern city like Cincinnati, exceeds $2,000,000 per year, i.e., if our pavements were laid and maintained by a public service corporation, a fair annual rental would exceed the figure mentioned. Now, aside from shortening the life of the pavement, these openings cause danger and annoyance to traffic, wear and tear to vehicles; they render cleaning more difficult, they are unsightly in themselves until repaired and they are costly to restore and they later become the source of additional repairs. Thus the importance of properly controlling such openings and reducing them to a minimum is really seen.

As a complete solution of this problem some have suggested subways or pipe galleries under the streets with laterals to property lines. Others have suggested subways under the sidewalks, necessitating double lines of mains. However, the investments tied up in the present form of underground construction, the enormous expense necessary for subways and the fact that much of the sidewalk space where subways are most needed is used privately for buildings as areaways, all tend to throw this solution, for most cities, into the somewhat distant future. The problem thus becomes one of best controlling the present cuts and reducing the number to a minimum.

When a street is to be improved notices of the two final steps in the legislation are sent to all the public service corporations, and again when bids are received, and again when the contractor is ordered to begin work. The object of these notices, of course, is to keep the companies informed of the status of the proposed improvement and allow them ample time to plan repairs, renewals or extensions. At the outset, however, it may as well be admitted that the franchises of these local public service corporations are such that we have little or no control over what they shall do along these lines.

As an additional lever, early this year a city ordinance was passed which virtually prevents any opening in a

newly laid pavement for a period of three years, except in regular emergencies. Notices calling attention to this ordinance are sent to all public service corporations and to property holders about three months before the actual work of construction begins.

The topography of Cincinnati is such that often the heavy cuts and fills practically prohibit the laying of mains until the street is graded. On all contacts now let, if the street does not already contain water and sewer mains, they are included in the street improvement contract. We only wish we might include gas in the same way.

To prevent, in so far as possible, openings for house connections, we are now serving notices on all property owners along a proposed improvement to make water and sewer connections to their lots, whether occupied or vacant. If these are not made in 20 days, the city makes such connections to the curb line and assesses the cost thereof against the individual property. This calls forth considerable objection, but it must be borne in mind that half the owners gladly make all connections and it is only just, that we should take such steps to prevent the other half from damaging the pavement.

The preceding may all be classed as preventive measures. There is also to be considered the proper control and restoration of the necessary openings.

An important step in an intelligent control of street openings is to know what you have under the pavements and where these structures are. This primary information is not always in the hands of cities. In connection with an investigation for a comprehensive sewer layout, a complete underground survey is being made to locate all of the subsurface structures. These plots will be made on a scale of 40 and 50 ft. to the inch. There will be possibly 1,000 sheets, 24 by 34 ins., in the complete set. When compiled these will be kept up-to-date as a basis for our underground records and we can then more intelligently direct future underground construction.

There is, of course, also to be considered the actual making of the restorations. Several years ago a city ordinance was passed making it unlawful for any person other than the street repair department to open any pavement without a permit therefor. This ordinance further provided that the application for this permit should state the location and size of the opening and the kind of pavement. Before the permit is issued a deposit is required, based on the published sliding scale of prices for the restoration of different sized openings in the various kinds of pavements. No persons other than the employees of the street repair department are allowed to permanently restore these openings.

The party making the opening does the backfilling and makes a temporary restoration of the pavement; if the backfilling is not properly done the street repair department does it over and bills it to the party responsible.

The street repair department handles the issuing of all permits and, of course, makes all rules in accordance with which such openings can be made. The control of the openings and the responsibility for their speedy and adequate restoration is thus centralized.

This outlines the principal steps taken here to control street openings. Some of these measures cause much friction and delay, especially those involving serving of legal notices which require definite periods of time before action can be taken. However, it is felt that the end justifies the means.

SIXTY-TON ELECTRIC CANTILEVER CRANE.

A large cantilever crane constructed for loading blocks for building the harbor at Valparaiso was described in a recent issue of Engineering (London). The crane lifts the full load of 60 tons at 52 ft. from the centre of the crane, and is intended for raising the blocks from the railway trucks and transporting them to a barge lying alongside the jetty. The load is carried on a travelling jenny, and the machine is fitted with three independent lifts—viz., one lift for the maximum load of 60 tons operated by a 40-brake-horse-power motor, and two separate lifting motions, each capable of dealing with loads of 7½ tons, and operated by two 20-brake-horse-power motors. This arrangement was fitted so that the crane could deal with tipping-skips, the intention being that the skip and its contents, weighing 15 tons, might be lifted by the two 7½-ton motions operating synchronously and tipped as desired by working them separately, each lift being fitted with an independent brake. The lifting barrels are capable of coiling sufficient rope to allow the hook to descend 25 ft. below the quay level. All the gear wheels, with the exception of the large barrel-wheel and pinion, are machine-cut from the solid. For the heavy lift there is a powerful solenoid brake, as well as rheostatic brakes, and a mechanical emergency brake is also fitted. The auxiliary brakes are fitted with both solenoid brakes and rheostatic brakes, and there is also a solenoid brake fitted to the reversing motion.

PEAT POWDER AS FUEL FOR LOCOMOTIVES.

A consular report announces that a Swedish engineer, has perfected a process for utilizing peat powder as fuel for locomotives. The news has awakened interest in the possibility of developing the extensive peat bogs of Sweden.

The powder is manufactured by the Ekelund process. A factory has been in operation for several years in Sweden, under the management of the inventor of the powder process. It does not appear that the Ekelund process has made much headway as yet, but it is now predicted that in connection with the new discovery, the use of peat powder will in time become extensive.

In this system the peat powder is fed by an automatic process into the furnace of the locomotive, which is especially arranged to consume it. The Ekelund process is on the market in various countries, including the United States, but little has been made public concerning the new method. According to Mr. Von Porat, the inventor, the results obtained with peat powder may be summed up as follows:—

Substantially the same results can be had from 1½ tons of peat powder that one ton of coal will produce. Peat powder may be burned with an admixture of about 5 per cent. of coal. As to firing with peat powder, the work is almost nothing in comparison with firing with coal, because the powder is forced into the furnace by automatic process. No change had to be made in the boiler and none in the firebox, except installing the special apparatus. There is no difficulty in bringing the powder from the tender to the firebox, as it passes through a conveyance pipe. Another advantage in using peat powder is that no cold air can get into the firebox and neither smoke nor sparks escape from the smoke-stack.

As a result of engineer Von Porat's invention, it is reported that a number of the Swedish railways are preparing to use peat powder instead of coal.

MECHANICAL HANDLING OF MATERIALS

CLASSIFICATION OF APPARATUS — FLIGHT CONVEYERS — THE FIRST OF A SERIES OF ARTICLES ON INSTALLATION, MAINTENANCE AND OPERATION OF CONVEYING MACHINERY.

By REGINALD TRAUTSCHOLD, M.E.

CONVEYING and elevating machinery, though indispensable in almost any modern industrial operation or enterprise, is of comparatively recent development; the manufacture of such apparatus not commencing much before the beginning of the last quarter of the nineteenth century. To-day, fuel for the power house, the disposal of ashes, the handling of materials in cement mills and of ores at the mines and smelters, etc., raw materials to and through mills and factories, the handling of finished products, distribution of merchandise, dredging and excavating operations of all kinds, etc., etc., all require some kind of conveyer or elevator if such operations are to be performed with the economy and efficiency demanded by modern conditions. Though apparatus for the mechanical handling of materials is comparatively new, much progress has been made in this branch during the past twenty years or so and the requirements for power, capacity, etc., and the cost of operation, of equipment, etc., are now pretty well standardized, and it will be the aim of this discussion to describe the more common types of conveying and elevating machinery with such data as will permit a conservative and reliable opinion to be formed as to the economic value of each class of apparatus. Tables, charts and formulæ will be interposed wherever practical and illustrations of typical installations inserted throughout the text. The tables and charts, giving costs of apparatus, operation, maintenance, etc., will be conservative and refer to *good practice* in the Dominion. Their reliability will therefore depend on the proper care and attention to all machinery, for the results attainable can only be realized with apparatus that is not subject to abuse or neglect.

Conveying machinery may for convenience be distinguished from elevating machinery by considering the first to include all apparatus for carrying material along a horizontal plane or raising it from one plane to another through a comparatively gradual incline, and the second all apparatus that elevates material in a vertical plane or raises it through a comparatively steep incline. Naturally these two classes cannot be rigidly adhered to for much machinery for the mechanical handling of materials performs both operations of conveying and elevating. However, the division will facilitate a comprehensive discussion. Conveying machinery may be again subdivided into three general classes: 1st, apparatus that pushes or pulls the load, the moving parts not carrying the weight of the load; 2nd, apparatus that carries the load on moving parts; and 3rd, conveyers which depend for their operation on other than mechanical forces. Elevating machinery is classified in only the two last subdivisions for elevating operations by apparatus that drags or pushes the load are performed by conveyers at comparatively slight inclination, pumps not being considered in this discussion of mechanical handling of materials.

Flight (Scraper) Conveyers.—The oldest type of conveyer and one that is in common use to-day, in somewhat modernized form, consists of an endless chain to which are attached at intervals plates, or flights, which scrape the material handled along a trough in which are gates through which the load is discharged where desired. These conveyers may have simply one chain attached at the centre of the flight or else have two chains, one attached to each end of the flight. In the latter type of flight conveyer—double chain conveyer—the flights are usually equipped with wearing shoes that slide along guides on the sides of the conveyer and carry the weight of the moving parts preventing the flights themselves from coming in contact with and dragging along the trough, or else the flights are furnished with small wheels, or rollers, that run on rails or guides on the sides of the trough and perform the same functions as the shoes in the cruder type. Naturally the roller flight conveyer consumes rather less power than does a shoe flight conveyer under similar service, but the roller flight conveyer is somewhat more expensive. The balance of apparatus required for a flight conveyer consists simply of the trough, which is usually of steel, or some other material that will resist abrasive wear or of wood lined with a suitable wear-resisting metal; sprockets over which the conveyer chain runs; suitable driving mechanism, consisting usually of a system of gears by means of which the speed of the power unit is reduced to the proper amount; the gates and chutes through which the material is discharged from the conveyer, and chutes for loading the conveyer.

Three conditions govern the capacity of flight conveyers—the weight of the material to be conveyed being neglected—1st, the speed at which the conveyer is run; 2nd, the area of the flights presented against the material dragged along the trough; and 3rd, the distance between flights (intervals). The advisable speed of conveyer depends largely upon the nature of the material to be conveyed and may be anywhere from 100 to 200 feet per minute. The flights are usually rectangular in shape with a length (slightly less than the width of the trough) about three times as great as their width (the dimension at right angles to the plane of the trough) and are spaced from one to two feet apart. Two other conditions effect the capacity of this type of conveyer, however, which depend upon the nature of the material conveyed more than upon the conveyer itself. They are, the weight of the material and its angle of repose. The first effects the capacity of the conveyer directly; that is, the capacity of a given conveyer at a given speed varies directly with the weight of the material handled. The second condition has little effect on horizontal conveyers—the angle of repose of the average class of material handled by flight conveyers not varying to any very great extent—but does effect the capacity of inclined conveyers. For all practical purposes, however, the reduction in capacity of an inclined flight conveyer depends directly upon the inclination of the conveyer. For instance, the capacity of a flight conveyer inclined 10 degrees to the horizontal is but about 80 per cent. of that of a similar horizontal conveyer; a conveyer inclined 20 degrees, about 66 per cent.; while a flight con-

veyer, inclined 30 degrees to the horizontal, about the limiting inclination for such a conveyer, would have a capacity about one-half as great as that of a conveyer running in a horizontal plane. Flight conveyers carrying a load from one elevation to a lower one has increased carrying capacity, the limit being that point at which the angle of repose of the material is equal to the angle of declination. These latter conveyers, those running down hill, are so rare, however, that they may be overlooked in this discussion, any such installation being quite special and presenting a distinct engineering problem. Flight conveyers, though depending directly upon the weight of the material handled for their capacity, should not always be run at the same speed nor is there any other rule but experience for ascertaining the most advisable speed of conveyer. Efficient speeds for certain materials handled by this type of conveyer are given in Table I., together with the average weight of such materials per cubic foot. Table II. gives the capacity of some of the common sizes (width x length of flights) of horizontal flight conveyers carrying material weighing 100 pounds per cubic foot at a speed of 100 feet per minute, conveyer being uniformly and continuously loaded. The capacity of similar conveyers carrying material of other weight and at different speed varies directly with both the weight and speed. For instance, a conveyer carrying material weighing 50 pounds per cubic foot at a speed of 200 feet per minute would have a capacity the same at that given in Table II., conveyer handling material weighing 100 pounds at a speed of 100 feet per minute. Inclined conveyers have their capacity reduced from 1⅔ to 2 per cent. for each degree of angle of inclination. The approximate capacity of any flight conveyer may also be ascertained through the use of formulæ. (See Formulæ I. and II.).

Table I.—Economic Speeds of Flight Conveyers for Various Materials.

Material	Weight per cubic foot	Advisable Speed
Coke	32 to 35 pounds	100 ft. per min.
Broken Stone (course)	160 to 170 pounds	125 "
Lump Coal—R/M	50 to 60 pounds	125 "
Ashes	About 45 pounds	150 "
Lime and Cement	50 to 80 pounds	150 "
Ore	About 125 pounds	175 "
Crushed Stone	150 to 170 pounds	175 "
Sand and Gravel	100 to 120 pounds	175 "
Fine Coal	About 50 pounds	200 "

Table II.—Capacity of Flight or Scraper Conveyers.

Horizontal Conveyers.

Capacity in tons per hour at a conveyer speed of 100 feet per minute. Material weighing 100 pounds per cubic foot.

Size of Flights	Flights Spaced			
	12"	16"	18"	24"
4" x 10"	90	67	60	45
4" x 12"	114	85	76	57
5" x 12"	138	103	92	69
5" x 15"	186	139	124	93
6" x 18"	240	180	160	120
8" x 18"	360	270	240	180
8" x 20"	420	315	280	210
8" x 24"	540	405	360	270

$$W_h = \frac{0.0002443\ AVw'}{S} \qquad \text{Formula I.}$$

$$W_i = W_h - \frac{0.016285\ L'W_h}{S} \qquad \text{Formula II.}$$

Where:—

W_h = Weight of maximum load in tons per hour—Horizontal Conveyer.

W_i = Weight of maximum load in tons per hour—Inclined Conveyer.

V = Velocity (speed) of Conveyer in feet per minute.

A = Area of Flights in square inches (width x length).

S = Spacing of Flights (intervals) in feet.

W' = Weight of material conveyed in pounds per cubic foot.

L' = Inclination of Conveyer in degrees—Inclined Conveyer.

The consumption of power in running a flight conveyer or any other similar piece of mechanism may be divided into that required to run the conveyer itself and that required to drag the load. In the case of flight conveyers, however, the latter operation is so much more severe that the power required to run the empty conveyer is but a comparatively small percentage of that required to run one fully loaded. The power required for moving the load depends upon the load handled and is relatively so great, compared with the requirements of the unloaded conveyer, that the latter may be taken, for all practical purposes, as also depending upon the load handled. This simplification of the power question has led certain manufacturers of such equipment customarily to figure the power requirements of conveyers with shoe flights and those with roller flights as identical. These two refinements of the old-fashioned drag conveyer have considerably reduced the power consumption of such conveyers, one to an appreciably greater extent than the other, however, and this fact is taken into account in the derivation of the following formula for ascertaining the horse-power required properly to drive a flight conveyer that is continuously and uniformly loaded—Formula III. Conveyers without shoe or roller flights are now limited to small sizes and to those that are relatively short, so that, while Formula III. is not exactly applicable to such conveyers, the error (lack of power) is so slight that the formula may be used by making an allowance of small percentage in cases of conveyers without the refinements of shoes or rollers. In fact, the choice of the power unit depends so largely upon the sizes of standard motors, engines, etc., that the most convenient size of power unit has usually an abundance of power to care for the slight error. For instance, a conveyer requiring 8½ horse-power would probably be equipped with a 10 horse-power motor which would have a capacity more than sufficient to care for any additional power required. The use of Chart I., which of necessity cannot be read as accurately as the results attainable by the use of the formula, will obviate the necessity of making any such corrections, the chart readings being sufficiently conservative to cover any small error.

Horsepower:—

W = Weight of load conveyed in tons per hour.

V = Velocity (speed) of Conveyer in feet per minute.

H = Height to which load is elevated in feet.

W_c = Weight of moving parts of Conveyer in pounds per foot. (average) = 0.74 W—Conveyers with shoe flights.
0.92 W—Conveyers with roller flights.

W' = Weight of load conveyed per minute per foot in pounds $= \frac{33W}{V}$

f_s = Speed factor = 0.18—from experiment—shoe flights.
= 0.09—from experiment—roller flights.

f_l = Load factor = 0.7—from experiment.

Horsepower required to run Conveyer empty.

$$HP = \frac{\left.\begin{matrix}0.74\ W\\0.92\ W\end{matrix}\right\} \times \frac{33W}{V} \times \left.\begin{matrix}0.18\\0.09\end{matrix}\right\} \times V \times L}{33000}$$

$$= \frac{0.1332\ WL}{1000}$$ (Conveyers with shoe flights.)

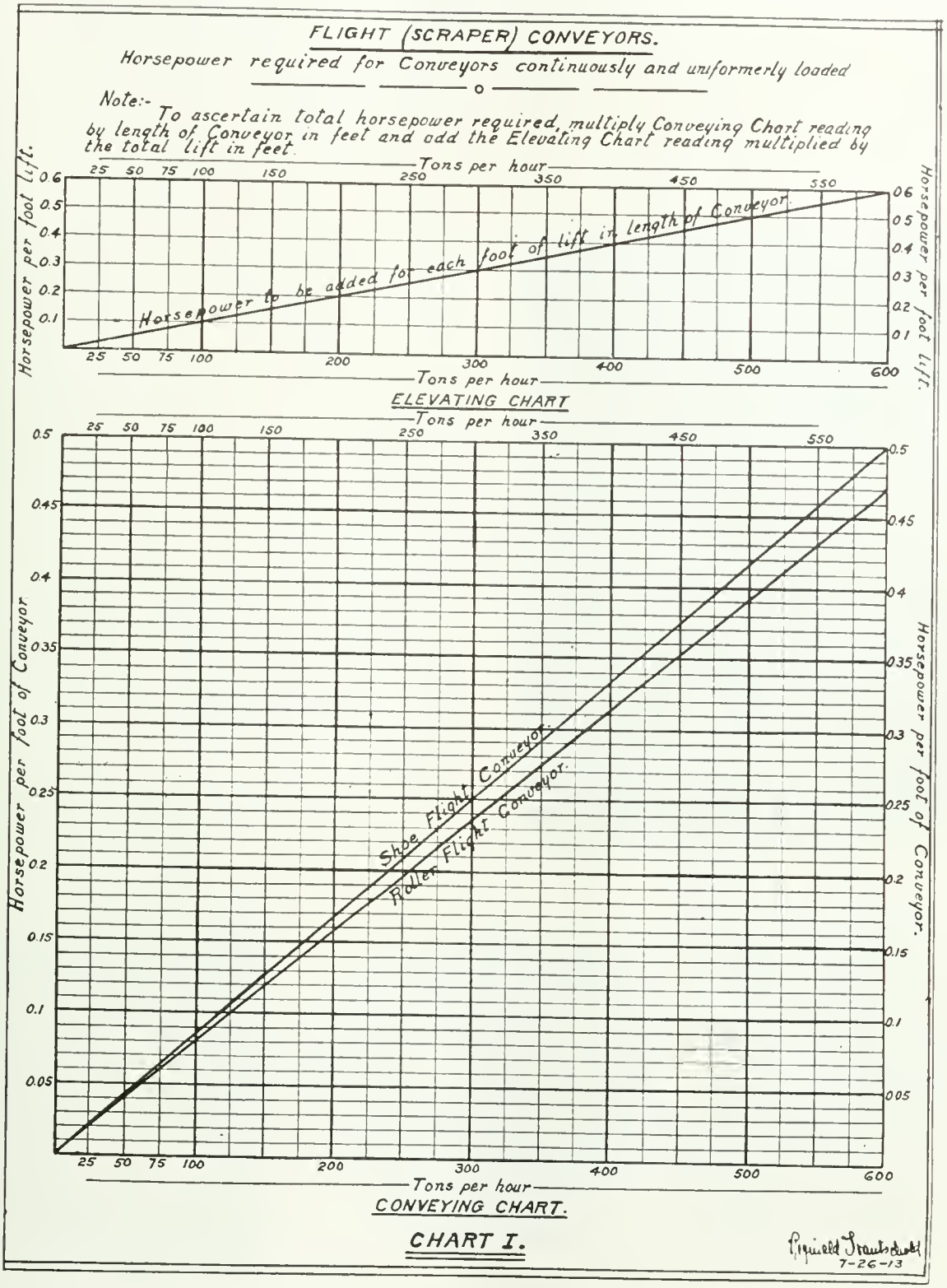
$$= \frac{0.0828\ WL}{1000}$$ (Conveyers with roller flights.)

Total horsepower required.

$$HP = \frac{C\ WL}{1000} + \frac{WH}{1000}$$ Formula III.

Where:—

C = Constant = 0.8332—Conveyers with shoe flights.
= 0.7828—Conveyers with roller flights.


FLIGHT (SCRAPER) CONVEYORS.
Horsepower required for Conveyors continuously and uniformerly loaded
Note:- To ascertain total horsepower required, multiply Conveying Chart reading by length of Conveyor in feet and add the Elevating Chart reading multiplied by the total lift in feet.
Horsepower per foot lift.
Tons per hour
25 50 75 100 150 250 350 450 550
0.6 0.5 0.4 0.3 0.2 0.1
Horsepower to be added for each foot of lift in length of Conveyor.
25 50 75 100 200 300 400 500 600
Tons per hour
ELEVATING CHART
Horsepower per foot of Conveyor
Tons per hour
25 50 75 100 150 250 350 450 550
0.5 0.45 0.4 0.35 0.3 0.25 0.2 0.15 0.1 0.05
Shoe Flight Conveyor.
Roller Flight Conveyor.
25 50 75 100 200 300 400 500 600
Tons per hour
CONVEYING CHART.
CHART I.
Reginald Trautschold
7-26-13

Horsepower required to convey load.

$$HP = \frac{W \times 0.7 \times V \times L}{33000} = \frac{0.7\ WL}{1000}$$

Horsepower required to elevate load.

$$HP = \frac{W \times V \times H}{33000} = \frac{WH}{1000}$$

As the total weight of a well designed and proportioned flight conveyer bears a close relationship to its capacity, and as the cost of such a conveyer also varies nearly directly with the weight of the apparatus, it is possible to form a very close approximation of the cost of the ordinary flight conveyer in terms of its capacity; that

is, in terms of size and length of conveyer. The area of the flights governs largely the capacity of any flight conveyer, the strength of the chains required, sizes of sprockets, power of drive, etc., and consequently governs the cost of these component parts. The load handled by a particular size of conveyer naturally has some bearing on the strength of the individual parts, etc., but not so much as would be supposed; standardization of apparatus and economies of manufacture fixing pretty closely the size of chain, weight of flights, thickness of trough, etc., for any conveyer of particular size, irrespective of the actual requirements for strength. Hence, a formula that is applicable to nearly every installation of flight conveyers, giving results that may be considered as accurate

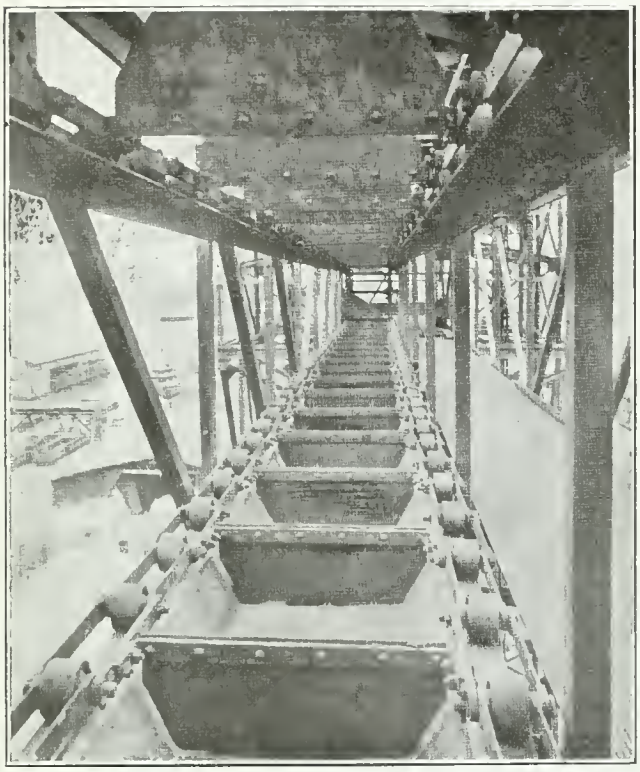


Fig. 1.—100-ton-per-hour Flight Conveyer, 360 Feet in Length, Used by the Philadelphia Rapid Transit Co.

for figuring the cost of operation of such equipment, may be derived which will give approximately accurate results for the cost of equipment, expressed in terms of size and length of conveyer—such a formula follows—Formula IV.

Cost of Equipment.

C = Cost of Flight Conveyer in dollars.
A = Area of flights in square inches—width x length.
L = Length of Conveyer in feet.

SINGLE CHAIN CONVEYER

Average cost of chains	$0.00066\ AL$
flights (roller) ..	$(0.00568\ A+3.0)L$
(shoe)....	$(0.00568\ A+1.5)L$
sprockets, drive, &c.	$6.0\sqrt{A}$
trough and rails, &c.	$(0.0413\sqrt{A}+0.0039\ A)L$
gates, &c.	$(0.01033\sqrt{A}+0.00089\ A)L$

ADDITIONAL—DOUBLE CHAIN CONVEYER

Chain Attachments, &c.	$0.000163\ AL$
Sprockets, &c.	$1.0\sqrt{A}$

Then :—

$$C = (DA+0.05163\sqrt{A}+E)L+F\sqrt{A} \qquad \text{Formula IV.}$$

Where :—

D = Constant = 0.01113—Single Chain Conveyer.
= 0.011293—Double Chain Conveyer.
E = Constant = 3.0—Conveyers with roller flights.
= 1.5—Conveyers with shoe flights.
F = Constant = 6.0—Single Chain Conveyer.
= 7.0—Double Chain Conveyer.

The cost of equipment as given by Formula IV., covers the cost of erection of a simple installation, but, if very special structures are required for support, etc., they should be figured upon separately and charged to the cost of equipment. Such extra expense is, however, frequently an item that can be charged to general plant equipment and construction, so, for practical purposes, Formula IV. may be considered as covering all such initial expenses as are chargeable to the conveyer installation. The average materials handled by such a conveyer do not vary (in respect to weight) to any very great extent, so that it is also possible to express the cost of the average flight conveyer equipment in terms of tonnage capacity; that is, the cost of equipment at so much per ton carrying capacity. Fixed charges of interest on investment, insurance, taxes, etc., chargeable to the yearly cost of operation, can be proportioned to the tonnage actually handled. Depreciation, renewals and repairs vary considerably for the component parts of the equipment, but all these items are pretty well known, in the case of the average conveyer subjected to proper attention and in operation a reasonable number of hours each day, so that an average yearly charge per ton capacity of conveyer can be arrived at. The question of power consumption depends directly upon tonnage handled and, knowing the cost of a horse-power, a charge per ton handled is easily figured. Labor, or attendance, supplies, etc., depend largely upon the use of the conveyer and, like power, can be charged to the tonnage handled. These various relationships permit the derivation of a formula for ascertaining the average net cost of operation of a flight conveyer per ton handled, consisting of two general items, the fixed charges per year and the expenses entailed during the hours of operation of the conveyer, divided by the total number of hours the conveyer is in actual operation during the year. See Formula V.

Net Cost of Operation—Net Operating Cost (N.O.C.).

W = Weight of load conveyed in tons per hour. (Capacity.)
L = Length of Conveyer in feet.
H = Height (distance) through which load is elevated in feet.
N = Number of hours (total) Conveyer is in use per year.
P_e = Price (cost) of a horsepower per hour in dollars.

Average cost of equipment :—
= 0.0146 WL + 0.75 W—Single Chain Conveyer.
= 0.0147 WL + 0.85 W—Double Chain Conveyer.

Fixed charges :—

Interest —6% total cost Insurance—1% Taxes —2%—¾ cost	=	Single Chain Conveyer 0.0012410 WL + 0.06375 W Double Chain Conveyer 0.0012495 WL + 0.07225 W

Depreciations, renewals, &c. :—

SINGLE CHAIN CONVEYER.
= 0.0035 WL + 0.0807 W—Conveyers with roller flights.
= 0.0040 WL + 0.0807 W—Conveyers with shoe flights.

DOUBLE CHAIN CONVEYER.
= 0.0037 WL + 0.0922 W—Conveyers with roller flights.
= 0.0038 WL + 0.0922 W—Conveyers with shoe flights.

Horsepower, attendance, supplies, etc. :—

HORIZONTAL CONVEYERS.

Cost of Power :—
= 0.0007828 WLNP_e — Conveyer with roller flights.
= 0.0008332 WLNP_e — Conveyer with shoe flights.
Cost of labor or attendance :—
= 0.000025 WLN — average.
Cost of supplies, &c. :—
= 0.0000676 WLN — Conveyers with roller flights.
= 0.0000909 WLN — Conveyers with shoe flights.

INCLINED CONVEYERS.

Cost of extra power :— = 0.00101 WHNP_e — average.
Cost of extra labor, &c. :—Negligible.
Cost of extra supplies, &c. :— = 0.0000133 WHN — average.

Then :—

$$\text{N.O.C.} = \frac{AL + B + CLN + 1.33\,HN + (DL + 101\,H)\,NP_e}{100{,}000\,N} \qquad \text{Formula V.}$$

Where :—

A = Constant = 474.10 — Single Chain Conveyer—roller flights.
= 524.10 — Single Chain Conveyer—shoe flights.
= 494.95 — Double Chain Conveyer—roller flights.
= 504.95 — Double Chain Conveyer—shoe flights.

B = Constant = 14445 — Single Chain Conveyer.
= 16447 — Double Chain Conveyer.

C = Constant = 9.26 — Conveyers with roller flights.
= 11.59 — Conveyers with shoe flights.

D = Constant = 78.28 — Conveyers with roller flights.
= 83.32 — Conveyers with shoe flights.

Examples.

Conditions :—

Length of Conveyer....	100′ 0″	= L
Material elevated	20′ 0″	= H
Service.....	2400 hours per year	= N
Cost of power.....	$0.02 per horsepower per hour	= P_e

Single Chain, roller flight, Conveyer.

$$\text{N.O.C.} = \frac{47410 + 14445 + 2222400 + 63840 + 472704}{240000000} = \$0.01175 \text{ per ton.}$$

Single Chain, shoe flight, Conveyer.

$$\text{N.O.C.} = \frac{52110 + 14445 + 2781600 + 63840 + 496896}{240000000} = \$0.01421 \text{ per ton.}$$

Double Chain, roller flight, Conveyer.

$$\text{N.O.C.} = \frac{49495 + 16447 + 2222400 + 63840 + 472704}{240000000} = \$0.01176 \text{ per ton.}$$

Double Chain, shoe flight, Conveyer.

$$\text{N.O.C.} = \frac{50495 + 16447 + 2781600 + 63840 + 496896}{240000000} = \$0.01421 \text{ per ton.}$$

Conditions :—

Same as in preceding example except that service is but 1200 hours per year.

Single Chain, roller flight, Conveyer.

$$\text{N.O.C.} = \frac{47410 + 14445 + 1111200 + 31920 + 236352}{120000000} = \$0.01201 \text{ per ton.}$$

Single Chain, shoe flight, Conveyer.

$$\text{N.O.C.} = \frac{52410 + 14445 + 1390800 + 31920 + 248448}{120000000} = \$0.01448 \text{ per ton.}$$

Double Chain, roller flight, Conveyer.

$$\text{N.O.C.} = \frac{49495 + 16447 + 1111200 + 31920 + 236352}{120000000} = \$0.01204 \text{ per ton.}$$

Double Chain, shoe flight, Conveyer.

$$\text{N.O.C.} = \frac{50495 + 16447 + 1390800 + 31920 + 248448}{120000000} = \$0.01448 \text{ per ton.}$$

The use of Formula V. gives results that agree very closely with those attained in ordinary good practice, and it is interesting to note that the economic value of the conveyer does not vary greatly with service, if subjected to reasonable usage. In the examples cited—the conditions of which are common in practice—there is only a difference of less than 2½ per cent. between the net cost of operation when using the conveyer 2,400 hours per year and 1,200 hours. Of course, much less than 1,200 hours' operation per year would materially increase the net cost of handling the material but the value of an installation of which such slight service only is required would be problematic. Another point of interest is that there is practically no difference in the net cost of operation of a one-chain or a two-chain conveyer—indicating the correctness or accuracy of the formulæ—although the refinement of roller flights does considerably reduce the cost of handling, the reduction of about 17 per cent. indicated by the formulæ being confirmed in practice as a fair record of the difference in actual operating costs of the two types of flight conveyers. The choice between a one and a two-chain conveyer is governed almost exclusively by the size of the conveyer—the larger conveyers usually having two chains. Severe conditions, however, under which operation must be performed sometimes makes it advisable to equip even the small sizes of conveyers with the two chains. In such a case, the initial cost of equipment would be somewhat increased in order to obtain satisfactory wear and operation of the conveyer and Formula V. would be applicable even under such conditions.

The foregoing discussion has been limited to the ordinary type of flight conveyer as found in the average mine or industrial plant, but many other adaptations and modifications of this standard type of conveyer are in common use; such as log hauls, ice conveyers and crude drag conveyers of all descriptions, which present many problems that require individual solution that cannot be taken up in the present discussion. The problems presented in these special cases are not, however, difficult of solution and modifications of the formulæ that have been given will be found to meet the requirements of almost any installation of flight or drag conveyers.

Fig. 2.—Log Haul.

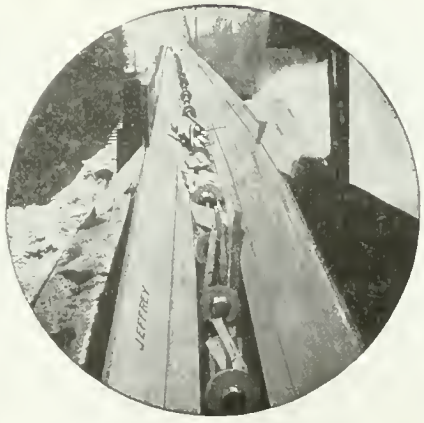


Fig. 3.—Wire Rope Offal Conveyer.

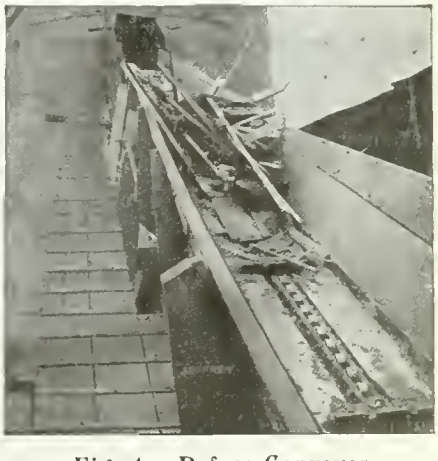


Fig. 4.—Refuse Conveyer.

Drainage work in Manitoba made good progress during 1912, according to the report of the Department of Public Works for the fiscal year ending November 30th, 1912. At that date 1,844.8 miles of drains had been constructed, benefiting in the neighborhood of 1,984,000 acres.

THE BOUCANNE RIVER VIADUCT

GENERAL FEATURES OF THE DESIGN OF THIS NATIONAL TRANSCONTINENTAL RAILWAY VIADUCT—OUT-OF-THE-ORDINARY METHODS OF ERECTION — PAPER PREPARED FOR INSTITUTION OF CIVIL ENGINEERS, GREAT BRITAIN.

By P. L. PRATLEY, M.E., Assoc. M. Inst. C.E.
Designing Engineer, Dominion Bridge Co., Limited, Montreal

THE National Transcontinental Railway crosses the Boucanne River at a point 167.2 miles east of the Quebec Bridge, which is the St. Lawrence River crossing of the same line. Both crossings are situated in the province of Quebec, in the B district of the eastern division of the railway.

The Boucanne River crossing occurs just north of the peak of Maine, where this State geographically juts into British territory. Although the river at this point is but a shallow stream with a depth varying with the seasons from a few inches to 5 feet, and a width of about 100 feet, the valley in which it flows is quite a considerable depression. These conditions, together with the fact that the line follows generally the the "height of land," necessitate a crossing 790 feet in length, with a maximum height of 127 feet from the base of the rails to water-level. The viaduct is of the trestle type, and as indicated by the general outline in Fig. 1, it consists of five towers of 30 feet span and two of 40 feet, with intermediate spans of various lengths.

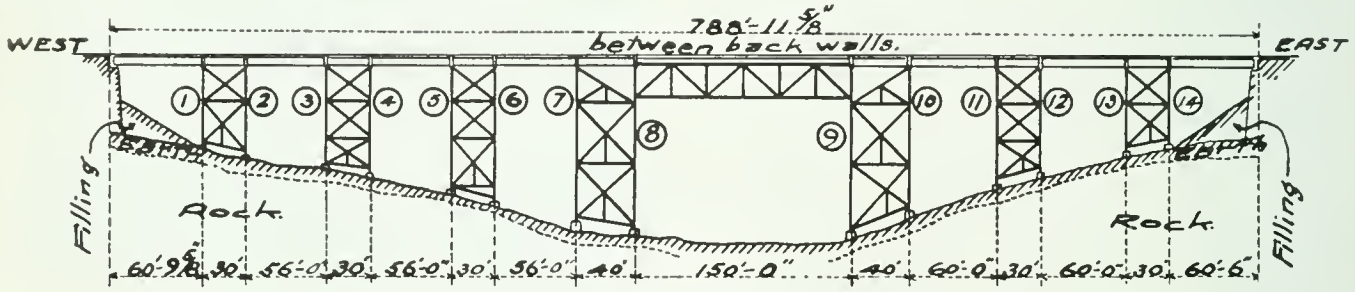


Fig. 1.—General Outline of Viaduct.

The viaduct is perfectly straight, except for about 135 feet at the west end, where it lies on the approach spiral to a 6° curve (radius 977 feet), which commences 165 feet west of the bridge. The transition spiral is thus 300 feet long, and is laid out as a cubic parabola with the equation $y = kx^3$, y being the offset from the tangent, x the distance from the beginning of the spiral measured along it, and k a constant, in this case equal to 0.00000058232; so that at the end of the transition spiral, where $x = 300$, $y = 15.72$ feet.

The viaduct is of the deck type, that is, the track is laid on cross timbers or "ties" placed with 4-inch spaced between them. The ties are 10 inches wide by 12 inches deep, and are generally 14 feet long, "dapped" ½ inch over the top flanges of the girders, and held in place longitudinally by timbers running along the ends of the ties and "dapped" over them. The girders are 9 feet apart between centres, and are uniformly 6 feet deep. The transverse batter of the towers is 1 in 6, and this, together with the depth of the truss and its detail, brings the width of the truss span to 17 feet 2¼ inches between centres. The viaduct is also on a gradient of 1.10 per cent. (1 in 90), falling toward the east. The gradient is, of course, affected by the vertical spiral at the west end whereby the superelevation of the 6° curve is gradually attained, but not to any larger extent than can be adjusted by the size of the ties used on the end span. The necessary tilting of the track on the bridge is also small enough to be effected in the ties.

The ground at the side is principally earth and boulders, with solid rock about 10 feet below, so that the concrete pedestals and abutment-walls were well founded on the bed rock.

Points in the Design.—The viaduct is designed in accordance with the specifications issued by the Dominion Government in 1908, with one or two further restrictions imposed by the bridge-engineers of the National Transcontinental Railway, which will be specifically alluded to later. The steel was proportioned for a live load known as Class "Heavy." This consists of two engines with tenders, the whole weighing 180 (short) tons, on a combined wheel-base of 104 feet, followed by a uniform train-load of 4,750 lbs. per lineal foot of track. This uniform load can be obtained with a train of heavy steel wagons weighing up to 30 or 35 tons each, and each carrying up to 60 tons of coal, their length being 36 to 40 feet over the couplings. The maximum axle-load on the driving-wheels of the locomotive in this class is 49,400 lbs.

The specification calls for an extra allowance of load for impact equal to the figure obtained by dividing the square of the live load by the sum of the dead and live loads. In addition to this, for all spans of less than 80 feet, including the stringers and cross floor-beams of the truss span, the live load itself is increased by a percentage which depends upon the length of the span, having a maximum of 40 per cent. at the theoretical span of zero, diminishing according to the formula $0.40 - \frac{l}{200}$, where l is the length of the span in feet, and vanishing at 80 feet. In the Transcontinental Railway bridges this increment of live load is introduced into the live-load figure used in the impact formula, as well as into the pure live load, so that for the girders of the Boucanne River Viaduct the impact load was obtained by dividing the square of the increased live load by the sum of the increased live

load and the dead load. The sum of the dead load, the increased live load, and the impact, thus obtained, is treated as the total load both for shear and bending moments. For this load a unit shear of 10,000 lbs. per square inch is allowed on the gross section of the webs of plate-web girders; and on the net section of the tension flange a unit fibre-stress of 16,000 lbs. per square inch is permitted.

Fig. 2.—View of the Completed Viaduct.

The gross area of the compression flange is made equal to the gross area of the tension flange, and 75 per cent. of the gross bending value of the web-plate is considered as effectively assisting the flanges to resist the induced bending-moments.

Under these specifications the weight of steel in the 60-foot deck plate-girder spans is 57,000 lbs. per span, including both girders and all wind- and sway-bracing. In the 56-foot spans the corresponding weight was 51,000 lbs., in the 40-foot spans 29,000 lbs., and in the 30-foot spans 17,500 lbs. per span.

The principal object of this paper is to describe the methods employed in the erection of the larger towers and the truss span. The trusses of the 150-foot span, as will be seen from Figs. 1 and 3, have six panels of 25 feet, are in vertical planes, measure 25 feet deep between the centres of gravity of the chords, and are of the Warren type. The cross girders or floor-beams at the intermediate panels are 4 feet 4¼ inches deep over the flange-angles and are riveted to the vertical members of the truss just under the top chord. The end floor-beams, which have to support the 40-foot girder spans, are 5 feet ¼ inch deep over the flange-angles, and are 1 foot lower on the truss than the intermediate beams, in order to allow for the difference in depth between the 40-foot girders mentioned and the stringers of the truss span. The latter are also plate-web girders, their depth thus being 5 feet ¼ inch from back to back of the angles against the uniform 6 feet ¼ inch of the girder spans. It will thus be seen that the stringer girders sit on top of the floor-beams and are 9 feet apart between centres, being in fact 25-foot deck plate-girder spans. The floor-beams are similarly single-web plate girders with webs 7/16 inch thick and flange-angles 6 inches by 6 inches by 9/16 inch in the deeper and 6 inches by 6 inches by ⅝ inch in the shallower. The material in the top chord is ½ inch throughout, while both angles and plates in the bottom chord are 7/16 inch in thickness in the first two panels at each end and ¾ inch thick in the two central panels. The web system of vertical and diagonal members is consistently of H shape, the plate being ⅜ inch thick, except in the compression diagonals, where ½-inch plate is used. The angles are 9-inch by 3½-inch by ½-inch bulb angles in all the diagonals and the end verticals, whilst in the verticals that are merely hangers they are 6-inch by 3½-inch by ⅜-inch angles, and in the intermediate compression verticals 7-inch by 3½-inch by ⅝-inch angles. The main or end compression diagonal is further reinforced by 19-inch by ¾-inch plates on the outside of each pair of bulb angles.

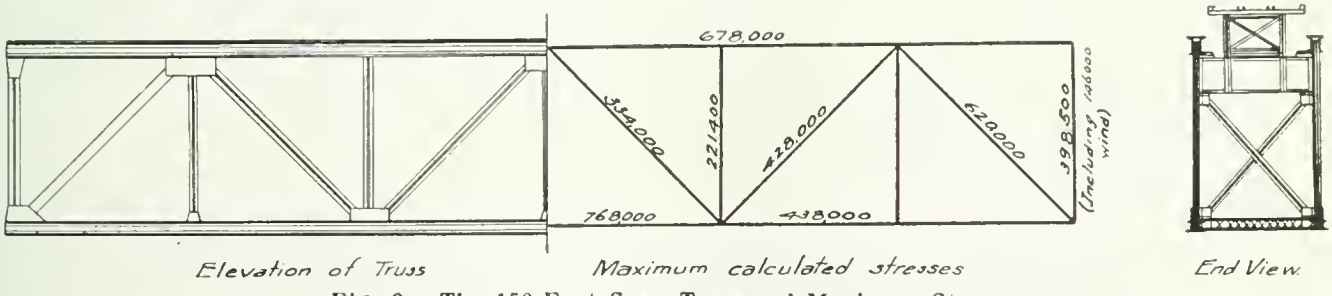


Fig. 3.—The 150-Foot Span Truss and Maximum Stresses.

The impact-formula explained above will be seen to be based on two main assumptions. The first is that the greater the dead load of a span of given length, the less will be the dynamic effect of the sudden application of the live load. For example, a pony-truss span carrying a ballast and concrete floor would suffer less impact load than girders carrying the usual timber deck. The second assumption is that the longer a span, the less likely is the maximum dynamic effect to occur with the maximum live load. The shorter the span, the more suddenly will the live load reach the maximum and the more severe will be the vibratory effects of unbalanced engine-wheels and jumping loads. On the other hand, the longer the span the more gradually does the induced stress attain its maximum, and the more generally distributed will be the effect of impinging loads.

The maximum stress in the top chord, composed of dead load, live load and impact load, amounts to 678,000 lbs., for which a section of 50.5 square inches is provided, the maximum unit compression allowed by the engineers of the Transcontinental Railway being 13,600 lbs. per square inch. This figure is an arbitrary restriction on the government specification, which would permit 14,600 lbs., the formula followed being $16{,}000 \div \left(1 + \frac{l^2}{18{,}000\, r^2}\right)$, assuming fixed ends.

The bottom chord receives a possible maximum stress of 768,000 lbs., which at 16,000 lbs. per square inch requires 48 square inches of net sectional area. To meet this 48.76 square inches is supplied, being the effective net section obtained from the 60.76 square inches gross

section provided. The Transcontinental Railway also prescribes that the Government formula for free-ended compression members shall be used for their vertical struts, whilst for the compression diagonals the intermediate formula $16{,}000 \div 1 + \frac{l^2}{12{,}000\, r^2}$ is used, the constant before r^2 being 9,000 for free ends. By this means the units indicated in Fig. 3 are obtained, and by their aid the necessary cross section is calculated. The tension unit is 16,000 lbs. per square inch throughout.

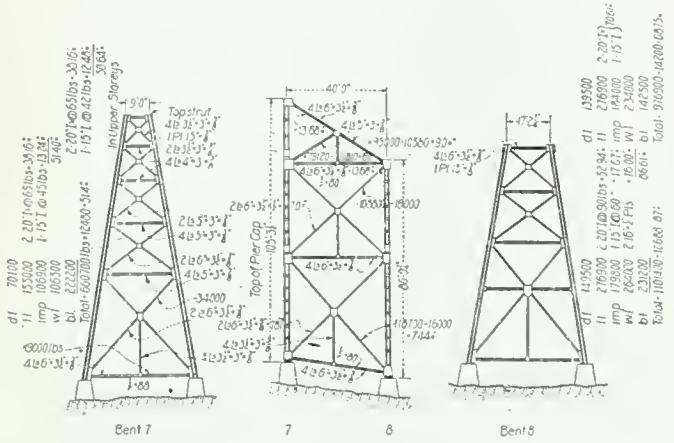


Fig. 4.—Typical Compression Stresses.

The trusses are braced together horizontally by both top and bottom lateral systems, the top consisting of crossed single diagonal angles in each panel, connected to the underside of the chord-angles and to the bottom flange of the stringers. The bottom lateral bracing consists of transverse horizontal struts of four angles laced in pairs and of cross diagonals similarly constructed. They are made the full depth of the chord, for the sake of simplicity and efficiency in connection. Undtr each floor-beam there is a sway-brace consisting of cross diagonals connected to the vertical members of the trusses and to the bottom struts.

An interesting feature of the specification, perhaps, is the clause governing the dimensions of the lattice bars. The lower side of the top chord is, of course, latticed between gusset-plates, and here 5½-inch by 9/16-inch single lacing is used. The bottom chord is laced in both its upper and lower faces with 3-inch by ½-inch double lacing, whilst the lacing of all the lateral struts and diagonals is 2½ inches by ⅜ inch. The specification requires that the thickness of the bars shall be at least 1/40 of the distance between the rivets that connect their ends to the two leaves of the members which they lace, if singly laced, and 1/60 of that distance if doubly laced. On the upper chord, the web-plates being 14¼ inches apart, the gauge-lines on the angles are 20¼ inches, which with approximately 60° lacing gives 23 inches between rivets and 23/40 inch or 0.575 inch as the required thickness, for which 9/16 inch was used. The width is governed by the fact that two rivets were required at each end, and these could not be obtained with the necessary edge distances on the lattice bar under 5½ inches. Similarly on the bottom chord, the same 20½ inches with 45° lacing gives 28½ inches between end rivets and calls for bars 28.5 inches

$\frac{28.5}{60}$ or 0.48 inch in thickness. One rivet being sufficient connection, a 3-inch bar was adopted here. The latticing in the bracing members need only be made 75 per cent. as heavy as the above specification, and so ⅜ inch is the usual dimension.

The stresses permitted in rivets are 10,000 lbs. per square inch in single shear and 20,000 lbs. per square inch bearing stress. These figures are for shop-driven rivets: for rivets driven by power in the field a reduction of 10 per cent., and for hand-driven rivets a reduction of 25 per cent. is prescribed. The gusset-plates in the main truss were principally ⅝ inch thick, and the minimum thickness of material allowed throughout the bridge was ⅜ inch.

The towers are of the usual viaduct construction, and consist of two "bents" braced together longitudinally. Each bent consists of two inclined posts with sway-bracing between them. As indicated in Fig. 4, the sway-bracing is made up of panels of crossed diagonals and horizontal struts. This is the type most usually adopted, although occasionally the struts are omitted except at the extreme top and bottom, and the diagonals are made rigid enough to resist compression effectively. In the usual design, typified by the Boucanne River Viaduct, the diagonals, although made of stiff shapes, are proportioned for tension with a limit of slenderness determined by making the maximum permissible ratio of unsupported length to radius of gyration equal to 200. The horizontal struts are then calculated as compression members, and their stiffness is governed in turn by a clause limiting l/r to 120. Under these conditions the choice of sections is governed more generally by the stiffness than by the calculated stress.

The longitudinal bracing between the bents is calculated to take any stress that might occur from applying or releasing suddenly the brakes on the train. Here again, however, with the National Transcontinental Railway, the same stiffness clauses operate: in the smaller towers they determine the dimensions of the diagonals and struts, whilst in the larger towers carrying the ends of long spans the calculated stresses often call for thicker metal. A typical diagram is given (Fig. 4) showing the stresses computed and the material supplied for the particular tower to be considered in this paper.

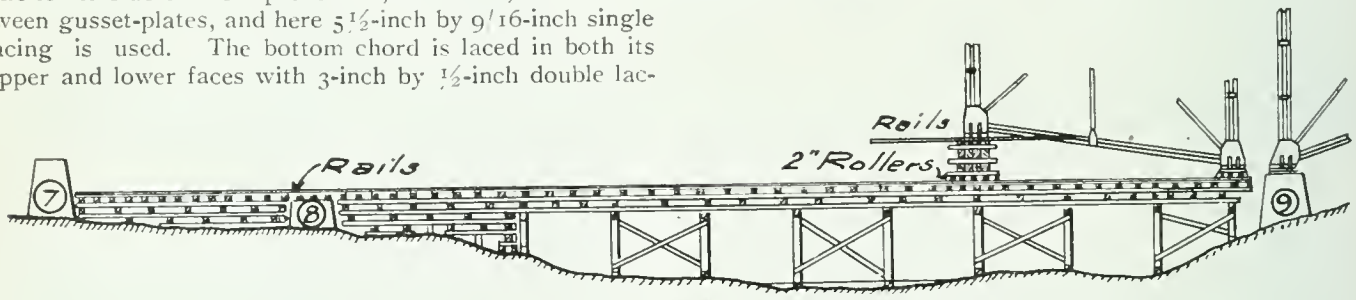


Fig. 5.—Staging Track for Moving Towers Into Place.

As shown in Fig. 4, the posts are made up of three I-beams riveted together to form an H section, reinforced by side plates where necessary. This form of section for posts entails the minimum of shop-work, and secures reasonable connections for all bracing. When the two I's

are deep, they may be connected at suitable intervals between bracing-points by batten-plates, or may be latticed continuously. In the case of the Boucanne Viaduct the batten-plate system was employed, and 9-inch by ⅜-inch plates 1 foot 3 inches long were provided on each face at intervals of about 5 feet. In the tower 7-8 under consideration the lowest story was built up of two 20-inch I-beams, each weighing 90 lbs. per lineal foot, with a diaphragm I-beam 15 inches deep and weighing 60 lbs. per

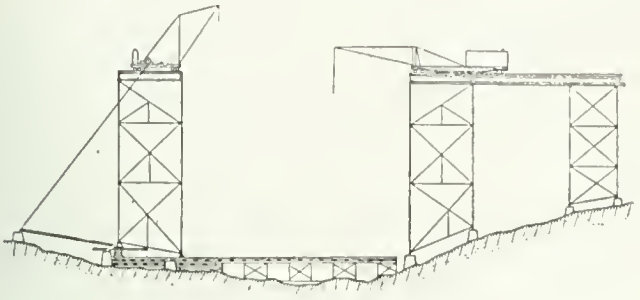


Fig. 6.—Method of Moving Tower.

foot. In addition, there were two 16-inch by ½-inch side plates, one on the outside of the web of each 20-inch beam, giving a total gross section of 86.6 square inches. The beams are of heavy American standard sections, and were rolled by the Carnegie Steel Co. The loads on this post, No. 8, are computed to be as follows:

Dead load	149,500
Live load	276,900
Impact	179,800
	606,200
Wind load	264,000
Brake load	231,200
Total	1,101,400

These loads are the maximum that can co-exist according to the specification and not necessarily the maximum amount of each and every class of load. Now the unit compressive stress allowed by the specification is that given by the formula $16{,}000 \div \left(1 + \frac{l^2}{9{,}000\, r^2}\right)$. This applies, however, to the combination of dead, live and impact loads which, as above detailed, amount to 606,200 lbs. In the story under inspection $l/r = 72$ and consequently $f = 10{,}150$ lbs. per square inch. But in consideration of the remoteness of the possibility of all the wind load and all the brake load occuring together and at the same time as such a large impact load, which the braking load either removes or replaces, the allowed unit for the full combination of live, dead, impact, wind and brake loads is increased above that already determined by 25 per cent. There are thus two cases to be considered in every post—first, the ordinary combination at the ordinary unit; and, second, the extraordinary combination at the increased unit. In the present case, as with most cases of high towers and long spans, the second case governs and so the unit of 12,688 is used, necessitating 87 sq. ins. of section.

The feet of the posts are shod with a steel shoe plate 2 ins. thick which rests upon a steel bed plate 1½ ins. thick, the latter being anchored to the pedestals. The anchor bolts for bent 8 were 1¾ ins. diameter and 6 ft. long, two to each post, whilst to bent 7 were given 2½-in. diameter bolts 13 ft. 3 ins. long, two to each post. A few inches of each bolt project above masonry to receive nuts and washers above shoe plates, and the rest is built into the pedestals. A space is left around the bolt to allow of slight adjustment and then after the towers are completed this space is filled with cement grout.

One post of each tower was rigidly fixed to its bed plate, but the other three were allowed freedom to move under expansion or contraction from temperature or loading. Each of the posts adjacent to the fixed one is permitted to move in the direction of the line adjoining to the fixed one; that is, the one transversely to the viaduct axis, and the other longitudinally with the viaduct axis, while the diagonally opposite post can move in any direction. In other words, one shoe being fixed two had one degree of freedom and the other two degrees. Tongue and grooves in the bed and shoe plates, respectively, were used to accomplish this, and in the particular tower under notice the S. E. post was the fixed one. The tongues were 2½ x 5/16-in. flats and the grooves were planed out 7/16-in. depth.

Construction Details.—The viaduct was erected from the east end, and as the line itself was the only approach, the steel had to be forwarded from Montreal to the station on one of the existing railways nearest to the constructed track. This meant the carrying of all steel by the derrick cars from the east end storage to the actual site and over the erected portions. The process, therefore, was to erect bent 14 and place the 60-ft. girders from the east embankment. The derrick then moving into the 60-ft. girders erected bent 13 and the longitudinal bracing and the 30-ft. girders. This method, obvious and ordinary, was followed to bent 9. For the higher bents a horizontal temporary strut is employed to steady and support the first bent of a tower, being erected between it and the last completed tower. These temporary struts serve to stiffen the bent while the 60-ft. girders are placed and the derrick advanced to erect the rest of the tower. They were wooden in the case of the Boucanne River Viaduct, but are of steel for larger and higher towers.

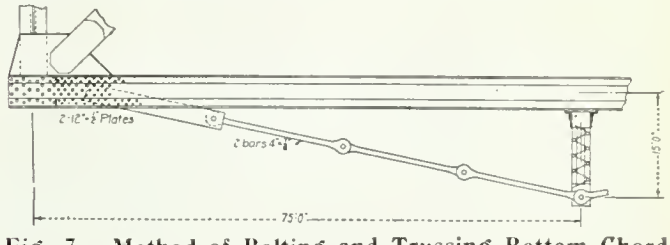


Fig. 7.—Method of Bolting and Trussing Bottom Chord for a One-Piece Erection.

When the tower 9-10 was completed, the next necessary undertaking was bent 8, which in its final position was to be 150 ft. west of bent 9. As this could not be erected from the west end, there being no line, it was essential to scheme out some method of building the complete tower 7-8 before the truss span which it was destined to carry. Although the river was but a foot or two in depth, falsework for the truss was considered too expensive and troublesome, and the plan now to be presented was selected as the most feasible and desirable means of erecting both the trusses and the tower. The outline of the scheme was the building of tower 7-8 on low staging close to 9-10 within reach of the derrick booms and approximately at its final level, and then rolling or sliding it westward into place. The company had before had experience with the moving of towers by this means and

were satisfied from past successes that this was a possible and practicable scheme. Temporary wooden staging was built across the river upon which were laid the skidding or rolling track rails. These were laid at such a height that between their bases and the top of the pedestals of 8 there was just room for an ordinary railroad tie and an inch or two of blocking, Fig. 5. On top of these rails were then built the posts of bent 8. The base of bent 7 being 6 ft. higher than bent 8, this amount of timber blocking was built upon the rails 40 ft. west of bent 8 and upon this small timber tower bent 7 was erected. When the bracing and 40-ft. girders of this tower had been completed a stiff-leg derrick was built on top of the tower by the erection derrick on tower 9-10, Fig. 6.

Between the shoe plates of bent 7 and the blocking upon which they rested was placed another set of rails, so that when the tower had been rolled westward until blocking under bent 7, having passed pedestal 8, was about 8 ft. from pedestal 7 they would project over pedestal 7 and when staged or blocked, would form a track upon which

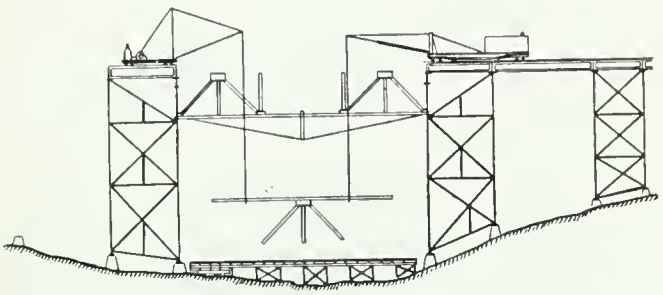


Fig. 8.—Method of Hoisting and Erecting Trusses.

the shoes of bent 7 could slide the last few feet of their travel, the shoes of bent 8, of course, still rolling. Thus for the first 135 ft. or so the two bents of the tower rolled on the lower tiers and afterwards the higher shoes slid on the upper tiers. The rollers were 2 ins. in diameter and about 4 ft. in length. In this manner the tower was rolled to position and then jacked down onto its anchor bolts which were already in place on the pedestals. The rolling was effected by the winding engine of the stiff-legged derrick on top of the tower rolled. Lines from its spools to a hitch west of pedestal 7 passed back to the tackles, which were placed around posts at gussets and around the blocking under 7. The derrick up above thus pulled the tower carrying it into place. The movement was very easily accomplished and without any trouble or hindrance.

The next problem was the erecting of the truss span. The two bottom chords were lowered piece by piece to the staging already referred to, a few feet only from the ground, and there they were bolted up and trussed as shown in Fig. 7, by temporary eye bars and short struts. By this means they were made strong enough to carry themselves and a part of their respective trusses as spans of 145 ft. 6 ins. length. The end vertical posts of the trusses had, of course, been already erected as part of the towers and the bottom chord and splices were arranged to permit of the trussed chord being hoisted vertically and immediately bolted to the short end sections, which were shop riveted to the gusset plates at the foot of the vertical posts incorporated into the towers. By this means the two bottom chords were hoisted into place and connected, the stiff-legged derrick on 7-8 taking hold of about 40-ft. out and the main traveller taking hold of about 50 ft. out. The bottom lateral bracing was then put in place and the chords thus stayed horizontally.

The next process (Fig. 7) was the erecting on the low staging of the web members of the two panels at each end of each truss; that is, the main compression diagonal, the first vertical and the main tension diagonal. These were then hoisted into place and immediately braced by the placing of the first floor-beam and sway-bracing. The second verticals being added, the remaining central portion of each truss was assembled down below with the four panels of top chord and then similarly hoisted up to position and bolted on. The intermediate floor-beams, sway-bracing and top lateral bracing followed and the addition of end sections of top chords and stringer girders completed the span. When sufficient riveting had been done the temporary eye bar trussing was removed and everything was ready for the laying of track and the passage of the erection derrick. The stiff-legged derrick was dismantled and the erection of the remaining towers was proceeded with on the same plan as above described for the eastern shore. The photograph of the placing of the last girder is interesting in that it shows the device whereby a brace frame is hoisted above the second girder of a span, so that immediately both girders are correctly placed they can be braced together.

The main erection derrick had an interesting feature in its telescopic booms. They were built of steel sections in two lengths each, and so arranged that the outer half could enter the inner half and the effective boom thus shortened. Holes and pins were provided in the webs of each position of each boom whereby various lengths could be obtained and retained. The capacity of the booms was 15 tons per boom when shortened down to about 40 ft., and 10 tons each when acting at their full extension of 62 ft.

The greatest weight lifted in this viaduct was about 20 tons, divided between the derrick and the stiff-leg erected on tower 7-8. This weight comprised the centre portion of the 150-ft. span, was 394,185 lbs., and the total in the viaduct 913 tons.

The steelwork was manufactured and erected by the Dominion Bridge Co., Limited, of Montreal, under the supervision of R. F. Uniacke, bridge engineer to the N.T.C.R. Mr. F. P. Shearwood is the designing engineer of the company, and Mr. J. Finley the erection superintendent, while the author as assistant designing engineer was in responsible charge of the designing of the work above described.

The year 1910 has stood the record year for the production of coal in British Columbia, with a total of 3,139,235 tons (2,240 lbs.). The production in 1912 amounted to 3,025,709 tons, which is the second highest annual production, labor troubles being responsible for the lesser output than that of 1910.

Engineers and contractors from many sections of the country are to gather at Cleveland, Ohio, September 17 and 18, on the occasion of the tenth annual meeting of the National Paving Brick Manufacturers' Association. In former years the association has held its annual meetings during winter months, but at the last yearly assemblage of the paving brick manufacturers, it was decided to hold future conventions during an "open season." This will afford, besides the usual programme of written papers, discussion and criticism of brick street and brick road construction methods while work on the highways is in actual progress. The large amount of construction work in the district, will afford splendid opportunity for investigation in a most practical way.

COAST TO COAST.

Saskatoon, Sask.—The city council has decided to prospect systematically for natural gas throughout this district, and Mr. W. R. Martin, a leading expert from Medicine Hat, has been engaged for that purpose. Mr. Martin will endeavor to trace the gas strata to where it comes closest to this city. Borings will then be made, and, in the event of the discovery of gas, the practicability of piping it to the city will thereafter be considered. It will be remembered that Calgary pipes her gas from Bow Island, a distance of 185 miles.

Saskatoon, Sask.—The construction of the big Dominion Government interior elevator at Saskatoon will be commenced upon within the next few weeks. At the outset, its capacity will be three and one-half million bushels. The plans, however, permit of its extension to twenty million bushel capacity, as occasion may later require. When here recently, Grain Commissioner Jones stated that the Saskatoon elevator would be able to handle 150 cars of grain per diem, and when completed would be one of the largest elevators on the continent, exceeding the elevator at Fort William, and having a larger capacity than either of the two Canadian Northern Railway elevators at Port Arthur. The structure will be of reinforced concrete, and absolutely fireproof. Contracts will be let before September 1st. The site will be served by the three railways. The location of the elevator at this city, of course, involves the establishment of a sample market also, and, in due course, a grain exchange.

Guelph, Ont.—At a recent meeting of the Sewerage and Public Works Commission, plans and specifications were presented for important improvements contemplated to the Neeve Street bridge. This shows that the board fully realizes that in order to prevent floods, such as occurred in the spring of 1912 and 1913 action must be taken this season while the water in the river is low. The plans call for another 24-foot arch on the north side of the bridge, and for other extensive improvements to the river and banks. It is proposed to clean out the bed of the river, both below and above the Neeve Street bridge for some distance, and also to erect a retaining wall for about 75 yards above the bridge, and also on the opposite side of the river below the bridge. Every effort will be made to allow plenty of room for the flood water to flow down the river without its flooding its banks. It is understood that this action on the part of the city will not in any way prejudice the case now before the courts, and the Board feel the necessity of taking immediate action to prevent a flood in 1914.

Regina, Sask.—Mr. A. S. Porter, who has been working diligently with a view to materially reducing the cost of production of power in this city, has offered to sell power to the city at $18 per horse-power per 10-hour day. The present rate for power is 1.1 cents per k.w., and Mr. Porter's offer is to sell to the city at .7 cents. It is not thought likely that the city will accept, however, as when the new power-house is completed, it is expected that the cost of production will be materially reduced.

Toronto, Ont.—Hon. Dr. Reaume is likely to introduce legislation at an early session changing the rural main road allowance from 66 feet, as at present, to accord with the newer standard. It is pointed out by the Government's engineers that the standard rural main roads are but 24 feet, and with allowance for paths of four feet on each side and ditches, 40 feet would be ample. The present road allowance leaves a vast acreage of land which might be planted, and forms many miles of growth by vicious weeds. The new standard road likely to be authorized on recommendation of the Highways Commission will be of slight grade 24 feet wide, and with very sharp curves obliterated. The data obtained by the department show that the use of motor cars in Europe has multiplied the traffic in the main highways ten times, with the consequent cost of maintenance in proportion.

Toronto, Ont.—The Harbor Commissioners are congratulating themselves on an advantage obtained by the building of the new western channel, which did not enter into their considerations at the time the new channel was planned. The good result obtained is the practical clearance from the bay of debris. Some time ago the suggestion was made by a prominent engineer that the bay water could be kept clear by the construction of a channel at a point about half way between Centre Island and Hanlan's Point, but owing to the big expense involved nothing was done in the matter. The result now obtained has been caused by a strong current which flows from the eastern channel west and out through the western channel and keeps the bay clear. A current strong enough for this purpose was not to be had when the old western channel was used, which was too narrow, and was only about 10 feet deep in places. The new wide channel is more than 18 feet in depth, and is apparently situated just right to catch the current.

Vancouver, B.C.—The fourth annual convention of the Pacific Highway Association met in Vancouver a week ago. Delegates from Seattle, Portland, San Francisco, Los Angeles and a number of other cities are in attendance. The association aims to secure the construction of a first-class road along the Pacific slope from as far north as possible. Except for two short breaks in British Columbia, the highway now stretches continuously from Hazelton, B.C., to Yuma, Ariz. During the winter large sections of the road are impassable, and the association is working to secure the co-operation of the different communities toward an early improvement of the conditions.

Ottawa, Ont.—It is understood that the Canadian Northern Railway is seeking from the Government running rights over the Intercolonial Railway, to take effect from the time when their Montreal to Port Arthur line is finished. The privilege will, of course, not be required until the construction of the line is much further advanced than it is at present. When it is completed next year, the Canadian Northern will have a line as far as Quebec, but will lack connection with the eastern seaboard. No definite plans have ever been formulated by the company to build a new line to St. John or Halifax, and apparently it has been intended to fill that gap by the acquisition of running rights over the Intercolonial. For that reason the application made to the late Government is again being pressed. The intention of the Government towards the application has not been officially stated, though it is known in connection with the question of Government assistance to the line that the matter has been under consideration from time to time. When the former ministry granted liberal bond guarantees to the Canadian Northern it was understood that if at any time the Intercolonial Railway desired running rights west over the Canadian Northern such would be granted. The same privilege is still available, but it is not known whether the Government will utilize it.

Stratford, Ont.—The city's sewage disposal plant, which has been in operation for only a year, is reported to be giving unsatisfactory service. F. A. Dallyn, C.E., of the Provincial Board of Health, recommends the following improvements to increase the efficiency of the system: New sedimentation beds and improved sprinkling equipment, including an auxiliary gas engine; a chlorination device, and a humus bed between the sprays and the creek into which the purified effluent empties.

Regina, Sask.—Mr. Moreley J. Donaldson, vice-president of the Grand Trunk Pacific Railway, while in the city recently stated that a contract would be let within the near future for the construction of the balance of the Regina-Moose Jaw line of his company. With regard to the boundary line, Mr. Donaldson stated that the laying of steel to the boundary would be completed within the course of a few days, and that the line would be ballasted to the boundary by September 15th sufficiently to permit operation. He also stated that the Great Northern Railway line would be completed to the boun dary to connect with the Grand Trunk line as soon as the Grand Trunk Pacific line is completed.

PERSONAL.

GUSTAVE KAHN, general manager of the Trust Concrete Steel Company, of Canada, Limited, Walkerville, Ont., is at present in the West on a business trip.

HENRY F. CLAYTON, general manager of Boving & Company, of Canada, Limited, is spending the month in Western Canada on a tour in the interests of business.

L. S. BRUNER, manager of publicity for the Canada Cement Company, Montreal, is returning from a visit to the company's mills in British Columbia and the Western States.

R. F. UNIACKE, chief engineer of the Transcontinental Railway, has just returned to Ottawa from an inspection as far west as Winnipeg of the bridges and general condition of his road.

W. C. HARVEY is acting city engineer of Lethbridge, Alta., since the resignation of A. D. C. Blanchard. Mr. Blanchard is now associated with C. H. Rust in the city engineer's department of Victoria, B.C.

ARTHUR H. BLANCHARD, M. Can. Soc. C.E., professor in charge of the graduate course in highway engineering at Columbia University, has been retained by the State highway department of Pennsylvania as consulting engineer on the appraisal of certain toll roads.

CHARLES H. EDMONDS, for nine years works chemist and carbonizing engineer for the Birmingham Gas Department, and who subsequently erected and managed a large chemical plant at Middlesborough, England, for Messrs. Reckett & Sons, is now in this country.

J. G. McMILLAN, B.A.Sc., has returned from James Bay, where he has spent five months for the Provincial Government towards the establishment of a suitable harbor location for the proposed terminus of the T. and N.O. Railway. The work of sounding the Bay has been completed.

WILLIS CHIPMAN, of the firm of Chipman & Power, Toronto and Winnipeg, has been engaged by the city of Edmonton in the capacity of consulting engineer for a period of two years at an annual salary of $3,600, Mr. Chipman to visit the city four times in the year, the visits to aggregate thirty days spent in the city.

L. S. ODELL, B.A.Sc., a member of the firm of Linn, Collis & Company, Nipigon, Ont., was in the city last week completing arrangements and securing equipment for the commencement of their contract with the Canadian Northern Railway. This contract covers the concrete work in the construction of fourteen bridges on the eastern division of the Sudbury-Port Arthur line.

D. P. WAGNER and FRED. G. McALISTER have been appointed secretaries of the new Provincial Highway Commission, the former in the capacity of general secretary, and the latter as secretary in charge of statistical work. Both are graduates of the University of Toronto, and Mr. Wagner is a graduate of Oxford as well. Mr. McAlister has acted as secretary of the Good Roads Association for the past year.

JAMES NEWTON GUNN, general manager of the Studebaker Corporation, of South Bend, Ind., has resigned in order to meet the demands made upon his time and services by other clients. Mr. Gunn will remain upon the board of directors of the Studebaker Corporation, but will devote practically his entire time to the firm of Gunn, Richards & Company, engineers and accountants, of New York and Montreal With the assistance of the large staff of engineers and accountants employed by the latter firm, Mr. Gunn and his partner, Mr. Richards, are managers of, or engineers for, a large number of industrial and engineering concerns, several of which are in Canada. Gunn, Richards & Company have a Canadian office at Montreal under the management of H. Victor Brayley.

JOINT MEETING OF PEAT SOCIETIES.

The seventh annual meeting of the American Peat Society will be held jointly with the Canadian Peat Society at the Canadian Society of Civil Engineers' building in Montreal, August 18th, 19th and 20th. Papers to be presented and discussions will embody the results of progress in the production of peat fuel, peat gas and peat moss litter. Emphasis will be given the subject of peat and bog utilization in agriculture, both on this continent and in Europe.

COMING MEETINGS.

ONTARIO MUNICIPAL ASSOCIATION.—Annual Meeting to be held in Toronto, August 28th and 29th. Secretary-treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.

THE NEW ENGLAND WATERWORKS ASSOCIATION.—Annual Convention to be held in Philadelphia, Pa., September 10th, 11th and 12th, 1913. Secretary, William Kent, Narragansett Pier, R.I.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Third Annual Meeting in Regina, September 18th, 19th and 20th. General Secretary, Major Lorne Drum, Ottawa; Local Secretary, R. H. Murray, C.E., Regina.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D. C.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—First Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

19948—July 30—Refusing the application of R. H. Souch, Tp. of Darlington, Ont., to construct a subway on his Lots 3 and 4, Con. 2, Tp. of Darlington.

19949—August 1—Amending Order No. 19741, dated July 3, 1913, which authorized the C.L.O. and W. Ry. to cross the G.T.R. at mileage 89.9, Tp. of Murray, by adding after the word spur, the words "temporarily for a period of eighteen months from the date of this Order."

19950—August 2—Amending Order No. 19815, dated July 17, 1913, which authorized the City of Regina to construct a street railway across the Arcola Branch of the C.P.R. and the commercial spur of the company, by striking out the words C.N.R. and substituting C.P.R.

19951—July 29—Authorizing C.P.R. to construct a road diversion in Lots 2566 and 9005, Kootenay Dist., at mileage 40.24 to mileage 41.23 from Golden.

19952—July 30—Authorizing the C.N.O. to open for carriage of traffic, the extension of its main line to connect with the Algoma Eastern Ry., mileage 0.0 to mileage 2.39.

19953—July 30—Authorizing C.L.O. and W. Ry. to cross Bogart avenue and Wilkie street, Belleville, Tp. of Sydney, at mileage 78.46 and mileage 78.61 from Glen Tay.

19954—July 29—Authorizing G.T.R. to construct spur to premises of Dowsley Spring and Axle Co., Limited, Chatham, Ont.

19955—July 29—Approving revised location G.T.P. branch lines, Tofield-Calgary branch, southeast quarter of Sec. 11, Tp. 31, Range 24, West of Fourth Meridian, Province of Alberta.

19956—August 2—Approving plan C.N.O. Ry. structure, crossing Montreal Park and Island Ry. Co. at Sault au Recollet, Que.

19957—August 2—Amending Order 18373, dated Sept. 17, 1913, which authorized Toronto Suburban Ry. Co. to cross tracks of G.T.R. at Acton but provided that in addition to tracks authorized to be crossed, authority be given to cross G.T.R. tracks at some further point.

19958—Aug. 8—Authorizing the C.P.R. to construct its Forsyth St. Branch across certain highways in Maisonneuve, P.Q.

19959—Aug. 1—Authorizing the C.P.R., subject to the terms of the consent with the exception of clause 6, to alter the location of the present siding across De Gaspe Ave., and to construct, maintain, and operate an extension to the said siding in Lot Cad. 10-287, incorporated village of St. Louis (Civic) Laurier Ward, Montreal, Co. Hochelaga, Que., for the Sicily Asphaltum Paving Co., Ltd., Montreal.

19960—Aug. 6—Authorizing the C.P.R., subject to the terms of the consent with the exception of clause 5, to construct, maintain, and operate the said branch line of railway or spur, for the Imperial Wire & Cable Co., Montreal, from a point on the C.P.R., thence across St. Patrick St. and across Cad. Lots Nos. 992, 993, 994 and 995 to and into the premises of the said Imperial Wire & Cable Co., situate in said lots.

19161—Aug. 1—Approving change or alteration in the C.P.R. as constructed, at or near the junction of its railway with the C. L. O. & W. Ry., at Glen Tay, Ont.; also approving location of C.P.R. station at Glen Tay at mileage 15.57 on its railway, and at mileage 0 on the C. L. O. & W. Ry.

19962—Aug. 1—Authorizing the C. L. O. & W. Ry. to construct, by means of grade crossings, the tracks of its main line of railway across thirteen highways in the city of Belleville, Ont.

19963—Aug. 8—Amending Order No. 19962 by striking out the words "as lessee of and exercising the franchises of the Alberta Railway and Irrigation Co." in the recital to said Order.

19964—Aug. 7—Authorizing the C. L. O. & W. Ry. to construct bridge No. 76.85 over the Moira River at Belleville, Ont.

19965—Aug. 6—Ordering the C.P.R. to provide and construct a suitable cattle-pass, utilizing the ditch on the farm of R. J. Patterson, of Omemee, Ont.

19966—Aug. 1—Authorizing the C.P.R. to construct an additional track across Bloor St., Lansdowne Ave., and Brock Ave., Toronto.

19967—Aug. 5—Approving and authorizing the clearances of C.P.R. siding at the proposed warehouse of the Colonial Wire Manufacturing Co., Ltd., in St. Emard Ward of the city of Montreal, on the Lachine Canal, South Bank Branch of C.P.R.

19968—Aug. 6—Authorizing the C.N.R. to construct its line of railway across certain highways on its Alsask Southeasterly Line.

19969—Aug. 5—Ordering the C.N.R. to erect a standard passenger and freight shelter station and platform at Dufresne, Man., within sixty days from date of this Order.

19970—Aug. 6—Authorizing the C.N.R. to construct, maintain, and operate a spur line of railway for Thomson, MacDougall & Co., near Woodlands, Man., through Secs. 21, 20, 19 and 18, Twp. 14, Rge. 2, W.P.M., and Secs. 13 and 12, Twp. 14, Rge. 3, W.P.M., mileage 0 to mileage 5.21, and to construct said spur line across certain highways.

19971—Aug. 5—Authorizing the C.N.R. to construct its line of railway across and divert the public road between Sec. 36, Twp. 25, Rge. 22, and Sec. 1, Twp. 26, Rge. 22, W. 3 M., on its Alsask Southeasterly Line.

19972—Aug. 5—Authorizing the L. E. & N. Ry., subject to the terms of the said consent, to construct its line of railway across two highways in the Township of Brantford.

19973—Aug. 1—Postponing the effective date of the proposed increased rate on brick from Milton to Toronto until the 1st day of November, 1913.

19974—Aug. 2—Amending Order No. 5850 authorizing the crossing by wire of the Toronto and Niagara Power Co., over the right of way of the G.T.R. at Davenport Road, Toronto, Ont., and providing that the said crossing be made in accordance with plan No. 6132, dated April 30th, 1913.

19975—July 30—Approving location of Lake Erie and Northern Railway from Station 0, Lorne Bridge, Brantford, to Station 4.50.

19976—Aug. 6—Ordering the G.T.P. to open the crossing between Secs. 8 and 17, Twp. 10, Rge. 13, W. 2 M., Sask.; and to divert highway between Secs. 8 and 9, to a connection with the road between Secs. 8 and 17.

19977—Aug. 7—Authorizing the C.P.R. to use and operate certain bridges on its line of railway.

19978—Aug. 7—Relieving, for the present, the G.T.R. from providing further protection at the Wilson Street crossing, Woodstock, Ont.

19979—Aug. 5—Extending the time within which the G.T.R. were ordered to construct station at St. Gregoire, Que., until Sept. 30th, 1913.

19980—Aug. 7—Ordering the C.N.R. to enlarge present station at Morinville, Alta., to provide a waiting room at least 30 ft. by 30 ft., with seats for accommodation of the public; lengthen platform to accommodate a four passenger train; and erect a freight shed independent of the passenger station.

19981—Aug. 7—Relieving, for the present, the Windsor, Essex and Lake Shore Electric Ry. from providing further protection at the crossing of the highway known as Pelton Crossing, 7th Con., Twp. of Sandwich South, Ont.

19982—July 30—Approving location of the Lake Erie and Northern Railway Company's line from Station 1107-40.7, in the Twp. of Townsend, to Station 1282-32.3, Twp. Woodhouse, passing through Simcoe, Ont.

19983—Aug. 7—Authorizing the G.T.R. to construct, maintain and operate a branch line of railway, or siding, commencing at a point on its railway on St. Patrick St., St. Anne's Ward, Montreal, thence extending upon, along, and across St. Patrick St., crossing the C.P.R.'s spur on said street, to and into the premises of the Imperial Wire and Cable Co. on the south side of said street.

General Order No. 108, Aug. 11th—Ordering the C.P.R. to withdraw its special rule "F" applying to western lines and hereafter observe the uniform rules of the Board regarding yard limits.

19985—Aug. 11—Relieving, for the present, the C.P.R. from providing further protection at the crossing of the road allowance between Secs. 24 and 25, Twp. 31, Rge. 1, west of the 5th Mer., Didsbury, Alta.

19986—Aug. 9—Approving location of C.P.R. proposed shelter on the N.W. ¼ of Lot 10, Con. 8, Twp. of Ops, Co. Victoria, Ont., at Hillhead.

19987—Aug. 11—Refusing application of the Board of Trade of Limerick, Sask., for an Order directing the C.P.R. to provide and construct a highway crossing over its railway on Galway or Brian Sts., townsite of Limerick.

19988—Aug. 5—Authorizing the G.T.R. to construct and maintain a culvert under its tracks, Twp. of Tecumseth, at the Seventh Con. line.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Albert County, N.B., extension of breakwater	Sept. 2.	Aug. 14.	80
Cascades Point, Que., rebuilding head of Guard Pier	Aug. 29.	Aug. 14.	78
Cayuga, Ont., macadam road	Sept. 16.	Aug. 7.	88
Cravelburg, Ont., interior fittings of post-office	Aug. 25.	Aug. 14.	78
Hamilton, Ont., conduit system	Aug. 28.	Aug. 14.	78
Nelson, B.C., vault	Aug. 25.	Aug. 14.	80
Ottawa, Ont., residences	Aug. 25.	Aug. 14.	80
Ottawa, Ont., substructure of bridge at Smith Falls	Sept. 6.	Aug. 14.	76
Ottawa, Ont., steel steamer	Aug. 28.	July 24.	80
Poupore, Que., training pier and revetment wall	Sept. 2.	Aug. 7.	80
Prince Albert, Sask., drill hall	Aug. 25.	Aug. 7.	82
Quebec, Que., installation of hot water heating apparatus.	Aug. 25.	Aug. 14.	80
Regina, Sask., construction of grade	Aug. 23.	Aug. 14.	78
Steelton, Ont., public building	Sept. 9.	Aug. 14.	82
St. Malo, Que., locomotive and car shops	Sept. 2.	Aug. 14.	76
Toronto, Ont., Toronto harbor works	Aug. 25.	July 17.	84
Toronto, Ont., harbor works	Sept. 2.	Aug. 7.	86
Toronto, Ont., pumps	Aug. 26.	Aug. 14.	78
Victoria Harbor, Ont., wharf	Sept. 8.	Aug. 14.	80
Victoria, N.S., bridges and culverts	Aug. 23.	Aug. 14.	78
Welland, Ont., Severn section	Aug. 25.	Aug. 7.	86
Welland, Ont., third section Welland ship canal	Aug. 27.	Aug. 14.	80
Winnipeg, Man., rifle range	Aug. 25.	Aug. 14.	82
Winnipeg, Man., drill hall	Sept. 3.	Aug. 7.	82

RAILWAYS—STEAM AND ELECTRIC.

Moose Jaw, Sask.—Double tracking on the Canadian Pacific Railway will be completed to Swift Current in a short time. The double track is now in operation, west as far as Chaplin, 54 miles, and east to Regina, 42 miles.

Ottawa, Ont.—Tenders will be received up till September 8th, 1913, for double tracking the line between St. Romuald and Chaudiere Curve, P.Q. Plans and specifications may be obtained at the Station Master's office, Levis, P.Q.; office of the Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, Ontario; and also at the Chief Engineer's office, Moncton, N.B. L. K. Jones, Assistant Deputy Minister and secretary, Ottawa.

Toronto, Ont.—Mayor Hocken has just signed the final plans providing for the construction by the railway companies of a viaduct along the waterfront, thus confirming the statements of the transportation companies that they will be in a position to invite tenders this autumn.

BRIDGES, ROADS AND PAVEMENTS.

Brantford, Ont.—Tenders will be received up till August 30th, 1913, for the construction of 7,810 linear feet of four-foot cement sidewalk. Plans and specifications may be obtained from Alan Mair Jackson, Town Engineer.

Cayuga, Ont.—Tenders will be received up till September 16th, 1913, for the construction of 26½ miles of stone macadam road. Plans and specifications may be obtained from County Engineers, Messrs. Jackson & Kyd, Dunnville. T. A. Snider, County Clerk.

Cranbrook, B.C.—Work has been commenced on the construction of the bridge across the Kootenay River from Mayook to Bull River.

Dover, Ont.—Tenders will be received up till August 25th, 1913, for the erection of two steel and concrete bridges, 73-ft. span over Little Bear Creek. Plans and specifications may be obtained from the offices of the Clerk or Engineer, W. G. McGeorge, Queen Street, Dover.

Galt, Ont.—An important move in the good roads direction was made by the council in contributing a thousand dollars towards a sixteen foot macadam road from Galt to Preston. North Dumfries Township gives two thousand. Waterloo also aids and the Auto League subscribes $1,000. The Government grant makes up the balance.

▲—**London, Ont.**—Tenders will be received up till September 11, 1913, for the supply and erection of three 130 feet spans rivetted truss steel highway bridge over the River Thames, the substructure for which is already under construction. Plans and specifications may be obtained from Wm. N. Ashplant, city engineer, London.

Moncton, N.B.—Tenders will be received up till August 22nd, 1913, for the extensions to sewers. Plans and specifications may be obtained from J. Edington, City Engineer.

Montreal, Que.—The Board of Control is considering contracts for a large amount of asphaltic macadam pavements and awards will likely be made within a few days. Tenders were opened last week, bids being received from a number of firms, including the Sicily Asphaltum Paving Co., the Warner-Quinlan Co., the Bitulithic Company, etc.

New Westminster, B.C.—The Great Northern Railway has decided to replace the old building near the Fraser River bridge, which has been for years designated as a station, with a temporary building to cost in the neighborhood of $5,000.

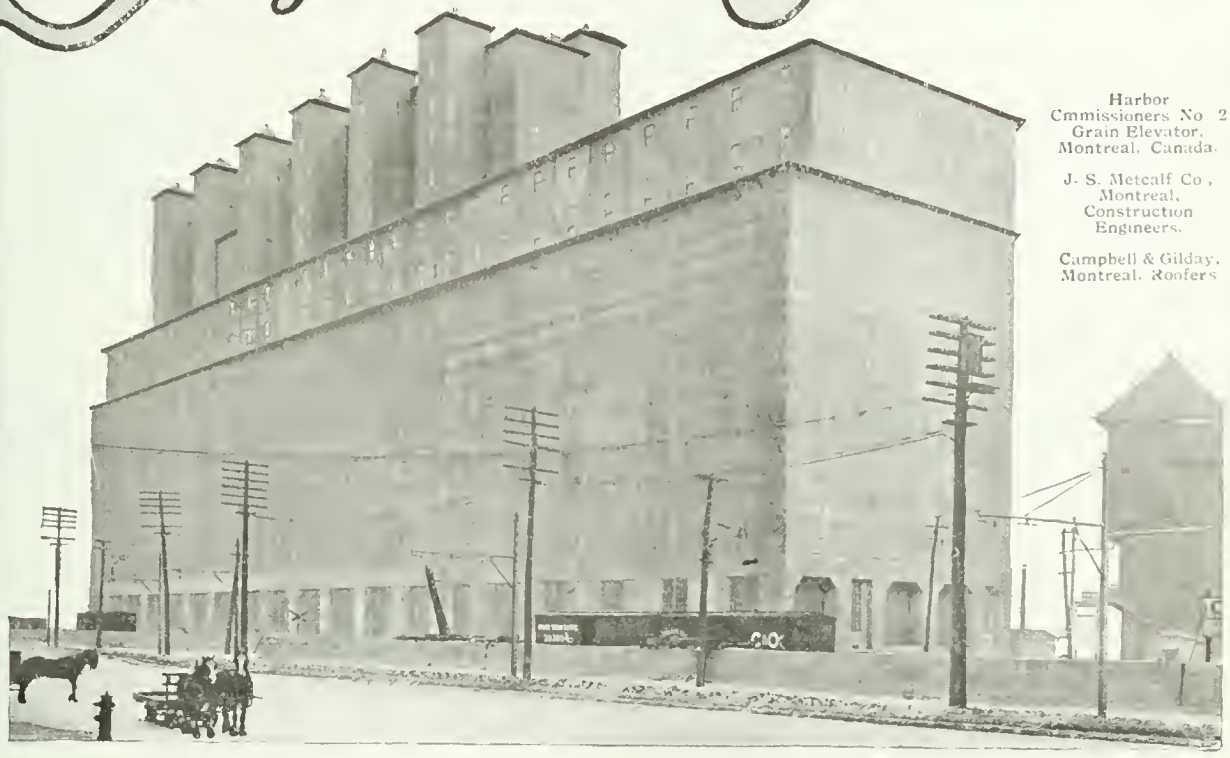
Ottawa, Ont.—An attempt is being made to get the Government to sanction the carrying out of the Channel Tunnel scheme. It is the desire of the English people to build a bridge across the English Channel. This bridge would be seventy miles long and the cost is estimated at $110,000,000.

+—**Regina, Sask.**—The following are the contracts for bridges that have been recently awarded by the Government:—Pinto Creek district, three bridges; North Battleford district, three bridges; Yorkton and Canora districts, four bridges to construct and five to repair; Prince Albert district, two bridges; Pelly district, four bridges: Saltcoats district, four bridges; Maple Creek district, two approaches to be graded; Pheasant Hills district, five bridges and repairs to a dam and bridge.

Regina, Sask.—The city council has contracted with the WESTRUMITE PAVING COMPANY for the construction of the paving on Rose Street, from the Canadian Pacific Railway station to South Railway Street. The company's tender was $1,701.60.

Regina, Sask.—Five steel bridges have been authorized by the provincial government and work will be proceeded with immediately. The bridges are as follows:—100 foot span over the Qu'Appelle River, near Disley; 40 foot span

Barrett Specification Roofs



Harbor Commissioners No 2 Grain Elevator, Montreal, Canada.

J. S. Metcalf Co., Montreal, Construction Engineers.

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As we have frequently pointed out, most of the large commercial buildings of the day are covered with a Barrett Specification type of roof.

For example, here is the great new grain elevator at Montreal. It is said to be the largest in the world, with a capacity of 2,600,000 bushels. It carries a Barrett Specification Roof 55,000 square feet in area.

The engineers chose this type of roof because it is the lowest-priced and most reliable roofing known.

Barrett Specification Roofs require no repairs or attention of any kind, they invariably last twenty years or more, and are fire-retardant.

Architects, engineers and owners of permanent buildings of all kinds should have a copy of the Barrett Specification on file.

A request will bring it by return mail.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification revised August 15th, 1911, using the materials specified and subject to the inspection requirement.

THE PATERSON MANUFACTURING COMPANY, LIMITED

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near Kandahar; 150 foot span over the Assiniboine River, near Preeceville; 126 foot span over the Whitesand River, near Canora; 150 foot span over the Assiniboine River, near Kamsack. The abutments of these bridges will be completed this fall.

Saskatchewan, Sask.—The Canadian Pacific high-level bridge across the Saskatchewan River, from Strathcona to Edmonton, is now completed, the cost of which is slightly over $1,000,000.

St. Catharines, Ont.—The city of St. Catharines is preparing to construct rocmac and concrete pavements to the estimated cost of over $26,000. J. A. Pay, City Clerk.

St. Catharines, Ont.—The city of St. Catharines is making provision for the construction of 4 and 5-foot concrete sidewalks, the estimated cost of which amounts to over $6,000. J. A. Pay, City Clerk.

Walkerton, Ont.—Mr. A. G. HAMPSON has been awarded the contract of putting on a new floor and repairing the East End bridge. The contract price is $1,700.

LIGHT, HEAT AND POWER.

Calgary, Alta.—Tenders will be received up till September 3, 1913, for the manufacture of luminous arc lamps standards. Plans and specifications may be obtained from the office of the City Electrician, Calgary, Alberta. J. M. Miller, City Clerk.

Cochrane, Ont.—Sutcliffe and Neelands, engineers, of New Liskeard, are making preparations to build a new concrete power house and install the new steel flume. The power house will be fitted with first-class machinery for the development of electric power.

Montreal, Que.—Tenders will be received up till August 21st, 1913, for the electric lighting installation at Bonsecours Market. Plans and specifications may be obtained from the Superintendent, Lighting Department, City Hall. L. N. Senecal, Secretary.

New Dundee, Ont.—New Dundee is carrying on an active campaign with a view to securing Niagara power. The proposition is to connect with the Baden line at Petersburg and to carry power south to New Dundee six miles. Mr. Purcell, one of the engineers of the Hydro Commission, was in New Dundee and explained matters. Now it is only a question as to the amount of power to be subscribed. The villages of Phillipsburg and Wellesley are also seeking information with a view to carrying the power north.

Regina, Sask.— BRUCE, PEEBLES & COMPANY, LIMITED, of Edinburgh, have been awarded by the City Commissioners the contract for supplying a 1,200 K.W. motor generator.

Wentworth, Ont.—Tenders will be received up till August 25th, 1913, for alterations to the steam heating system in the Court House. For particulars apply to George Anderson, Engineer.

GARBAGE, SEWAGE AND WATER.

Calgary, Alta.—City Waterworks Engineer Fawkes is now investigating for Calgary the advantages of a modern mechanical filtration plant and pumping stations with a capacity of forty million gallons per day. Calgary has considered filtration before, but owing to the possibilities of being able to obtain a pure mountain supply the filtration project was abandoned. Mr. Fawkes is strongly in favor of filtration, and, supported by the administration and general public, will expedite matters along these lines at an early date.

Moncton, N.B.—Tenders will be received up till August 22, 1913, for extensions to sewers. Plans and specifications may be obtained from J. Edington, City Engineer.

Ottawa, Ont.—The city council awarded LOAMIS, McBEAN & WILLIAMS, of Montreal, the contract for lifting the old intake pipe, repairing and relaying it. The estimated cost is $17,000.

Peterboro, Ont.—An 18-inch feed main will be added to the waterworks system, on account of the rapid increase in population. Later in the year further extensions will be made.

Port Arthur, Ont.—Tenders will be received up till August 25th, 1913, for the installation of water main from Second Avenue to Midway. Plans and specifications may be obtained from City Engineer, Port Arthur, Ont. J. J. Hackney, Commissioner Utilities.

Regina, Sask.—The operation of the new sewage disposal works was commenced last week. All the work has now been completed, and it is hoped to be able to give the system a good try-out before winter sets in.

Saskatchewan, Sask.—The work on the Saskatchewan River is good for navigation as far as Le Pas, Manitoba, and orders have been received to complete it to Grand Rapids. A channel ten to twenty feet deep was found the entire way from Cumberland House and extra work was unnecessary. Eventually the waterway will be continued through to Winnipeg, Manitoba.

Stratford, Ont.—The Council instructed City Engineer Manson to proceed at once with plans for addition to the sewage disposal works, as ordered by Provincial Engineer Dallyn, including sedimentation tanks, chlorination device, humus beds and auxiliary pumping equipment.

St. Catharines, Ont.—The city of St. Catharines intends to construct tile sewers on a number of its streets, the estimated cost of the work being $3,500. J. A. Pay, City Clerk.

INDUSTRIAL WORKS.

+—**Burrard Inlet, B.C.**—Grant, Smith and McDonnell have been awarded the contract for the under-structure work on the warehouses to be built on the new Great Northern Railway. Work will commence shortly.

Calgary, Alta.—A report from Ottawa states that the Government will shortly undertake the construction of a $300,000 office building for the accommodation of local federal officials.

Calgary, Alta.—The Federal Government intends to build one of the finest post-offices in the Dominion.

Calgary, Alta.—A new government armory building will be commenced as soon as the council can decide upon a suitable site.

Dundas, Ont.—The Tocan Manufacturing Company, capitalized at a quarter of a million dollars, has purchased a factory on Cross Street, and will shortly start to manufacture different kinds of sheet metal goods.

Edmonton, Alta.—Nicholson & Bain, of this city, will spend $70,000 in the construction of a six-story warehouse. It will be of brick and stone, with a concrete foundation.

Edson, Alta.—The town council are considering the arrangements for the construction of a new fire hall.

Fort William, Ont.—The Department of Militia and Defence is calling for tenders for the construction of an armory building. The proposed armory will be one of the largest and most up-to-date in the Dominion. Plans of the building may be seen at the office of the City Clerk of Fort William.

Fort William, Ont.—Tenders will be received up till September 4th, 1913, for the construction of a new drill hall. Plans and specifications can be obtained at the offices of the District Officer Commanding Military District No. 10, Winnipeg, Man.; the City Clerk, Fort William, Ont., and the Director-General of Engineering Services, Headquarters, Ottawa. Eugene Fiset, Deputy-Minister, Ottawa.

+—**Fredericton, N.B.**—SMITH, MERRITHEN AND COMPANY have been awarded the contract for the construction of several buildings. The contract price is $39,400.

+—**Greenwood, B.C.**—JOHN BEMIS & SON have been awarded the contract for a public building. The contract cost is $41,000.

Halifax, N.S.—The new warehouse which is to cost in the neighborhood of $100,000 will be begun shortly.

Humboldt, Sask.—A new public school has been recommended for the town of Humboldt. It will cost in the neighbourhood of $65,000.

+—**Indian Head, Sask.**—James McDiarmid and Company, of Winnipeg, has been awarded the contract for a new drill hall. The contract price is $13,700.

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MANNESMANN TUBES

Six Hundred Authorities Are Using Mannesmann Tubes

in Great Britain in varying quantities up to 15 miles; in Canada, to 17 miles.

Seven hundred miles of weldless steel spigot and faucet tubes—quite apart from flanged tubes and lapwelded spigot and faucet tubes—are in use in the United Kingdom, as well as large quantities in Canada, Australia, South Africa, South America, India, China, New Zealand and Europe.

We are constantly adding new customers to our list, and, what is of even greater significance, more frequently still receiving repeat orders.

Solid drawn tubes are used in places where it is impossible to use cast-iron pipes or lapwelded tubes, as well as in places where the conditions are more normal.

In the past five years the sale of Mannesmann weldless steel spigot and faucet tubes (home trade alone) increased one thousand per cent., and during the last financial year reached the figure of about 5,000 tons, equal to 15,000 tons of cast-iron, in addition to a large export business.

MANNESMANN TUBE CO. LIMITED

59 Victoria Square, MONTREAL

BOOKLETS ON REQUEST

Listowel, Ont.—Tenders will be received up till September 16th, 1913, for the construction of a new drill hall. Plans and specifications may be obtained at the offices of the Officer Commanding the First Division, London, Ont.; the Town Clerk, Listowel, Ont., and the Director-General of Engineer Services, Headquarters, Ottawa. Eugene Fiset, Deputy Minister.

Medicine Hat, Alta.—The Western Threshing Machine Company, capitalized at $100,000, intend to erect a large plant here. They have been granted the usual concessions, and will manufacture a newly patented thresher. It is expected that it will be in operation in a very short time.

+—Montreal, Que.—John Metcalfe Company, of Montreal, have been awarded the contract for the erection of all buildings on the new lake shore line of the Canadian Pacific Railway, giving a double track between Montreal and Toronto.

+—Montreal, Que.—A. C. Stewart has been awarded the contract for the construction of the Fife Hardware Company's wholesale warehouse. The contract price is $40,000.

Montreal, Que.—The Imperial Wire and Cable Company have just received a permit to build a $1,100,000 works. The building will vary in height from four to eight stories and will be built by Mr. E. G. M. Cape and the Dominion Bridge Company.

Montreal, Que.—It is reported that Lockwood, Greene & Company, engineers and architects for industrial plants, are establishing a branch office in Montreal.

Montreal, Que.—A new grain elevator, especially for export trade, with a capacity of nearly three million bushels, will be built by the Harbor Commissioners. Although the site has not been decided upon, it was announced by an official that the new elevator will be situated in the east end in such a way that boats can be unloaded on one side and loaded on the other.

Moose Jaw, Sask.—Tenders will be received up till September 8th, 1913, for a grain elevator. Plans and specifications may be obtained from the Board of Grain Commissioners for Canada, Fort William, Ont. T. J. Code, Acting Deputy Minister, Ottawa.

North Battleford, Sask.—The following public buildings have been recommended:—A new school costing $145,000, and a new post office costing $50,000; also a government armory to cost $25,000.

+—North Lethbridge, Alta.—Bario Secont, contractor of Blairmore, has been awarded the contract for the erection of a factory for the Marinaro Brothers.

▲—Ottawa, Ont.—The Government has invited architectural sketch designs for the erection of departmental and courts buildings, which are to be in not later than January 2nd, 1914. Conditions for these designs may be had on application to R. C. Desrochers, secretary, Department of Public Works, Ottawa, and also at the office of the High Commissioner for Canada, 17 Victoria Street, London, England. R. C. Desrochers, secretary, Ottawa.

Prince Albert, Sask.—Tenders will be received up till noon, August 25th, 1913, for the construction of a drill hall. Plans and specifications may be obtained from Eugene Fiset, Deputy-Minister, Ottawa.

+—Red Deer, Alta.—NESBITT & MILLER have been awarded the contract for a drill hall. The contract price is $36,000.

+—Red Deer, Alta.—Nesbitt and Millar have been awarded the contract for an armory building. It will cost approximately $36,000.

Sarnia, Ont.—The harbor improvements here are being held up at the present time on account of the town councillors not being favorable to dredging in the bay, which is just above the waterworks intake pipe. It will be remembered that the Government set aside $50,000 last year to start these improvements.

Saskatoon, Sask.—Tenders will be received up till September 8th, 1913, for a grain elevator. Plans and specifications may be obtained from the Board of Grain Commissioners for Canada, Fort William, Ont. T. J. Code, Acting Deputy Minister, Ottawa.

Smith's Falls, Ont.—Contracts for all the new buildings along the new Canadian Pacific Railway line from Agincourt to Smith's Falls have been awarded to JOHN METCALFE. The contract includes seven brick stations, nine wooden stations, nine forty thousand gallon water tanks, a ten-stall engine-house and sand-house, an icehouse, nine freight sheds, seven station residences, twenty-five tool houses and other small structures, making a total of eighty-five buildings.

Steelton, Ont.—Tenders will be received up till September 9th, 1913, for the construction of a public building. Plans and specifications may be obtained from Thomas R. Wilks, 612 Queen Street, Sault Ste. Marie, Ont., and also from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

+—Sudbury, Ont.—DORAN AND DEVLIN, of Ottawa, have been awarded the contract for the construction of a public building. The contract price is $98,200.

Thorold, Ont.—Pilkington Bros., Limited, are erecting a glass factory at Thorold, Ont., and desire to get in touch with some first-class machine shops and foundries in which they could have fabricated the special machinery necessary to glass-making. Machine shops and foundries who might desire to bid on this work are requested to write to A. R. Turnbull, 29 Chestnut Street, St. Catharines, Ont.

Toronto, Ont.—The Department of Militia and Defence combined with the contract branch of the Department of Public Works, has cancelled the tenders for the new barracks at Long Branch, Toronto. It is expected that new tenders will be called for by the end of this month.

+—Trenton, Ont.—JOHN METCALFE COMPANY, of Montreal, have been awarded the contract for the erection of a new station, and also a freight shed nearly a hundred and fifty feet long, enclosed tank with 40,000 gallons capacity, tool house, turntable, twelve-stall locomotive house, machine and boiler house, and coaling plant.

+—Vegreville, Alta.—A. E. Jennings has been awarded the contract for the construction of a drill hall. The contract price is $15,000.

Winnipeg, Man.—Tenders will be received up till September 3rd, 1913, for the construction of a drill hall. Plans and specifications may be obtained from H. E. Matthews, Superintending Architect of the Dominion Public Buildings, Winnipeg. R. C. Desrochers, Secretary.

Yorkton, Sask.—The Provincial Government has announced its intention of erecting a new telephone exchange at this point in the near future.

MISCELLANEOUS.

Annapolis County, N.S.—Tenders will be received up till September 3rd, 1913, for the construction of ice piers. Plans and specifications may be obtained at the Department of Public Works, Ottawa, and at the offices of C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S.; F. G. Goodspeed, Esq., District Engineer, St. John, N.B., and on application to the Postmaster at Annapolis Royal, N.S. R. C. Desrochers, secretary, Ottawa.

Fort William, Ont.—Tenders will be received up till September 4th, 1913, for an armory and drill hall, which the Government will build on a site donated by the city. Plans and specifications may be obtained from A. McNaughton, City Clerk.

Fraser River, B.C.—Tenders will be received up till September 30th, 1913, for the construction of jetty and dredging at the North Arm of the Fraser River. Plans and specifications may be obtained from the offices of C. C. Worsfold, Esq., District Engineer, New Westminster, B.C.; W. Z. Earle, Esq., District Engineer, Winnipeg, Man.; J. S. MacLachlan, Esq., District Engineer, Victoria, B.C.; J. L. Michaud, Esq., District Engineer, Postoffice Building, Montreal, P.Q.; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Vancouver, B.C. R. C. Desrochers, secretary, Department of Public Works.

+—Hamilton, Ont.—The Canadian Porcelain Company, of Hamilton, Ontario, have awarded the SMART-TURNER MACHINE COMPANY, Ltd., of Hamilton, Ontario, the contract for one of their automatic feed pump and receivers.

+—Island River, N.D.—W. J. POUPORE has been awarded the contract for dredging Island River. The contract price is $6,800.

Montreal, Que.—JAMES HOWDEN & CO., LIMITED, Glasgow, Scotland, have been awarded the contract to install a Wallsend-Howden patent system of oil burning in connection with the locomotive tube boiler at McGill University, Montreal.

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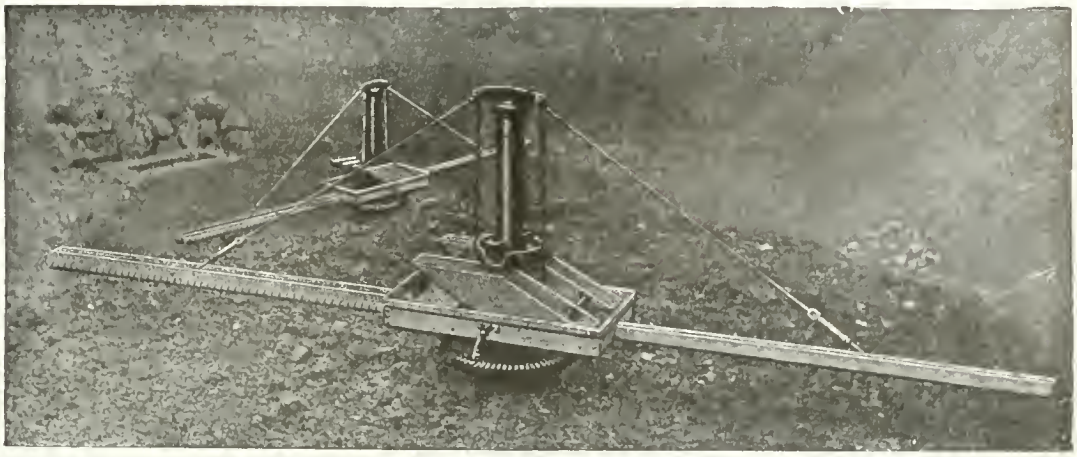

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CHEMICAL FEED DEVICES
OPERATING TABLES FILTER STRAINERS
"HEAD AND FALL" Recording Gauges for Water Wheel Plants
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Nine years of operation in large and important installations in England have demonstrated that an effluent exceptionally low in suspended solids and as free from odor as the entering sewage may be obtained with The Hampton Tank.

The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction ot the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

Sterilization Co.
Union Building, Clinton Street
NEWARK, N. J.
Also engineers for the electrolytic treatment of water.

Montreal, Que,—A new grain elevator will be built by the harbor commission as soon as a suitable and convenient site has been decided upon.

New Westminster, B.C.—BROLEY & MARTIN, of New Westminster and New York, have been awarded the contract for the completion of the first unit of the north jetty at the Fraser River sandheads. The contract price is $83,500.

Ottawa, Ont.—Tenders will be received up till September 2nd, 1913, for construction of a concrete foundation and floor, St. Gabriel Shed No. 1, Lachine Canal. Plans and specifications may be obtained from the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer of the Quebec Canals, New Birks Building, Montreal, Que. L. K. Jones, assistant Deputy-Minister and Secretary, Department of Railways and Canals, Ottawa.

Pembroke, Ont.—Tenders will be received up till September 2nd, 1913, for the construction of a new drill hall. Plans and specifications may be obtained from Town Clerk, Pembroke, Ont.; Director-General of Engineer Services, Ottawa, Ont., and also at the offices of the officer commanding the third Division, Kingston, Ont. Eugene Fiset, Deputy Minister.

Prescott, Ont.—Tenders will be received up till August 28th, 1913, for the construction of a single screw steel steamer. Plans and specifications may be obtained from the office of the Purchasing Agent of the Marine and Fisheries Department, Ottawa; at the offices of the Collectors of Customs, Toronto, Collingwood and Port Arthur, and at the Agencies of the Department of Marine and Fisheries at Montreal, Quebec, St. John, Halifax and Charlottetown. Alex. Johnston, Deputy-Minister.

▲—**Regina, Sask.**—Tenders will be received up till October 1st, 1913, for the supply of coal bunkers, ash hoppers, coal and ash conveyers and crushers. Plans and specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

Sarnia, Ont.—The harbor improvements are being held up at the present time on account of the town councillors not being favorable to dredging in the bay, which is just above the water works intake pipe. It will cost the Government $50,000 for improvements.

+—**St. Catharines, Ont.**—The Corporation of St. Catharines have awarded the SMART-TURNER MACHINE COMPANY, Ltd., of Hamilton, the contract for a duplex pump.

St. John, N.B.—Tenders will be received up till August 21st, 1913, for rebuilding wharf. Plans and specifications may be obtained from Common Clerk's office, St. John, N.B. H. B. Schofield, Commissioner of Harbors, Ferries and Public Lands.

Vancouver, B.C.—The Amalgamated Drydock and Engineering Company, of Vancouver, is applying to the Department of Public Works for a subsidy for the construction of a floating drydock to cost $2,500,000. The dock will be capable of accommodating the largest class of vessels.

+—**Walkerton, Ont.**—Mr. JOSEPH SCHICKLER, of Deemerton, was awarded the contract for the erection of a big cement breakwater. The contract price is $6.30 a cubic yard, the total cost of which will amount to $1,000.

+—**Welland, Ont.**—The Canadian Steel Foundries, Welland, Ontario, have awarded the SMART-TURNER MACHINE COMPANY, Ltd., of Hamilton, the contract for a centrifugal pump.

CURRENT NEWS.

Brantford, Ont.—The steel work on the Grand Trunk Railway bridge over the Grand River is progressing. Another span has been taken down and a new steel span has been placed at the eastern end of the bridge.

Saskatoon, Sask.—R. J. Lecky Company, of Regina, has been awarded the contract for the construction of the Twenty-fifth Street bridge, which will be the fifth bridge to span the river at Saskatoon. The sum involved in the contract is in the vicinity of $400,000, one-third of which will be paid by the city and two-thirds by the Provincial Government. Work will commence immediately and will be completed about the fall of 1915. The structure will be of reinforced concrete. After work is properly under weigh, a gang of 150 men will be continually employed. Lecky's tender was the lowest received. The others varied considerably, the highest being $800,000.

PATENTS.

Below will be found a complete up-to-date list of patents recently granted to inventors in Canada and United States, which is furnished by Messrs. Fetherstonhaugh & Company, patent barristers, solicitors, etc.; head office, Royal Bank Building, 10 King Street East, Toronto. Offices in Hamilton, Montreal, Ottawa, Winnipeg, Vancouver and Washington, D.C., from whom all information may be readily obtained:—

Canadian Patents.

G. Weston, et al., display racks; P. Szumenski, breakers for cars; E. Heroux, windows; J. J. Richardson, disinfecting apparatus; A. B. Woonton, et al., holding cardboard boxes; W. J. Brennan, et al., ladies' under vests; H. Schindel, et al., attachments for cars; J. D. Clemence, vulcanizers; C. De Cazen, cigarette-making machines; P. Garant, combination hat and coat hooks; J. A. Houle, pastry cutters; A. Jeffrey, advertising devices; Z. Langlais, fountain brushes; J. H. Letourneau, cow trusses; J. McAninch, feed-water heaters for locomotive boilers; S. C. Matthews, educational devices; J. E. Menancon, animal traps; E. Menkin, deodorizing and disinfecting appliances; J. E. Sargent, brushes; H. H. Vaughan, appliances for locomotive cabs and tenders; H. Videbak, automatic air steam coupler attachments for railway cars; A. H. Woodworth, ticket wickets; H. Schindel, et al., signalling devices; J. Schwab, railway signals.

United States Patents.

G. L. Hogan, oil burner; T. McOuat, valve for pulp-pumps; J. W. Mowbray, carbureter.

MONTREAL LETTER

Montreal, August 16th, 1913.

Philadelphia advices say that the falling off in daily rate of production of iron in July, 82,601 tons per day, compared with 87,619 in June, was 5.7 per cent., much the heaviest since production turned downward, although the rate has really been declining since February.

In that month the daily average rate was 92,369, or at the rate of 33,800,000 per year. July daily rate was equivalent to 30,150,000 tons per year, a reduction of 10.8 per cent. from the high record of February, the daily average of which month was the greatest ever recorded. The heaviest calendar month was May, when production was 2,822,217 tons, and daily rate was therefore 91,039 tons. July production of 2,560,646 tons was the smallest for any month of the year and was 261,571 tons less than May.

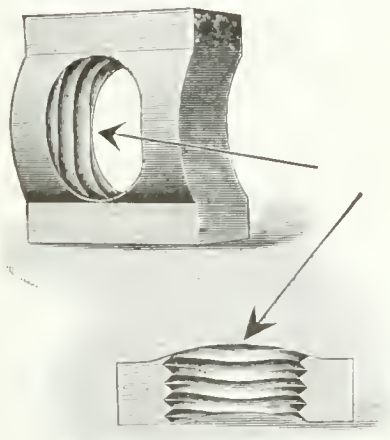
August will undoubtedly witness a continuance of curtailment in production. Sixteen furnaces went out of blast in July and those remaining in blast August 1, had daily capacity of 81,657 tons, compared with 88,020 July 1st. This would point to a reduction of about 2,450,000 tons in August, bearing in mind that actual production never quite reaches theoretical productive capacity. Production was affected adversely by the heat during July and this factor will probably be of smaller importance during the current month.

In the Montreal market, practically no change has taken place nor do iron and steel men look for any change of consequence for some time to come. The tightness of money is now undoubtedly the controlling factor. During the past few days, this tightness seemed to be giving way if one were to judge from the stock markets, but apparently the revival was only temporary and is apt to be succeeded by some re-action. In any case, it seems unlikely that there can be any marked improvement until the money situation alters materially, and an alteration of this character cannot be brought about over-night. It looks, therefore, very much as though buying will not recover very greatly.

Pig iron is moving in small quantities and there will be some recovery before the close of navigation. Throughout the market for iron and steel and products there has been very little alteration in price.

Carl Zeiss (London), Limited, of England, have made arrangements with E. R. Watts and Son, Canada, Limited, of Winnipeg and Ottawa, for the latter firm to act as sole agents for Canada for the sale of Zeiss surveying and engineering instruments.

Throw Away Your Keys and Cotter Pins



This cut shows an exaggerated curve in thread pitch—or more (in order to emphasize this feature) than is given in practice.

There is now no longer any need for them. They were good in their day, but have fulfilled their mission. The world moves and there is now a better way to keep nuts on.

The Grip Nut is the device to do it with. It requires no hole, slot or other change in the bolt and does away with the necessity for cotter pins, keys or other auxiliary fastenings.

The Grip Nut can be removed and put back on again without injury to the threads of either the bolt or nut. It starts easily with the fingers, and then can be tightened with a wrench.

Grip Nuts

Are being used by the millions on all kinds of machinery, elevators, conveyors, concrete mixers, steam shovels, bridge construction, motor trucks, automobiles, pumps, agricultural implements, etc. They are also being used in vast quantities by the leading railroads.

Universal use is the surest indication of satisfaction.

The secret of the efficiency of the Grip Nut is in the arch, and it is by means of this arch that the thread deflection is given, which enables the Grip Nut to lock on the threads of the bolt.

Manufacturers of machinery, from which it is important that nuts should not lose off, are now using Grip Nuts instead of the old style cotter pins and split keys, or double nut practice.

Grip Nuts are made in all sizes, square and hexagon.

We will cheerfully send catalogue and sample nuts on request. Mention size of bolt.

SALES AGENTS

The Canadian Fairbanks-Morse Co., LIMITED

ST. JOHN QUEBEC MONTREAL OTTAWA TORONTO
WINNIPEG SASKATOON CALGARY VANCOUVER

TENDERS CALLED FOR

THE COMMISSIONERS OF THE TRANSCONTINENTAL RAILWAY.

NOTICE TO CONTRACTORS.

TENDERS FOR LOCOMOTIVE AND CAR SHOPS AT ST. MALO, P.Q.

SEALED TENDERS addressed to the undersigned, and marked on the envelope, "Tender for Shops," will be received by the Commissioners of the Transcontinental Railway at Ottawa, Ontario, until 12 o'clock noon of **Tuesday, 2nd September, 1913,** for the construction and erection complete, in accordance with the plans and specifications of the Commissioners of a Locomotive and Car Shop repair plant at St. Malo, P.Q.

The plans, details and specifications, which will include the locomotive and car shops, the yard sewerage system and drainage system, yard water system, and the yard grading and track-laying, may be seen at the office of Mr. Gordon Grant, Chief Engineer, Ottawa, Ontario, and at the office of Mr. A. E. Doucet, District Engineer, Quebec, P.Q.

Persons tendering are hereby notified that tenders must be made on the printed forms supplied by the Commissioners. These may be had on application to Mr. W. J. Press, Mechanical Engineer, Ottawa, Ontario, or to Mr. A. E. Doucet, District Engineer, Quebec, P.Q.

Each tender must be signed and sealed by all parties to the tender, and witnessed, and be accompanied by an accepted cheque on a chartered bank of Canada, payable to the order of the Commissioners of the Transcontinental Railway for the sum of ($50,000.00) Fifty Thousand Dollars.

The cheque received from the party whose tender is accepted will be deposited to the credit of the Receiver-General of Canada, as security for the due and faithful performance of the contract, according to its terms.

Cheques received from parties whose tenders are rejected will be returned within ten days after the signing of the contract.

The right is reserved to reject any or all tenders.

By order,

P. E. RYAN,
Secretary.

The Commissioners of the Transcontinental Railway.

Dated at Ottawa, Ont., July 28th, 1913.

Newspaper inserting this advertisement without authority from the Commissioners will not be paid for it.—45825.

CAYUGA, ONT.

Sealed tenders will be received up to noon on the 16th day of September, 1913, by the undersigned at Cayuga, Ontario, for the construction of twenty-six and one-half miles of stone macadam road in the county of Haldimand.

The work will be let in three separate and distinct contracts, not necessarily to the same individual.

Tenderers are required to examine the localities of the work and are requested to be present at the opening of the tenders at 2 p.m., on Wednesday, the 17th day of September, 1913.

Plans and specifications may be seen at the office of the County Engineers, Messrs. Jackson and Kyd, Dunnville, or may be had from them on the payment of $10, which sum will be refunded on return of the documents.

Lowest or any tender not necessarily accepted.

T. A. SNIDER, K.C.,
County Clerk,
County of Haldimand,
Cayuga, Ont.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

WELLAND SHIP CANAL.

SECTION No. 3.

NOTICE TO CONTRACTORS.

SEALED TENDERS, addressed to the undersigned and marked, "Tender for Section No. 3, Welland Ship Canal," will be received at this office, until 2 p.m., on **Wednesday, August 27th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, St. Catharines, Ontario.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered bank of Canada, for the sum of $400,000.00, made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 2nd August, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—46052.

CITY OF LONDON.

TENDERS FOR STEELWORK.

Sealed proposals addressed to the Chairman and Members No. 2 Committee will be received at the office of the City Clerk up to 5 p.m. on Thursday, 11th day of September, 1913, for the supply and erection of three 130 feet spans rivetted truss steel highway bridge over the River Thames, the substructure for which is already under construction.

Plans, specifications and all particulars can be had at the office of the City Engineer.

No tenders will be considered unless accompanied by a deposit cheque for 5 per cent. amount of the bid.

The lowest or any tender not necessarily accepted.

B. W. BENNETT,
Chairman No. 2 Committee.

Wm. N. ASHPLANT,
City Engineer.

(For further Tenders see page 86.)

When designing

structures do you pay sufficient attention to the various matters that govern insurance ratings?

Not only can you add greatly to the fireproofness of buildings by adopting our suggestions, but it is very likely that you can do so without the improvements costing anything ultimately. They will be paid for by the lower insurance rates.

Correspondence solicited. We have a staff of engineers and inspectors trained in this highly specialized line. Make use of our services.

E. M. SELLON & CO.

LIMITED

INSURANCE ENGINEERS

and Insurance Brokers

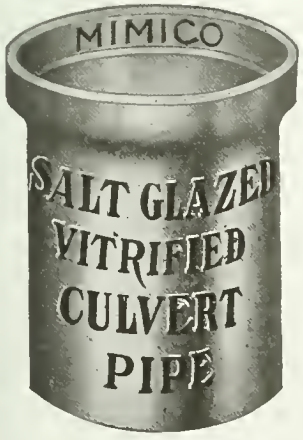
DIRECTORS:

E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

In making sewer pipe

many pieces come from the kilns with imperfections. They are rendered imperfect by having pieces broken out of the socket or spigot end, or having fire cracks at either end or extending partly through the body of the pipe. Or they may be imperfect in shape, out of round or not straight; not thoroughly vitrified or glazed; or with blisters or scales blown off the outside. Such pieces cannot be classed as strictly first-class pipe. When buying pipe from us one can rest assured that we will never deliver pipe with imperfections such as above unless "seconds" are particularly asked for by the purchaser.



Round Pipe and Square Dealings *Write for 1913 Catalogue*

The Ontario Sewer Pipe Co.

LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

RENOUF PUBLISHING CO.

25 McGill College Ave.

MONTREAL

NOW READY

The Elements of Specification Writing

A Text-book for Students in Civil Engineering.

By Richard Shelton Kirby, C.E., Professor of Civil Engineering, Pennsylvania College; Member of the Society for the Promotion of Engineering Education. 8vo, vii + 125 pages. Cloth, $1.25 net.

A text-book on the art of specification writing. While intended primarily for the classroom, it will also prove of value to the young engineer in practice. Includes the fundamentals of a contract, particularly of a construction contract with its attendant plans and specifications concisely brought out.

FOURTH (Revised and Enlarged) EDITION

Treatise on Wooden Trestle Bridges and their Concrete Substitutes

According to the present practice on American Railroads.

By Wolcott C. Foster. 4to, ix + 440 pages, 180 figures, 76 full page plates. Cloth, $5.00 net.

This revision will prove of benefit and use, not only to those engaged in steam railroad work, but also to those engaged in electric railway work and to manufacturing plants having or desiring to construct elevated tracks for the cheap handling and unloading of materials.

FOURTH EDITION, Revised and Enlarged

Steam Power Plant Engineering

By G. F. Gebhardt, Professor of Mechanical Engineering, Armour Institute of Technology. 8vo, xvi + 989 pages, 605 figures. Cloth, $4.00 net.

The development of steam power plants has been so rapid during the past three years that it has become necessary to re-write the book. Particular attention is called to the chapters on Fuels, Combustion, Engines, Turbines, Condensers, Finance & Economics.

Note the reduction in price from $6.00 net to $4.00 net.

Steam Engineering A Text-book

By William R. King, U.S.N., Retired. Principal of the Baltimore Polytechnic Institute. 8vo, vii + 450 pages, 177 figures. Cloth, $4.00 net.

A text-book for students of universities and advanced secondary technical institutes.

Presents concisely the principles and constructive details of the make-up of a steam-power plant, together with such calculations as are necessary for a practical knowledge of steam engineering.

Tenders Called For

PROPOSED GOVERNMENT BUILDINGS, OTTAWA, ONT.

Architects are invited to submit sketch designs in a preliminary competition for the erection of departmental and courts buildings.

From the designs submitted in this preliminary competition, six will be chosen by the Assessors, the authors of which will be invited to submit more matured designs in a final competition, for which the five unsuccessful competitors shall each receive an honorarium of three thousand dollars ($3,000).

The author of the design placed first by the Assessors will be entrusted with the work which the Government intends carrying out at once.

The competition is limited to British subjects practising in the British empire.

The Government has appointed Mr. T. E. Collcut, Mr. J H. G. Russell and Mr. J. O. Marchand, as Assessors to act in its behalf.

The designs in the first competition must be delivered in Ottawa (carriage paid) not later than 12 o'clock noon, 2nd January, 1914, addressed to the undersigned.

Conditions for both competitions may be had on application to the undersigned, and at the office of the High Commissioner for Canada, 17 Victoria Street, London, England.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, August 18, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—44890.

CITY OF REGINA, SASK.

Sealed tenders, registered and clearly marked on the outside of the envelope "Tender for Power-House Equipment," and addressed to the City Commissioners at Regina, Sask., will be received up till noon of October 1st, 1913, for the supply of:—

Coal bunkers, ash hoppers, coal and ash conveyers and crushers.

Price to be on equipment erected on foundation built by the City of Regina according to contractor's requirements.

A marked cheque for 5 per cent. of the amount of the bid, and made payable to the City Treasurer, City of Regina, must accompany each tender.

Specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

The City Commissioners reserve the right to reject any or all tenders.

(For Further Tenders see page 84.)

NEW INCORPORATIONS.

Edson, Alta.—Edson Hotel Company, $50,000.

Weyburn, Sask.—United Coal Company, $25,000.

Victoria, B.C.—Clark & Lyford, $20,000 (lumber dealers).

New Westminster, B.C.—Jones Cornell Construction Company, $50,000.

Medicine Hat, Alta.—Birnie Brothers, $150,000. Power Cities Investments, $30,000.

Napanee, Ont.—Wallace's Drug Store, $40,000. T. B. Wallace, W. K. Huston, C. M. Warner.

Vancouver, B.C.—Ship Simla Company, $5,000. C. G. Johnston, H. Boultbee, W. H. Walton.

Sault Ste. Marie, Ont.—Northern Laundry, $25,000. W. J. Harris, J. G. Duncan, E. C. Miller.

Newburgh, Ont.—Selby Telephone Company, $5,000. J. W. Demille, T. I. Winter, H. M. Ryan.

Lachine, Que.—La Compagnie Fournier, $99,000. A. Fournier, J. E. Morency, J. I. Fournier.

Windsor, Ont.—Bartlet, Macdonald and Gow, $350,000. C. Macdonald, A. Gow, G. F. Macdonald.

Haileybury, Ont.—Burnside Gold Mines, $3,000,000. T. H. Connor, E. W. Kearney, J. McN. Hall.

St. Agathe des Monts, Que.—Lafleur Industrielle, $49,000. J. E. A. Decelles, I. Demers, G. Wilson.

Quebec, Que.—Anglo-Canadian Abattoir and Cold Storage Company, $149,000. H. Ievers, J. P. Ross, R. R. Anderson.

Sherbrooke, Que.—Denault Grain and Provision Company, $150,000. D. O. E. Denault, A. Veilleux, A. C. Demers.

Bridgeburg, Ont.—International Specialty Manufacturing Company, $20,000. W. G. Edwards, F. E. Jackson, W. R. Krafft.

St. Stephen, N.B.—Clark Brothers, $49,000. John Clark, Lynchburg, U.S.A.; J. F. Clark and W. E. Clark, both of Marlboro, U.S.A.

Saint-Felicien, Que.—La Compagnie Industrielle de Saint-Felicien, $20,000. P. Dechene, Herbertville. Adjutor Rousseau, J. Guilmette.

Vancouver, B.C.—Deep Cove Development Company, $10,000. Okanagan Falls Water and Irrigation Company, $75,000. Wingdam Company, $75,000 (mining).

Vancouver, B.C.—Bridgeport Lumber Company, $250,000. Jovian Power Company, $10,000. Northern Oil Company, $200,000. McLennan, McFeely & Company, $5,000,000 (dealers in machinery). Vancouver Box Company, $100,000.

Calgary, Alta.—Evangelical Lutheran Immanuel Church, U.A.C., St. Mark's Church of the First Born, Ross Brothers, Limited, $25,000. Alberta Packing Company, $150,000. A. McKillop and Company, $250,000. Standard Wagon Company, $250,000. Dominion Oil Company, $10,000. Erz Automatic Lock Company, $60,000. Rjay Segar Stores, $10,000. Alberta Hotel of Okotoks, $25,000.

Montreal, Que.—LaSalle Construction Company, $50,000. W. R. L. Shanks, F. G. Bush, G. R. Drennan. American Flexible Bolt Company of Canada, $75,000. A. E. Howard, J. DeWitt, H. C. McNeil. Canadian Gurney Elevator Company, Limited, $50,000. G. W. MacDougall, L. Macfarlane, C. A. Pope. Argus Fire Alarm Company, $100,000. A. Guenette, L. A. Guenette, H. Guenette. Mexican Tin Corporation, Limited, $1,000,000. A. H. Duff, J. L. Muir, A. McMath. Willow River, Fort George, Syndicate, $150,000. W. R. L. Shanks, F. G. Bush, G. R. Drennan. Metals Extraction, $100,000. L. A. Rivet, L. G. Glass, J. A. Sullivan.

Toronto, Ont.—Hunton Gold Mines, $2,500,000. G. H. Sedgwick, A. G. Ross, E. V. McMillan. Zebrun and Barben Construction Company, $50,000. L. Macaulay, G. E. Anderson, M. L. McKinnon. Eglinton Park, $150,000. H. R. Moses, C. W. O. Goshorn, G. D. Waters, Newcastles, $200,000 (brokers). G. D. Waters, C. W. O. Goshorn, J. J. Flint. Standard Wrapping Machines, $220,000. J. P. Northey, T. H. Plummer, A. P. Holden. City Towel, Apron Supply and Laundry, $150,000. O. H. King, E. McL. Rowand, W. C. Johnston. Italian Courier Publishing Company, $40,000. G. Danovaro, L. Zaccaria, G. Colombo. Turbine Equipment Company, $40,000. J. L. Ross, D. J. MacLean, C. J. F. Collier. Buckham, $40,000 (fur dealers, etc.). J. P. White, Wasabika Binesott $1,000,000. Dillon, Parmenter, A. J. Thomson, W. S. Morlock. John A. McRae, $40,000 (ladies headwear and dress manufacturing). J. A. McRae, J. A. McRae, junr., F. W. Cooper. Real Estate Corporation of Canada, $40,000. H. M. Grills, J. C. Grills, W. H. Woulfe.

Refined to Definite Standards
BITUMEN 99%

MEXICAN EAGLE ASPHALT

TRADE MARK

Every Barrel Guaranteed Uniform
BITUMEN 99%

Mexican Eagle Paving Asphalt is specially adapted to the Canadian climate. It is not susceptible to changes in temperature. It will not mark in the hottest weather, nor is snow or ice likely to crack it. Dow and Smith, Chemical Engineers, say: "This is a very high quality of asphalt."

Every barrel of our asphalt is guaranteed to be uniform and according to analysis. This is the guarantee of our principals, the Mexican Eagle Oil Co. Limited, a Company that has over twenty-five million dollars working capital.

Mexican Eagle Paving Asphalt is superior in purity to Burmudez, Trinidad, Californian or any other asphalt on the market. It is a favorite also for its high cementing value and ductility.

We can also supply different grades of Mexican Eagle Asphalt for asphalt fillers, road binders, roofing asphalts, wooden water pipe coatings, waterproofings, etc. Also Durazzo Sicilian Rock Mastic Asphalt for sidewalks.

ANALYSIS
By DOW & SMITH, Chemical Engineers.

"Bitumen soluble in Carbon Disulphide	99%
"Bitumen soluble in Carbon Tetrachloride	99%
"Bitumen soluble in Penna naphtha boiling between 40° and 60° C.	78%
"Penetration at 77° F.	44
"Ductility unfluxed	22 cms.
"Penetration of Asphaltic Cement at 77° F.	50
"Ductility of Asphaltic Cement at 77° F.	45 cms.

"Remarks: This is a very high quality of refined Asphalt and is suitable in every respect for paving purposes."

For prices, samples and full particulars, please address

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

Illustration below shows a portion of our Mexican plant in the Isthmus of Tehuantepec. Every structure in sight belongs to the plant, but a large portion to the left is unseen. The capacity was recently increased by over fifty per cent. We can get 75,000 tons of the world's very best paving asphalt from this plant in 1914 if the Canadian cities and towns require that quantity.

SECOND-HAND MACHINERY

Second Hand Rock Crushers

100% of service in these machines, at **50% of their cost** when new. Send for complete Price List.

1—30"x 14" "Buchanan" Crushing Roll
1—24"x 14" "Buchanan" Crushing Roll (Manganese steel shells)
1—25"x 16" "Mosser" Crushing Roll
1—No. 5 "Gates" Gyratory
1—No. 4 "McCully" Gyratory
2—No. 3 "McCully" Gyratory
1—9" x 15" "Farrell" Jaw
1—No. 3 "Champion" Jaw
1—8" x 8" "Jeffrey" pulverizer

L. F. SEYFERTS' SONS, Inc.
437 North Third St., PHILADELPHIA, Pa., U S.A.

New and Second-hand
Contractors' Machinery For Sale
IMMEDIATE DELIVERY.

1—8"x12", double cylinder, double drum hoist with boiler (new).
1—7"x12", double cylinder, double drum hoist with boiler (new).
1—6"x12", double cylinder, double drum hoist with boiler (new).
1—6½"x8", double cylinder, double drum hoist with boiler (new).
1—5"x6", double cylinder, single drum hoist with boiler (new).
1—1 yard "Faivrette," clam bucket (new).
1—No. 2 Boom Swinger (new).
1—No. 21 Ransome Concrete Mixer on wheels (used).
1—No. 2 Austin Rotary Stone Crusher on wheels (used).
1—10"x10"x10", Steam Driven Air Compressor (new).
1—8"x10"x8" Steam Driven Air Compressor (used)
4", 5" and 6", Centrifugal Pumps d.-c. to Vertical Engines (new).
5, 8 and 12 ton stiff leg Derrick Irons (new).

H. W. PETRIE, Limited Front Street W. TORONTO

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

GAS ENGINE, 8 h.p., for sale cheap; in first-class condition. M. Pullan and Sons, Bay and Wellington Streets, Toronto.

FOR SALE at a snap: 60-H.P. Cowan and Co. engine and 80-H.P. Cowan and Co. boiler. Write for particulars, J. F. Barnard and Son, Spencerville, Ont.

FOR SALE.—One second-hand Marion steam shovel; model 20; has seen very little service and is in fine repair. Also one second-hand Marion shovel; model 30; revolving; in good repair. Low price for immediate sale. Address, R. B. Stewart, Whitby, Ont.

FOR SALE

Plant of the Alberta Engineering Company, Limited, in Manchester Sub-division, Calgary, Alberta; building 96 x 34, equipped with electric power, complete machinery with individual motors for structural steel plant, made up as follows:—

High-speed Friction Saw 40 inch blade, electric drive.
Rock River Power Shear, belt driven, 32 inch gap.
Rock River Punching Machine, belt driven, 30 inch gap.
Stewart Drill Press, belt driven, up to 1½ inch dia. drill.
Landis Bolt Cutter, belt driven, up to 1½ inch bolt.
Power Hack Saw.
Jib-boom Derrick, 40 foot boom.
Allan Squeeze Rivetter, 18 inch gap, compressed air.
Blaisdell Air Compressor, belt driven, 8 x 8, with receiver and cooling tank.
Gardner Air Compressor, 6 x 6, mounted on truck, with motor drive.
Grinder, 24 inch mandrill, double head, belt drive.
Two 10 H P., 3 phase, 60 cycle, 220 volt motors.
One 15 H P., 3 phase, 60 cycle, 220 volt motor.
Two 5 H.P., 3 phase, 60 cycle, 220 volt motors.
One 2 H P., 3 phase, 60 cycle, 220 volt motor.
All with starting boxes.
Two 3 ton "Cyclone" Chain Blocks.
One 2 ton Chain Block.
Boyer Air Hammer, 8 inch stroke.
Cleveland Pneumatic Hammer, size 9.
Cleveland Pneumatic Hammer, size 6, with snaps and hose complete.

The foregoing may be inspected at the plant of the Alberta Engineering Company, located as above, at any time, any working day, and will be offered for sale as a going concern or in individual units.

E. A. CUNNINGHAM,
Liquidator,
Alberta Engineering Company, Ltd.

NEW INCORPORATIONS.

Orangeville, Ont.—Dods Knitting Company, $100,000. A. Dods, M. MacDonald, F. H. Snider.

Listowel, Ont.—Perfect-Knit Mills, $50,000. M. K. Becker, Toronto, W. Climie, J. H. Bender.

Walkerville, Ont.—Walkerville General Hospital (no share capital). R. H. Revell, H. H. Walker, W. E. Seagrave.

Kingston, Ont.—Frontenac Floor and Wall Tile Company, $250,000. J. C. Connell, J. T. Richardson, C. A Macpherson.

Grand Mere, Que.—La Compagnie de Raffinerie Canadianne, $49,000. A Brunelle, A. Audet, O. Bernard, all of Three Rivers.

Couteau du Lac, Que.—La Compagnie Hydro-Electric du Couteau du Lac. A. Jeannotte, Couteau Landing; J. A. Bourbeau, Quebec; J. Langevin.

Carberry, Man.—Manitoba Independent Oil Company, $100,000. F. L. Saunders, Carberry; R. W. Simpson, Portage la Prairie; F. W. Rosser, MacGregor.

Ottawa, Ont.—Theatre Francais, $40,000. M. H. Mark, S. Ginsburg, E. L. Falk. Brantwood, $100,000 (real estate). W. Y. Dennison, E. F. Holcombe, J. H Barker.

Toronto Ont.—Page & Company, $250,000 (builders). W. Page, G. H. Kilmer, J. A. McAndrew. Bay of Quinte Wood Company, $500,000. C. E. Bailey P. C. Deeble, A. M. Denovan.

Winnipeg, Man.—Austin Paper Manufacturing Company, $150,000. L. N. Austin, Mrs. A. M. Austin, R. D. Waugh. Maple Leaf Wine Company, $25,000. W. G. Lock, H. Green, D. M. Gunn.

Quebec, Que.—Tunnel Land Company, $70,000. Lockwell and Leclerc, P. A. Choquette, E. P. Bebube. Mount Murray Woodlands Corporation, $25,000. A. Galipeault, L. L. St. Laurent, H. Laferte.

The Industrial Engineering and Machinery Company, Limited, located in the Shaughnessy Building, Montreal, have taken the agency for chain belt concrete mixers manufactured in Milwaukee, Wisconsin, and will act as exclusive agents.

CANADA Portland CEMENT

SOME men ask for so many bags of "cement"—

Others, more careful, say they want "Portland Cement"—

But the man who does the best work insists upon getting "Canada" Portland Cement—

And he looks to see that every bag bears this label

To specify Canada Portland Cement, is to introduce an additional safety factor into your calculations. Architects, contractors and engineers know the value of "making assurance doubly sure."

Canada Cement Company Limited

Head Office, - - - - MONTREAL

Sales Offices at

MONTREAL TORONTO CALGARY WINNIPEG

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

ENGINEER WANTED.—For erection of refrigerating, pumping and power plants with a Western Canadian Company, some commercial and drawing experience preferred. Must invest One Thousand Dollars ($1,000.00). Box No. 98, *The Canadian Engineer*, Toronto, Ontario.

MECHANICAL ENGINEER—Experienced Designer, Cost Estimator and Salesman, Works Supervision, all kinds of steam engines, boilers, hydraulic pumps, air machinery and mining plants, seeks position with Consulting Engineer, Contractor, Manufacturers or agency business. Highest references, some capital. Box 102, *The Canadian Engineer*, Toronto.

SUPERINTENDENT SEEKS re-appointment on heavy work, experienced in big plant, steam shovel work, rock, hardpan, concrete, etc. Highest references. Box 110, *The Canadian Engineer*, Toronto.

YOUNG CANADIAN ENGINEER.—Experience, paper mill, electric substation, hydraulic power plant, field and office, wishes to get in touch with a manufacturing concern requiring the services of a permanent resident engineer or plant chief; superior references. Address Box 112, *The Canadian Engineer*, Toronto.

YOUNG ELECTRICAL ENGINEER desires position either as consulting or plant engineer; first-class character and education; one who will take an interest and make good. Box 114, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Notice is hereby given in regard to Canadian patents 100,707, 100,980 and 129,756, steam turbines, and 135,000, 135,001, 136,321 and 137,222, classifiers, that Canadian Allis-Chalmers, Limited, Toronto, owner of rights under said patents, is prepared to supply devices covered by these patents.

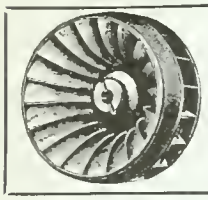
INDUSTRIAL CHEMICAL ENGINEER

with thirteen years' experience in England, holding highest references, is open to accept a position in Industrial or Municipal Plants. References can be seen at *Canadian Engineer* office, Toronto.

Address communications to

CHAS. H. EDMONDS

c/o Canadian Engineer, 62 Church St., Toronto



TURBINES

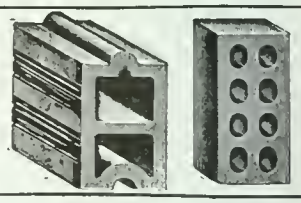
BRICK MAKING MACHINERY

KUHNERTWERKE. Akt.-Ges., Meissen, Germany

ASSETS ABOUT ONE MILLION WRITE FOR CATALOGUE

Correspondence Invited in German, French, English or Spanish

AGENTS WANTED A B C Code 5th Edition.



NEW INCORPORATIONS.

St. Catharines, Ont.—Lincoln Clay Products, $50,000. J. Widdicombe, H. E. Henry, A. G. Bradley.

Kingston, Ont.—John McKay, $150,000 (fur dealers). G. M. Mulholland, A. Todd, A. B. Sheppard.

Toronto, Ont.—Magann-Wells Construction Company, $400,000. S. S. Mills, W. W. Boyd, C. D. Magee.

Crimsby, Ont.—Northern Veneer Company $200,000. T. C. Haslett, W. F. McGiverin, G. E. McLachlin.

Fredericton, N.B.—The Victoria Steamship Company, $20,000. R. Fitzrandolph, W. G. Clark, F. G. Hoben.

Winnipeg, Man.—Daylight Prism and Glass Company, $12,000. C. A. Crawley, G. F. de C. O'Grady H. Dunk.

Lethbridge, Alta.—Lethbridge Wholesalers, $50,000. United Grain Producers, $100,000. Dalaney's, $250,000.

Hull, Que.—La Compagnie Immobiliere de la Cite de Hull, $140,000. J. E. Fontaine, J. Bourque H. P. Charron.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade were received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.—A London correspondent is open to purchase supplies of old scrap galvanized iron wire, and would like to hear from Canadian firms in a position to ship large quantities.

From the branch for city trade inquiries, 73, Basinghall Street, E.C.:—An English firm resident in Trieste, Austria, reports a good opening for sulphite wood pulp both in Austria and Italy, and is desirous of securing the agency of a Canadian manufacturer who can make regular shipments. London reference. A Scottish manufacturing firm who are patentees of lock-joint cast iron piping for water and gas works invite inquiries from Canadian engineers responsible for drafting projects for municipal and railway work.

54-inch pipe distributed for sewers at Montreal, Canada.

MERIWETHER SYSTEM
CONTINUOUS RE-INFORCED
CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, August 16th, 1913.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags repurchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight

Chain.—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in., $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ⅜-inch, $5.50, with 64 per cent. off for black, and 49 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 73½ per cent. off for black, and 63½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 73½ per cent. for black and 63½ per cent. for galvanized:—2-in., $36; 2½-in., $57.50, and 3-in., $75.50; 73½ per cent. off for black, and 63½ per cent. off for galvanized; 3½-inch., $95; 4-inch, $1.08.

Toronto, August 20th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Scbaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Wasbago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15⅞ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¾ cents pound. 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1¼c. per hundred. For 10-case lots and over deduct ¼ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1¼ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.51.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Sommerlee, $27; Hamiltoo quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Baogor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $6, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.85
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	13.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, August 19th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5½c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ⅜-inch, $2.40; ½-inch, $2.55; ¾-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

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Contents of this issue on page 373

The Canadian Engineer

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SCIENCE IN THE DESIGN OF STREETS

NECESSITY OF REGARD FOR FUTURE NEEDS—ARRANGEMENT DEPENDENT UPON TOPOGRAPHY, PRESENT ACTIVITIES AND FUTURE OUTLOOK OF SURROUNDING TERRITORY—POINTS IN CONSTRUCTION OF PAVEMENTS.

By J. RUSSELL ELLIS,
Assistant City Engineer, Regina, Sask.

THE problem of proper street design is as broad and varied as any problem could well be. If the matter were always handled in a scientific manner and by a skilled designer there would be little excuse for writing this article. Too often, however, are the very underlying and essential points in the problem which require study and skilled judgment arbitrarily fixed by the legally constituted authorities in charge without proper advice, thought or knowledge. We have probably all seen the street which is too narrow or too wide for the use to which it is placed, in the first instance permitting of insufficient roadway room or width of sidewalk or both, and in the latter case causing an excessive cost of maintenance or suffering for lack of the same. Even when the width of the street is satisfactory the location is often ill-adapted to the fundamental requirements of the traffic to which it is subjected. Again, the width and arrangement of roadway, sidewalks and parking strips are stupidly fixed. Still again, the choice of elevation, gradients, kind of paving materials and facilities for storm water drainage are commonly noticeable as features of which improper treatment has resulted in inexcusable confusion.

The first step required to be taken in dealing with the problem in a scientific manner is a reconnaissance of the territory tributary to the street. For the purpose of this paper it will be assumed that our street has already been laid out and various improvements made upon the abutting property as is the case nine times out of ten when the engineer is given a hand in the design. A map drawn to a fairly large scale—not less than one hundred feet to the inch—should be provided with the street lines and all abutting property divisions accurately shown. This should be used in conjunction with a small scale map if available showing the streets and natural topographical features in the section of the city or town which is traversed by the street under consideration. After a careful study of the maps, in which possible changes in width or location may be noted, the investigation will be carried to the field. Here all improvements along the street will be sketched in upon the large scale map in approximate position; any apparent diversion of traffic to other streets and the reasons therefor will be noted, and any obvious errors or omissions in the map lines or topography will be observed. The general character of the use of the contiguous territory, such as business, manufacturing, residential, residential mixed with business and public use, will be tabulated with the limits of each. Some study of the work involved in improvement, such as the cutting down of hills and the bridging or filling of depressions, should also be made. It will probably be possible at this time to make use of the conclusions drawn from the first study of the maps and to correct them where necessary. Along with these studies a reliable traffic census will be required. For this work it will be necessary to decide to what extent of detail the conditions will warrant the investigations to go. Various forms for recording the observations have been devised and rules established which are available for reference but need not be blindly followed. Certain it is, however, that records should be taken at different times during the day, at different seasons of the year and during different conditions of the weather. Where heavy and fairly continuous traffic is encountered it will probably be advisable to have the reports cover the entire twenty-four hours of the day. Concerning the information necessary to record, Professor A. H. Blanchard has made the following classification:—

1. Differentiation between horse-drawn vehicle traffic and motor car traffic.

2. Division of each of these classes of traffic into pleasure and commercial traffic.

3. Subdivision of commercial traffic into loaded and unloaded vehicles.

4. Determination of the weight per linear inch of width of tire of all types of commercial traffic.

5. Subdivision of the two classes of horse-drawn vehicles traffic, dependent upon the number of horses.

6. Subdivision of pleasure motor car traffic upon the basis of weight and speed, since, in many instances, the greatest damage to certain types of roads is caused by seven-seat touring cars, limousines or laundaulets, travelling at speeds of 40 to 60 miles an hour.

7. Extraordinary character of local traffic; for example, traction engines hauling trailers, motor bus traffic, ice wagons, mill drays, etc.

It would be well to remember, however, that this classification was made for the study of road design in general, and it seems to the writer that some modification might be made when considering street design alone. At

any rate, it would be necessary to consider to what extent in any case it is practicable to carry the investigation. For instance, the classification number 6 might well, in many cases, be omitted, since it should be feasible to estimate an average weight and speed of the pleasure motor cars, considering that such cars are generally standardized as to weight and that the speed is limited by law. This average could be obtained accurately enough for our purposes, and would curtail the work involved in taking the census to a considerable extent.

From the data obtained in making these preliminary studies a general tentative plan can be made. This plan will include any changes in location from the original layout that may be considered advisable as well as any changes in width. The considerations governing choice in these respects will, of course, be the class and amount of traffic and the topography of the ground.

The next work in order will be the preliminary surveys to consist of a proper alignment of the street as decided upon for mapping purposes and the taking of elevations for cross-sections and profile. This work should be carefully and accurately carried out, and the records taken will, in the end, be used for estimating purposes. The methods involved in this work are simple and familiar to all engineers. Suffice it to say that sufficient levels are taken to determine accurately the amount of material necessary to be handled in grading the street for improvement and for fixing the grade to suit probable requirements and existing conditions. The plan and profile will then be placed on the same sheet of profile tracing linen. In general, the scales preferable for use in profiles are forty feet to the inch longitudinal and four feet to the inch vertical. The scale for the plan will then be made to conform to the longitudinal scale of the profile, and the one will be placed directly below the other. With this data collected, we are now prepared to begin the detailed scientific study of the problem, and it is this portion of the work which is too often sadly neglected.

The first consideration affecting the question of the proper width of the street should be its classification as regards present or probable future use. The usual classification is placed under three heads, viz.: main thoroughfares, secondary thoroughfares and residential streets. The classification may be carried farther under a number of sub-headings. The traffic census and an estimate of future development, after careful study of the tributary territory, will be used in making the classification. It will be necessary to determine as best we can what facilities will eventually be required for the purpose of rapid transit. In large cities and on certain streets our conclusions will cause us to provide for underground or elevated railways, in other places the surface street railway only will be necessary. With the estimate of the amount of this traffic it is not difficult to calculate the width necessary to provide for taking care of it. For instance, the width required for single track street railway operation is eight to nine feet and for double track from nineteen to twenty-one feet. The general traffic should, as far as possible, be kept off of the railway allowance. Other public utility accessories that present a probability of being required on the street, such as pole lines, pipe lines, conduits, etc., will require consideration as to how much width will need to be excluded from other uses for them. Then the necessity or desirability of considering the ornate side of the problem as affected by planting spaces or parking strips should be given its proper place as going hand in hand with the scientific design. It may be considered that a width of four feet will be necessary for planting one row of trees, but the widths and arrangement of these spaces should not be fixed until after the width of roadway, sidewalks, etc., have been determined in order that the correct division or breaking-up of the space may be made. It might be noted here that the practice of placing sidewalks against the curbs where the roadway is less than fifty feet in width results in an improper division of the space.

The width of roadway exclusive of street railway allowance is a vital feature of the design. This is the point where one of the greatest aids of the traffic census comes in, though we will need to estimate the width that will be necessary for all future requirements as well as those of the present time. This may not call for the entire width being covered with pavement at first, but the estimated requirements should be provided for. After we have made a careful estimate of the amount and character of the traffic the problem of supplying the necessary width for its accommodation is of a more elementary character. It should be remembered that the principal purpose of the street is to provide efficient means for the necessary movement of the public and the opportunity for transporting the commodities required by it. To accomplish this necessitates providing the proper width to prevent congestion or inconvenience. We will need to fix a definite width to allow each vehicle on the street. Some authorities advise a width of eight feet, others nine feet. It would seem that on account of the tendency toward motor cars of wide bodies that where a preponderance of motor traffic is to be taken care of, the greater width should be used. Where it is estimated that most of the traffic will be composed of horse-drawn vehicles eight feet is sufficient. For calculating the widths of sidewalks required two feet is assigned to each pedestrian. Care will need to be exercised here that places where many people gather and leave at certain fixed times do not overtax the sidewalks. In all cases where feasible, however, the widths of the improvements necessary for the present use only should be adopted, with provision made for increasing them from time to time as needed.

The question of limiting gradients requires to be gone into carefully. The points affecting our decision in this matter are the maximum loads to be expected in the street car, motor and horse-drawn traffic, climatic conditions causing slipperiness, the damage accruing to existing improvements along the street by cutting below or filling above the level convenient for their use and, in some cases, the desirability of having the floor levels of large buildings at a distance not too varying from the street pavement. We will also need to begin thinking at this point about the class of paving materials that will be used in the construction, particularly with regard to their slippery tendencies. The grades should not be too steep to prohibit the ordinary desirable heavy loads being transported economically unless the interest value of the cost of reducing them, including all damage to abutting properties, would exceed the loss in cost of transportation. This problem should be figured out in detail where it is evident that large expenditures will require to be made in order to get the desired grades. In general, we may consider that a maximum grade of five per cent. is a desirable limit upon heavy traffic streets, and this maximum should only be employed wherever absolutely necessary and at infrequent intervals. A possible way of reducing the rate of grade upon a street is to have the roadway wind from one side to another. This method, when used, will probably necessitate a greater width of street and a different arrangement of the parking scheme. In this connection it may also be well to consider making detours from the

straight line in order that bad hills may be skirted instead of being crossed directly over their summits. By these means a considerable saving in steep grades may often be effected. The minimum rate of grade, too, depends upon the class of pavement used. It must be sufficient to allow prompt drainage of the surface water into the catch-basins. The expedient, however, of what is known as false grading in the gutters will allow roadway, curbs and sidewalks to be laid with a level longitudinal grade, if necessary, but the gutters will have to have sufficient grade to create a flow of water. The minimum grade for this purpose should in no instance be made less than four-tenths of one per cent., and this should be used as sparingly as possible.

The choice of kind of paving materials to be employed in the construction involves a great number of considerations which, however, can be investigated along scientific lines. Experience has already established that certain materials are undoubtedly best adapted for certain purposes, and the results may be made use of without further investigation. For instance, no one denies that Portland cement is the proper material for any permanent street pavement base and for the sidewalks, and the truth is equally as much evident that certain materials for the wearing surface of the roadway pavement are adaptable under certain climatic conditions while not under others. In considering the pavement base, however, we shall need to design the thickness and proportions of the concrete to safely withstand the loads and stresses to which it will be subjected. Ordinary practice has held pretty closely to the limits of four and eight inches, varying with the nature of the traffic and the condition of the sub-base. It is advisable to make an analysis of the bearing power of the soil and the stresses which will be produced by the traffic in each particular case where conditions vary materially from other cases which have been investigated. The principal stresses induced in the base are due to climatic forces and the loads causing compression. Variation in temperature tends to cause disintegration by expansion and contraction of the concrete, and water tends to penetrate through to the sub-base, making it soft and reducing its bearing power. Therefore, the base must be designed so as to expand and contract without breaking the bond, and the water must be kept out by an impervious surface. The loads tend to push the pavement into the sub-base, and hence the base must have strength and rigidity enough to distribute this force safely. In general, the safe load which may be allowed for the sub-base is two or three tons per square foot. It is probably needless to say that the width of tires will be considered as to the manner of transmitting loads to the base.

In designing the pavement wearing surface for the roadway a greater number of considerations enter. First, in the way of stresses we have to consider forces caused by impact, shearing and suction, as well as compression and temperature stresses. The forces caused by impact are received by the wearing surface only, and hence the wearing surface should have sufficient resilience to absorb these forces without damage. Standard tests have been devised for use in this connection. Shearing is induced by the tractive power of the wheels of a self-propelled vehicle and the feet of horses. The wearing surface must have sufficient strength to resist this force, and must have stability enough to prevent its being torn away from the base from the same cause. Hence the study and testing of the bonding properties are obligatory. Suction forces result from the partial vacuum created behind a rapidly moving motor vehicle. The individual parts of the wearing surface must be held together in order to resist this force. Compression and temperature stresses will be handled in a manner similar to that outlined for the concrete base.

Second, a comparison of the value of the different wearing surfaces should be made with especial reference to cost, durability, maintenance, cleaning, traction resistance, slipperiness, sanitary qualities, noise and possibly other qualities made desirable by local conditions. The U.S. Office of Public Roads, working along these lines some years ago, collected reports from the engineers of a number of American cities. The results of this enquiry were published in the form of a table which is reproduced below. Under the percentage column the various qualities desired in a pavement are assigned proportionate values, the total being 100 points. The pavement ranking first under any given quality is given the full quality percentage, the rest grading down from this value in proper proportion.

The table is not given here in order that the results shown may be taken as applying to any particular case, but merely to suggest the proper procedure for the investigation. In any one problem certain conditions of a local nature are bound to enter.

Comparative Value of Different Pavements.

Pavement qualities.	Per-centage.	Granite.	Sand-stone.	Sheet asphalt.	Asphalt block.	Brick.	Macadam.	Creosoted wood.
Cheapness (first cost)	14	4.0	4.0	6.5	6.5	7.0	14.0	4.5
Durability	20	20.0	17.5	10.0	14.0	12.5	6.0	14.0
Ease of maintenance.....	10	9.5	10.0	7.5	8.0	8.5	4.5	9.5
Ease of cleaning	14	10.0	11.0	14.0	14.0	12.5	6.0	14.0
Low traction resistance ..	14	8.5	9.5	14.0	13.5	12.5	8.0	14.0
Freedom from slipperiness (average of conditions).	7	5.5	7.0	3.5	4.5	5.5	6.5	4.0
Favorableness to travel ..	4	2.5	3.5	4.0	3.5	3.0	3.0	3.5
Acceptability	4	2.0	2.5	3.5	3.5	2.5	2.5	4.0
Sanitary quality	13	9.0	8.5	13.0	12.0	10.5	4.5	12.5
Total number of points.	100	71.0	73.5	76.0	79.5	74.5	55.0	80.0
Average cost per sq. yd. laid in 1905		$3.26	$3.50	$2.36	$2.29	$2.06	$0.99	$3.10

Note: Favorableness to travel is dependent chiefly upon smoothness and freedom from dust and mud, secondarily upon the qualities composing "acceptability." Acceptability includes noise, reflection of light, radiation of heat, emission of unpleasant odors, etc. It chiefly concerns the pedestrian and the adjoining resident. Cost per square yard includes concrete, but not excavation, curbing etc.: except for macadam, which is not usually laid on concrete.

When the available and seemingly desirable pavement surfaces have been thus compared it will be possible to reject those which do not meet requirements and thereby reduce the field of investigation. With those which are considered suitable the final test will be that of economy. Careful estimates should be made of the initial cost, the annual cost of maintenance and the life of each. Then, using the prevailing rate of interest with the amount of capital required to do the work, we can soon determine which is the most economical material to use.

A vital feature in street design from the aesthetic point of view is the parking treatment. There is no doubt that the average engineer would benefit exceedingly in collaboration with the landscape architect in this phase of the work, when this is possible. Certain elementary considerations, however, may be kept in mind, and a careful study of this question should not be dispensed with.

It is desirable to have residential streets planted with trees and grass in the strips reserved for parking purposes. Ordinarily the most suitable plan to follow is to place these spaces between the sidewalks and curbs, between portions of the roadway pavement where the space is available and, where the building line is at or near the street line, to have a space between this and the sidewalk. Trees should be planted in straight lines as a rule, twenty to thirty feet apart in a row, and the grass should manifestly be carefully cultivated. The selection of the kind of trees will be governed by local conditions, but the rapidly growing varieties are generally preferable. Low, dense growing trees, such as evergreens, are not often suitable for the purpose. They should produce a good shade and be shapely, the size being regulated by the available space and the proximity of buildings. It will be understood that certain varieties of trees will be unsuitable for urban planting on account of the condition of the atmosphere and the environment of surrounding improvements.

No one who is familiar with the methods of dealing with the various phases of the problem of street design as has been outlined will gainsay that no small amount of detailed effort will be involved in proceeding along these lines. It will be evident, however, that the results of the investigation of certain points will be applicable to the design of all streets in one town or city. Still other features will be similar when they apply to streets of like use throughout the municipality, and a majority of the results will coincide when relating to all of the streets of one classification within a limited territory. It should be borne in mind that the design of a street, when once executed, will be in a large measure permanent, and that countless numbers of users far into the future will suffer from any of the original defects. The economical side of the problem alone should appeal to all citizens, for not only will traffic be inconvenienced and made more costly, but abutting and nearby property values will be affected, and the community as a whole will be the loser in proportion to the enormity of the defects.

After all, the principal considerations are practically fundamental. When the reconnaissance and the preliminary surveys have been made, and the observations taken and data collected for determining width, limiting gradients, kind of paving materials and parking treatment, the sound judgment and knowledge of the competent designer, gained from study and experience, enable him to evolve a correct, scientific plan. There can be no excuse for any other.

A USEFUL ADDITION TO INDUSTRIAL MATERIALS.

A remarkable new material to take the place of hard fibre, glass, porcelain, hard rubber, built-up mica, pressboard, rawhide, moulded compounds, etc., has been developed by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. It is known as Micarta.

It is used for commutator bushings and brush-holder insulation, as noiseless gear blanks, as conduit for automobile wiring, as spools for sparkcoil and magnet windings, for refillable fuse tubes, for wireless coil separators, for arc shields in circuit-breakers, for water-meter discs, etc.

Micarta is a tan-brown colored, hard, homogeneous material having a mechanical strength about 50 per cent. greater than hard fibre. It can readily be sawed, milled, turned, tapped, threaded, etc., if a sharp pointed tool is used and the work done on a lathe. It can be punched only in thin sheets and cannot be moulded. Micarta is not brittle and will not warp, expand, or shrink with age or exposure to the weather but takes a high polish, presenting a finished appearance.

Two grades of the material are made. The grade known as Bakelite Micarta will stand a temperature of 150 degrees C. (300 degrees F.) continuously, or 260 degrees C. (500 degrees F.) for a short time. It is infusible and will remain unaffected by heat until a temperature sufficient to carbonize it is reached. Heat will not warp bakelite Micarta, and it will stand an electric arc better than hard fibre, hard rubber, built-up mica, or any moulded insulation containing fibrous or resinous materials. Its coefficient of expansion is low, being approximately .00002 per degree C.

Bakelite Micarta is insoluble in practically all of the ordinary solvents such as alcohol, benzine, turpentine, and weak solutions of acids and alkalis, hot water and oils. It is indifferent to ozone—an advantage over hard rubber, resins, etc., for electrical purposes. It is non-hydroscopic and impervious to moisture.

The other grade, designated as No. 53 Micarta, has the same mechanical and electrical properties as the Bakelite Micarta, but differs in its chemical and thermal properties. The plain Micarta behaves towards chemicals and heat very much as an ordinary resin. This grade is not used in plate form.

INFLUENCE OF METALLOIDS ON CAST-IRON.

A paper by H. I. Coe before the Iron and Steel Institute shows tests of 54 alloys, containing carbon 3.0, silicon from 0.4 to 2.24, manganese from 0.14 to 2.22, sulphur from 0.11 to 0.45, and phosphorus from 0.30 to 2.88 per cent. The author's conclusions are:—

Silicon decreases the strength and hardness of cast-iron, owing to its effect in promoting the decomposition of iron carbide.

Manganese to the extent of 0.5 per cent. softens silicious gray irons, owing to its effect on the condition of the carbon: the strength is increased by the addition of manganese.

Influence of sulphur is largely determined by the silicon present. Carefully controlled, it should be of considerable value to the iron founder in mixing his iron for any particular purpose.

In the absence of manganese, and with about 2 per cent. silicon present, very strong gray irons may be obtained if the percentage of sulphur be judiciously raised.

Phosphorus, up to about 1 per cent., is useful. It gives fluidity, slightly increases the strength, and also slightly diminishes the hardness of the metal. A higher percentage gives a hard, brittle material.

A 150-FOOT ARCHBRIDGE WITH SUSPENDED ROADWAY IN REINFORCED CONCRETE.

By V. J. Elmont, B.Sc., A. M. Can. Soc. C.E.

THE bridge described below (Fig. 1) carries a 14-foot 8-inch roadway and two 2½-foot sidewalks. It is calculated for a load of 120 lbs. per sq. ft. uniformly distributed and an additional load on the roadway of one road roller, weighing 30,000 lbs.

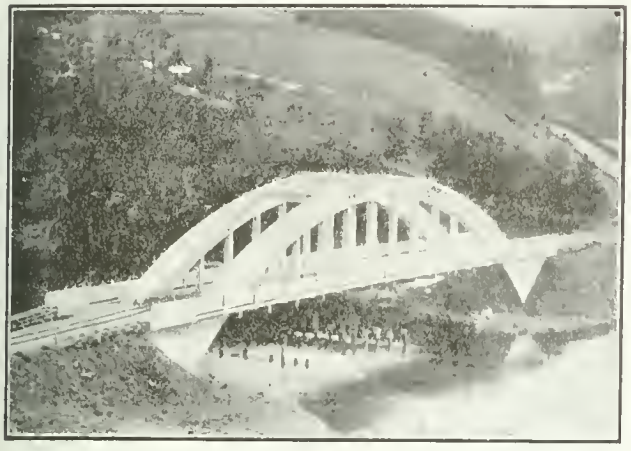

Fig. 1.—View of Finished Structure.

The macadamizing of the road rests on a crosswise reinforced slab, which again is supported by the floor-beams, spaced 9 ft. 10 in. centre to centre, and stringers. These are placed in the planes of the two archgirders and in the centreplane of the bridge. The sidewalks are supported by cantilevers from the floor-beams. The load from the floor is carried over to the arches through hangers.

The statical computation for the arches is made as for arches without hinges and by employment of influence lines. As basis for the figuring was used an allowable tensile stress in the steel of 14,000 lbs. per sq. ft. and

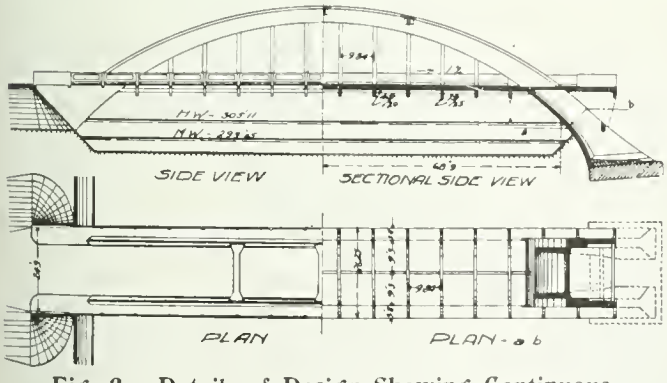

Fig. 2.—Details of Design Showing Continuous Arch-girders.

compression stress in the concrete of 550 and 700 lbs. per sq. ft. for roadway and arches respectively. Special care was taken in the investigation of the stresses due to change of temperature, which plays quite an important part in long-span arches with fixed ends, though, of course, much smaller than for a steel arch, as the conductivity of steel is much higher than that of concrete. Fifty degrees F. was considered as an average temperature at the time the bridge was constructed, and the limits of the temperature of the concrete in the finished structure were taken as 10° F. and 80° F. By this assumption the maximum bending moments produced by the live load and dead loads were increased by 20% at the crown and 69% at the springing line. This proves once more that the approximate figuring usually employed by designers without knowledge of calculating statically indeterminate structures, is nothing less than a menace to safe construction. As result of the statical computation the necessary depth at the crown of the arches was found to be 4 ft. and the width 2 ft. 2 in.

The usual design of placing the tie-rods for the arches in the roadway slab was not employed in this case, owing to the high value of the maximum horizontal pressure (290 tons for each arch). It would have been difficult to arrange the steel, necessary to resist this great pull, in the longitudinal beams between sidewalks and roadway, and also to ensure a safe connection between tie-rods and arches. The arches are stiffened by means of three cross T-beams, placed at their crowns.

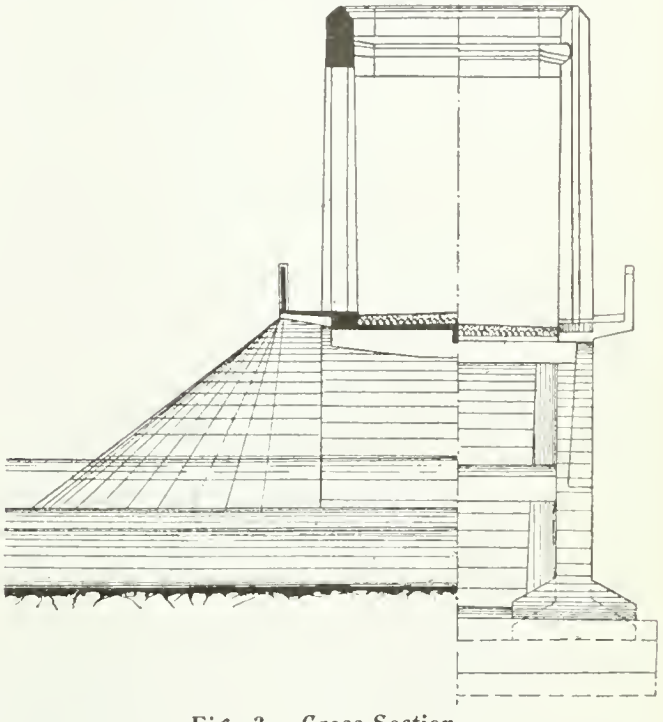

Fig. 3.—Cross-Section.

A somewhat unusual, but very economical, design, as compared with the solid concrete abutments, was employed for the abutments. The arch-girders are continued through the roadway to meet the foundation slab, which extends under both arches. (Fig. 2). Between the arches, and having the same curvature, a slab is constructed which, together with the extensions of the arches and two triangular wing-walls resting on the arches, form a container for the earth filling. The wing-walls and the arches are tied together by two cross-beams in each abutment. (Fig. 3).

The quantity of coal used for coke-making in the United States in 1912 was 65,485,801 short tons. The coke produced from this coal amounted to 43,916,834 short tons, valued at $111,523,336, besides large quantities of gas, tar, ammonia, etc., as by-products from the 11,048,489 tons of coke produced in by-product ovens.

ROAD MAINTENANCE IN ENGLAND.*

By Charles Vawser, A. M. Inst. C.E.I.

IT is generally accepted that municipal engineers can construct the best and most suitable roads for their particular districts, and, provided they have a free hand in the choice of materials and so forth, they can so construct them that they will be efficient and, at the same time, economical to maintain; but, unfortunately, in the case of main roads, and particularly old turnpike roads, many are found to be without efficient foundation, and the extent of their durability or life is limited to the surface or covering crust.

Foundations should be sound and solid in construction, so that they may withstand the weight, wear and tear of the present and future traffic, and, in addition, act as a protector to the surface against the many unknown evils which from time to time arise from underground air, fluctuating water levels, and other matters which have more or less evil effects, according to the chemical composition and geological construction of the material used.

There are several kinds of stone which wear better and longer in one district than in another. Frequently the users are at a loss to know the cause of this, but if one persists in his efforts to ascertain the failure he may find it comes more from underground sources than is usually realized.

The surface of the roads is one of the most debatable subjects that has ever been before the country, and not only is it debatable in every way, but it is also most fascinating on account of the many changes that are daily occurring due to mechanically propelled vehicles using the highways, which are increasing both in weight and number.

The writer eighteen years ago constructed roads with a surface of Welsh granite heated and mixed while hot with tar and pitch laid to measure 4 in. thick when consolidated, and he has no cause to change the opinion then formed that where macadamized roads are to be constructed, a bituminously constructed surface is the most efficient, sanitary and economical to maintain, provided it is on a good solid foundation.

It remains to be seen how long the present waterbound road will hold its position when modern circumstances demand a road of more homogeneous construction.

Cost and Maintenance.—The cost of making and maintaining highways is a most important and responsible obligation to all highway authorities, and while they all have to "pay the piper," unfortunately they are not always in a position to "call the tune," because they cannot regulate the class of traffic using the roads.

The cost is not so keenly felt in urban districts and towns where the roads from the first laying out are usually well constructed, and as the districts prosper and develop the increasing rateable value corresponding with such development prevents them from feeling the pinch of poverty to the same extent as in rural districts and large agricultural county areas where there is comparatively no increase in development.

In rural districts and county areas there are frequently long lengths of roads to maintain, through poor, agricultural districts, and their efficient upkeep is a source of grave anxiety to those in control on account of the great amount of touring traffic using the roads, and for which there is no return. The cost of maintenance falls very unfairly and unjustly upon the shoulders of highway authorities who have to maintain important trunk roads which, by their geographical position, form a connecting link from one centre of industry to another.

Until quite recently all roads were waterbound, and many mainly repaired with water binding; these, when dry, have been surfaced with a bituminous or tar coat. This undoubtedly prolongs the life, but unfortunately trunk roads leading from town to town are placed at a considerable disadvantage owing to it not being practicable to close the road until the bituminous material has become "set," with the unfortunate consequence that much damage is done. Furthermore, many roads are narrow, thus making it more or less impossible efficiently to carry out the work upon one half of the road and allow it to "set" before turning the traffic on to it.

Another point which the surveyor has to consider is the weather, and in this uncertain climate he endeavors to carry out the greatest amount of work when climatic conditions are most favorable.

This surfacing or tar-painting is both efficient and economical so far as it has gone, and has been suitable where the traffic was light. It is apparent that, while it may be suitable at present, the day is not very far distant when the surface of the tar-painting will have to be superseded by something more substantial. Circumstances are changing day by day, and one may anticipate future development of traffic in ratio to the progress of the last few years; consequently it seems obvious that motor and mechanical vehicles will increase as time proceeds. Should this prove to be the case, the annual cost of roads will become a serious matter to the authorities responsible for their maintenance.

When such eminent men as Sir John Macdonald state "the money value of good roads to the nation is enormous," and Sir George Gibb states that good roads constitute "the basis of national prosperity," it is apparent that good roads are appreciated; but up to now neither the "nation" nor "national prosperity" have paid their just proportion towards maintenance. It is well known that our highways were the foundation and nursery for developing the mechanical traffic during its infancy, which has now entered into a stage of prosperous commercialism, creating an enormous burden upon the local ratepayer without equal contributory advantage; and thus it appears a great misfortune that legislation should have limited the powers of the Road Board to contributing "towards" the cost of improvements.

Should (as predicted) the motor and mechanical vehicles increase, many highways will have to be reconstructed with stronger foundations according to the strata supporting them, the surfaces will have to be efficiently drained, made dust and waterproof with bituminous material of such thickness as will stand the heavy mechanical traffic without fracture, the fast motor traffic without ill effects from vacuum, and, at the same time, form a good foothold for horses and other animals. This will entail great expense, and it is to be hoped that this reconstruction necessitated by modern and future traffic will be met by monetary grants for capital reconstruction, and annual maintenance payments from the industries which have placed the obligations upon the authorities responsible for the efficiency of the highways.

*From a paper read at the Annual Meeting of the Institution of Municipal and County Engineers, Great Britain.

THE TOR HILL RESERVOIR, REGINA

DETAILS OF DESIGN AND CONSTRUCTION OF ONE OF REGINA'S TWIN RESERVOIRS FOR WATER SUPPLY—CONNECTIONS FOR INLET AND OUTLET MAINS—ITEMS OF COST.

By R. O. WYNNE-ROBERTS, M. inst. C.E., M. Can. Soc. C.E., F.R. San. Inst.,
Consulting Engineer, Regina, Sask.

THE city council of Regina, on the recommendation of Mr. A. J. McPherson, then city commissioner, now chairman of the Provincial Board of Highway Commissioners, decided to adopt a scheme which the writer had submitted, whereby an ultimate daily supply of ten million gallons of water can be made available, at an expenditure of about $2,000,000.

Such scheme included two five-million-gallon reservoirs. The construction of the first of these was commenced last summer, but owing to unforeseen delays in the supply of certain materials, it was found impossible to complete the work before the winter had set in. Immediately it was safe to proceed in the spring, the structure was finished as quickly as possible, and the reservoir has now been in use some four months. No signs of defects have been observed and the depth of water has been maintained at about 23 feet for about a month.

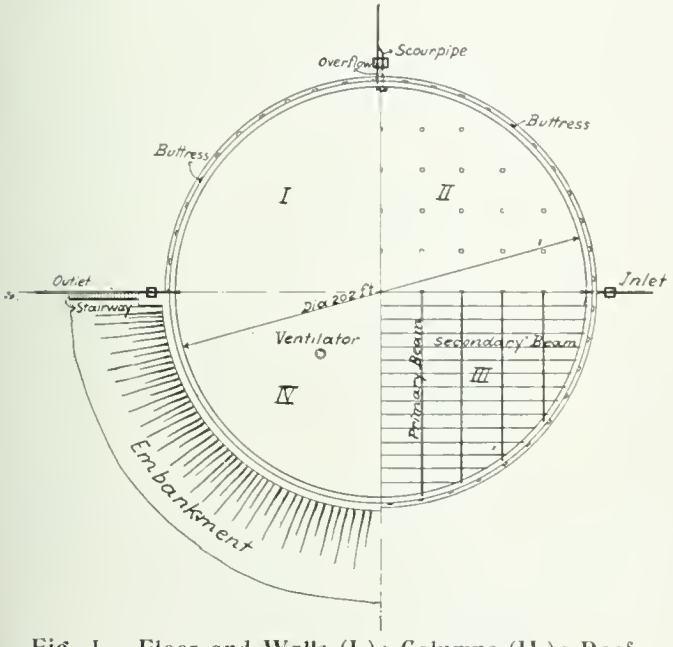

Fig. 1.—Floor and Walls (I.); Columns (II.); Roof-Beams (III.); and Cover (IV.).

Tor Hill reservoir is 202 feet in diameter, holds 25 feet depth of water, and its capacity is five million imperial gallons. This reservoir is circular in plan, reinforced concrete, and is located on a hill close to Boggy Creek waterworks, at an elevation of about 105 feet above the city; the top water line being about 120 feet above Regina level. It is so situated that it will answer in connection with future extensions of the water collecting works into five other watersheds.

The following is a description of the work as carried out:—

Excavations and Embankment.—The excavations averaged 9½ feet deep, the material removed was of a heterogeneous character, common to glacial formation, ranging from fine sand to heavy clay. This was excavated by horse-drawn wheel scrapers and the material deposited at convenient points, to be afterwards utilized in forming an embankment round the reservoir, in which work ordinary scrapers were employed. The quantity handled was about 12,500 cubic yards.

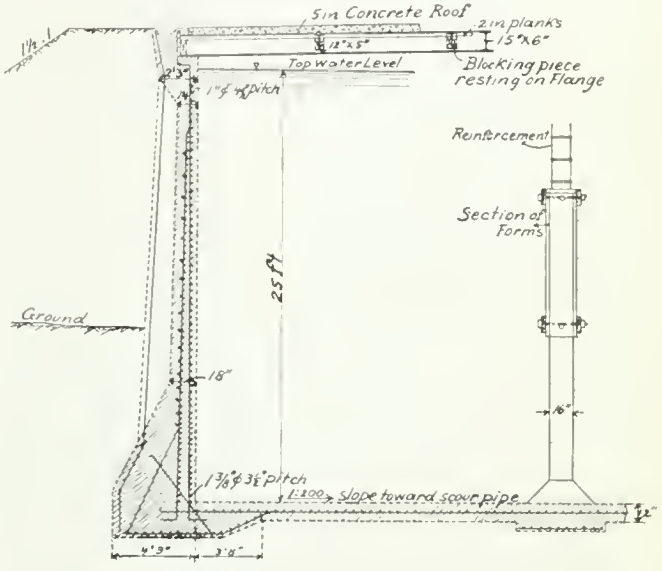

Fig. 2.—Section Through Wall, Roof and Base.

Footings of Walls.—The footings were first laid. They are one foot lower than the underside of the floor, except where the pipe connections are located, where the thickness was made two feet beneath the underside of the pipes. The footings extend for a distance of 3 ft. 8 ins. from the inner face of the wall under the floor, and are reinforced with half-inch round bars laid radially and circumferentially, and also a diagonal brace laid radially, at six-inch centres so as to form a strong tie between the wall and the floor.

Floor.—The reservoir floor is 12 inches thick, having a crossfall of one foot to the scour pipe, which is laid to a sump-hole at a depth of 2 ft. 3 ins. below the floor level. The floor was laid in two layers, each six inches thick, and between them were laid half-inch mild steel bars at six-inch centres, in two directions, at right angles to each other, tied together at every fifth intersection in one way and at every intersection in the other direction. The top surface of the concrete was worked to a fine close texture.

Columns.—There are 69 reinforced concrete columns, each 16 ins. by 16 ins., supported on truncated pyramidical bases 4 ft. by 4 ft., and 1 ft. 3 ins. high, which, with 6-inch sub-base, form an integral part of the floor. The sub-base was reinforced with half-inch bars laid at six-inch centres in cross directions.

The columns are reinforced with four ¾-in. round bars tied by 1 in. by 1/16 in. hoop iron links at 10-in. intervals. Where the bars join the base they are inserted into wrought iron tube sleeves one-quarter inch larger in diameter and grouted with neat liquid cement. After the bases had set these rods kept the forms from rising when they were filled with wet concrete.

The forms for the columns were made in three sections built of two-inch planks with 4 ins. by 4 ins. cross pieces at three feet centres and held together by ⅝ in. bolts. Each section was numbered so that three forms made a complete column. Sufficient forms for twenty

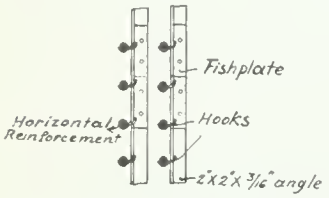

Fig. 3.—Standard and Hooks.

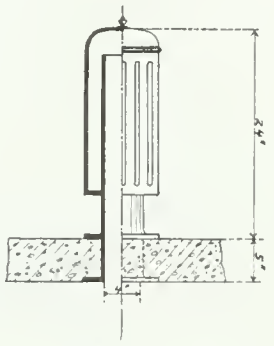

Fig. 4.—Ventilator.

columns were made and these were therefore used at least three times. These forms were assembled on the ground and hoisted up and lowered over the rods by means of a light gin pole on a monkey derrick built of skids. Lumber 2 ins. by 8 ins. was used to build up the derrick, and this was moved fom column to column by the men. The columns were braced by one-inch boards tied to the wall forms and were plumbed to assure the perpendicularity of the lower forms; the other forms were held in place by two bolts holding the second and third sections down to the one already filled in. One section about 9 feet high was filled each day.

Wall.—The wall is 57 inches thick at the floor level, while seven feet above the floor a steep batter on the outside reduces it to 18 inches, and from this point it tapers to 14 inches at the top water line. The wall then corbels out to allow a base for the roof beams and for a rain-water gutter. In the original design the wall was to be 9 ins. thick at the top and 14 ins. at a height of 5 feet above the floor, with three external reinforced concrete rings placed at points of equal pressure, to provide extra strength, as the work would be carried out under somewhat unusual conditions, but, owing to the delays already mentioned, it was deemed expedient to alter the design by eliminating the rings and thickening the walls by an equivalent volume of concrete and steel, so as to simplify the construction and thus expedite the work. The inside face of the wall is vertical.

The horizontal reinforcement in the wall was designed to take up the tensional stresses proportional to the varying depths of water. At the floor level there are two 1⅜-in. round bars at 3 ins. centres, curved to template to fit the curvature of the wall, and at the top 1 in. at 4½ ins. centres. These bars are held in place by 2-in. by 2-in. by ¼-in. angle steel standards in which holes were drilled at prescribed distances apart and ¼ in. steel hooks inserted to clip the rods. Such standards are 3 ft. 6½ ins. apart along the perimeter of the reservoir, and fixed so that there are 5 ins. of concrete between the horizontal steel reinforcement and the water face at the bottom, and 3 ins. at the top. This method of placing and fixing the horizontal bars resulted in a firm and satisfactory frame work which could not be disturbed when the men were placing the concrete.

The vertical reinforcement consists of half-inch bars at 8½ ins. centres, and are tied to the horizontals by black wire at every fifth intersection vertically and at each intersection on the fifth rows horizontally.

There are 45 buttresses spaced at 14 ft. 2 ins. around the outside of the wall. These buttresses are 2 ft. wide and project beyond the 14-in. wall at the top about 11 ins. and die out at the base. These are reinforced vertically by half-inch rods, spaced 4 ins. apart.

The walls, etc., were built in courses about 12 ins. high. Exery horizontal and vertical joint was thoroughly cleaned before the next layer of concrete was laid. Any concrete work which had been standing twenty-four hours or more had the laitance removed by picks, wire brushes, and plenty of water, so as to ensure a thoroughly sound bond. The concrete was well worked into the spaces between the steel rods, etc.

On the completion of the work, the wall, floor and columns were painted with hot liquid bituminous asphalte and afterwards limewashed.

The timber work necessary to form the internal surface of the wall consisted of bents erected about 14 ft. apart; the girts were spaced every five feet and on each row of girts were placed 6-in. by 6-in. beams. The one facing the studding had a segmental piece nailed on to its face to form the curve. On the top of the 6-in. by 6-in. timbers was built the runways or gangways which served to transport the materials. As the wall was built up to the level of the runways the timber work was made higher so as to command the next tier of concrete work.

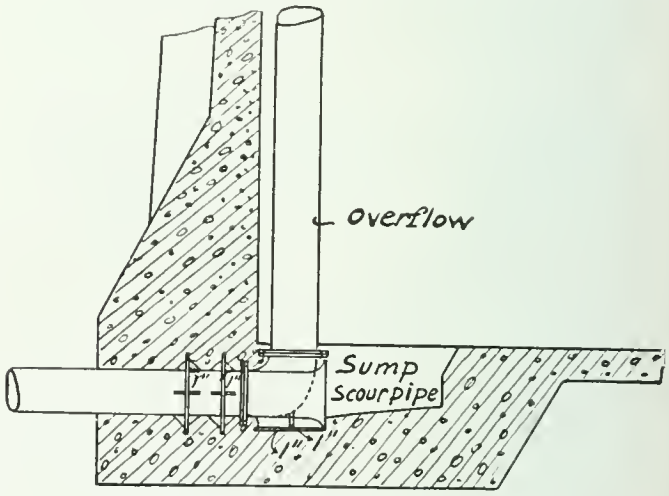

Fig. 5.—Overflow and Scour Pipe.

Roof.—The roof is constructed of 15-in. by 6-in. by 60-lb. rolled steel primary beams, cut to fit the 20-ft. spans and resting on the columns which are 20 ft. apart each way. The secondary beams are 12-in. by 5-in. by 31-lb. rolled steel joists fixed at 6 ft. 8 ins. centres and attached to the primary beams by angle iron brackets. The whole of the roof beams were rivetted together. The cover of the roof consists of 6 ins. concrete, reinforced with half-inch steel bars laid crossways at 6 ins. centres. The roof has a dome formation, being twelve inches higher at the centre than at the perimeter. The surface of the concrete was washed with hot liquid asphalte to prevent frost disintegrating the same.

Rolled steel joists were selected for the roof construction, as it would otherwise mean erecting false timber work to a height of 27 ft. to support the reinforced concrete beams. With the steel joists, however, the forms rested on the flanges, and this was a simpler and equally effective mode of construction.

The steel joists were elevated to the roof level by means of a fixed boom attached to the hoisting tower, which was used to raise the concrete and then landed on loose dollies and run within reach of a derrick. This placing derrick was built of 6-in. by 6-in. timber in the form of a double boom traveller, having a reach of 60 ft. when both booms were spread. It was slid along greased rails and carried a set of chain blocks at the end of each boom.

There are four cast iron ventilators in the roof.

Pipe Connections.—The 16-in. inlet and outlet pipes are placed diametrically opposite, and the overflow standpipe, and the scour outlet, which are together, are located half-way between the inlet and outlet. The overflow standpipe is held in place by 4-in. by ½-in. stays anchored into the wall.

All castings fixed in the concrete were uncoated and had puddle rings cast on, to prevent any water finding its way along the outside of the pipe. These rings are 6 ins. wide and 1 in. thick, strengthened by brackets 1 in. thick. All inside pipes have bell-mouths. The inlet and outlet pipes stand 6 ins. above the floor level.

All valves are located outside the reservoir, and enclosed in reinforced concrete manholes, measuring 3 ft. 6 ins. square at the top, and 3 ft. 6 ins. by 4 ft. 6 ins. at the valve level. The mains leading to and from the reservoir are of ample size to deliver at least five million gallons per day, and of such dimensions as to fit in with future extensions.

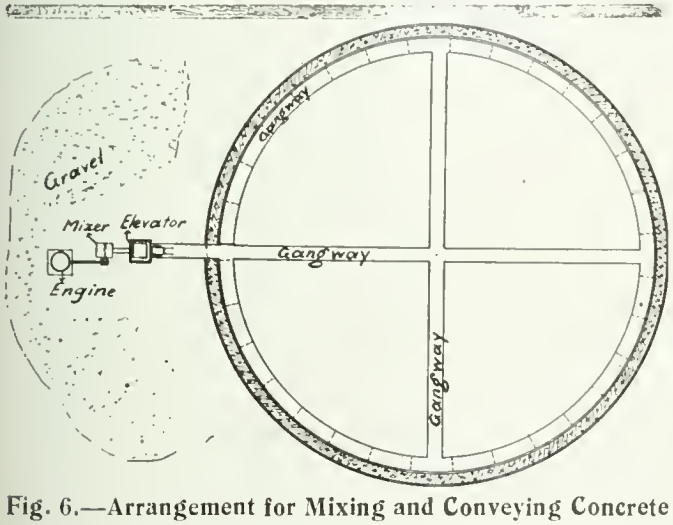

Fig. 6.—Arrangement for Mixing and Conveying Concrete

Wrought iron step ladders built of 4-in. by ½-in. stringers 18 ins. apart and ¾ in. rungs. The ladders are fixed into the concrete work at the top and bottom.

Reinforced concrete stairways are built at opposite points of the diameter to afford access. Stringers, 5 ft. apart, 15 ins. by 6 ins., and the treads are built monolithic and reinforced with half-inch rods lengthways and crossways.

Steel Reinforcements.—All bars or rods are medium steel, having an ultimate strength of 60,000 pounds per sq. in., and an elastic limit of not less than one-half of the ultimate strength, and elongate not less than 22 per cent. in eight inches, and bend cold 180 degrees round a diameter equal to the thickness of the piece tested, without fracture on the outside of the bend.

Steel bars were joined together by overlaps equal to forty times their respective diameter and tied with black wire. The working stress on the steel was limited to 15,000 pounds per sq. in. tension.

Portland Cement.—All the cement had to comply with the specifications prepared by the Canadian Society of Civil Engineers as revised in 1911, and the methods of testing were as near as possible those referred to in such revised specifications.

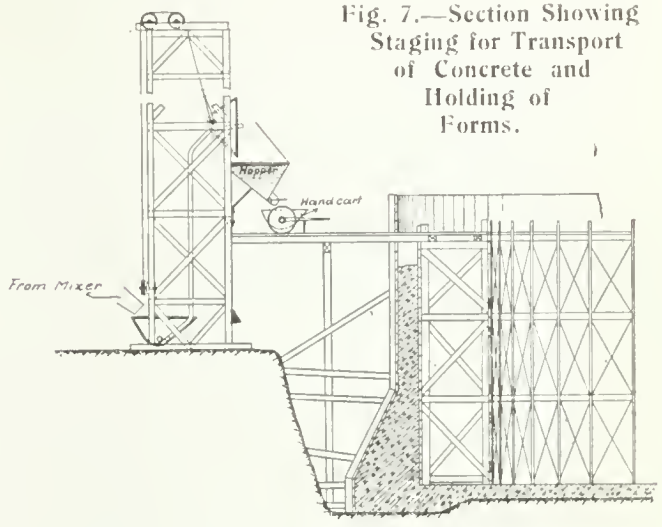

Fig. 7.—Section Showing Staging for Transport of Concrete and Holding of Forms.

Concrete.—The concrete was specified to be as follows: Floors, columns and wall, three parts of broken stone and gravel, one and one-half parts of sand and one part cement. The mass work round the pipes, in the valve chambers and in the roof cover were to be four, two and one, respectively.

The pit gravel obtained close-by, however, was found to conform fairly close to the specified proportions that a mixture of one cement to five pit gravel was substituted, care being taken to add more cement when necessary. About 3,400 cubic yards of concrete were laid. The limiting compressional stress in concrete was 500 pounds per square inch.

Mixing and Placing Concrete.—The concrete was mixed in a ¾ cubic yard Smith mixer, steam-driven. The concrete was mixed wet and was elevated by means of an Insley automatic roller hoist from the bottom into an Insley receiving hopper at the top, situated a few feet above the level of working operations from time to time. The concrete was then discharged into hand-drawn concrete hopper carts and wheeled over the gangways to all parts of the work. As the work proceeded the hoisting tower, gangways and forms were extended upwards.

Miscellaneous.—A Ham Baker water level indicator is being fixed to indicate the varying water level and by electric transmission to record the same at the Barton Pump House, half a mile distant.

A 20-in. by 10-in Simplex Venturi meter supplied by Messrs. Francis Hankin & Company, has been installed on the delivery main to the reservoir and near to the above pumping station. This meter automatically records the quantity of water pumped and also registers the total volume.

Supplies.—The ½ in. and ¾ in. steel rods were supplied by the Provincial Steel Company, of Cobourg, Ont.; Other steel was supplied by the Western Steel and Supply

Company, of Regina; cement by Canadian Cement Company, Calgary; cast iron by the Canada Iron Corporation, and the concrete machinery by Mussens, Limited, Winnipeg.

Some Itemized Costs.—The following are some of the itemized costs: Cast iron pipes, class C, 2¼ cents per lb.; special castings, 5 cents; cast iron covers and ventilators, 4 cents, all delivered Regina. Cement was $2.85 per barrel; steel, ½ in. and ¾ in. bars, 2.44 cents per lb.; 1 in. 2.80 cents; 1⅜ ins. 3.21 cents; 15-in. joists, 3.60 cents; 12-in. joists, 3.90 cents; standards, 3.90 cents, all deliverel f.o.b. Regina.

Placing of steel in the columns, average cost of labor was 26 cents per 100 lbs.; in floor, 12 cents; in walls, 30 cents.

Cost of labor, team and coal for mixing and placing concrete in column footings averaged $2; columns, $10; floor, 82 cents; walls, $1.10 per cubic yard.

Generally.—Tenders were invited for the construction of this reservoir, on the understanding that the city would supply all cement, gravel, steel and cast iron work, with the result that the lowest bid was $63,176. The engineer's estimate was $46,497, to which was added $6,974 for contractors' profit, making a total of $53,471. The offers were considered to be too high and it was decided to carry out the work by day labor, under the superintendence of Mr. Herbert Gibson. The total cost was about $88,000, of which the items which the city would supply under the contract absorbed about $58,000. The modifications in the design and specifications no doubt effected some reduction in the cost.

Mr. Theo. Brockman was resident engineer during the first season. Mr. L. A. Thornton, the city works commissioner, took an active part in the organization of the work, and Mr. J. McD. Patton, followed by his successor, Mr. J. Mackay, waterworks superintendent, attended to the matter of supply of materials. The reservoir was designed and supervised by the writer.

An important scheme has been put forward by the Egyptian Government for the Mahmoudieh Canal at Alexandria. It involves transforming the canal into a great fluvial harbor, seven miles in extent. At present the canal from the docks to Atfeh is under conflicting administrations. The importance of the canal to commerce and shipping is well borne out by statistics of vessels passing through it during 1910, when 6,512 lighters and sailing vessels and 165 steam tugs and steam barges passed down, and 6,507 and 179, respectively, up stream. These went through the tail locks of the canal at Alexandria, while for the Kafr Dawar lock 14,722 and 665 sailing and steam vessels, respectively, passed down and 13,323 and 680 up stream, and 19,713 boats passed through the Atfeh lock. The Government's scheme is to take away all control from the municipality and the other departments and transfer the canal to a single responsible body. From Hagar Nawatieh to the Mahmoudieh locks (seven miles) a fluvial harbor will be built along the banks, which will enormously improve the discharge of merchandise and facilitate the discharge of cotton. At present boats have been jammed for three weeks owing to the block of traffic and lack of control. Lewa Gedge Pasha has sounded the canal, and it is to be dredged soon and convenient landing stages constructed of concrete, each fitted with a crane capable of lifting four tons. The whole seven miles will not be dealt with at once, but the new fluvial harbor will first be made up to the Farkha Canal.

PIECE WORK SYSTEM APPLIED TO CITY FORCES.

MR. J. E. TUPPER, city engineer of Pomeroy, Wash., has an article in Municipal Engineering on the construction of municipal work by a new plan, some features of which, and the article describing them will be interesting to our municipal engineers, even although they, perhaps, cannot concur in all respects with the position taken by the author.

When the city of Pomeroy, Wash., was about to install its sewerage system the question of how it should be done, whether wholly by contract, partly by contract and partly by the city, or wholly by the city, was an important one and caused much discussion. We had no local contractors capable of handling the work and we were averse to letting the work to contractors from other places, even though there might be an apparent saving by doing so. The previous experience of the city in doing its work with city force had been so generally satisfactory that the council was strongly in favor of that method if some means could be devised of overcoming the one apparent defect in the system. While we had some men who would do as good work for the city as they would if working for a private individual, or even for themselves, a large number of the laboring men are inclined to take it easy when working for the public, and a by no means negligible element will "soldier" whenever and wherever possible. In all of the previous undertakings of the city the crews had been comparatively small, and it had been possible to eliminate the undesirable element, either by refusing them work when their traits were known, or by discharging them as soon as they began shirking.

In preparing for the installation of the sewers it was evident that a new factor entered the problem. The necessary force would be so much larger than any previously assembled by the city that we would need every available man, and would probably need to import some. Now, while the crew was small we could pick our men without causing much hard feeling, and even if a man was discharged for inefficiency, but little trouble was experienced, because his place was taken by another home man. When, however, it comes to replacing home labor with imported labor the matter becomes serious, and the offense would need to be flagrant to justify it.

It is well known to engineers and foremen that the efficiency of any crew is gauged very closely by the efficiency of the poorest man in the crew, and the example of one or two shirks will often have a disastrous effect on the discipline and efficiency of even the best of crews.

The problem that confronted us was that of employing all available home men, importing as few laborers as possible, and doing this without reducing the efficiency of the force below that of a picked crew.

The nature of our work was such that the employment of machinery to any considerable extent was impractical. Our water supply system, if system it could be called, is such a maze of pipes, the location of which is unknown, that the employment of a trenching machine would result in such utter demoralization of the water supply that the expense of repairing breaks in private pipes or cutting out and replacing them would more than offset the reduced cost of trenching. The water mains had been placed without any survey or record of location. In one case where the sewer location presumably paralleled a water main for 2,600 feet at a distance from the main of three feet, we found the water main in our trench for nearly one-third of the distance, and it crossed our trench eight times.

We knew that these conditions existed, and had a very good idea of the obstacles we would be likely to meet. The conditions were not favorable for letting a straight-out contract for the trenching. It was certain that a large portion of the trenches must be dug by hand, and the amount that might possibly be better handled by a machine was too small to warrant bringing in a machine for the purpose. In the purchase of supplies the city was in position to secure fully as advantageous terms as any contractor could possibly get. The manner in which the pipe was laid and the back-fill tamped was of such paramount importance that we felt that the city should retain full control over the workmen who were doing this work. This could only be secured by having the work done by city forces.

After a full canvass of the situation in all of its phases the council decided to have the work done entirely by city forces. It was then up to the engineering department to devise some scheme for overcoming, in part at least, the most objectionable features of that system.

The writer suggested the piecework method of payment, and advised its application to as much of the work as could be done without too much trouble. Many doubts were expressed as to the feasibility of the plan, and the council seriously objected to allowing it to be applied to the pipe-laying because of the danger of the work being slighted.

After considerable discussion the council agreed to allow a test of the method to be made on the trenches only, all other work to be done by day labor. The trenches could be handled by the new method more easily than any other part of the work, and if there should be any tendency to slight the work on the part of any of the workmen it could be easily corrected without endangering the perfection of the sewer. The accounting was a simple matter. Cross timbers for alignment and level purposes were set by the engineering force at 25-foot intervals, thus dividing the trenches into convenient one-man sections. The records of the engineer's office gave the amount of excavation in each 25-foot section, and a single setting of the slide rule gave the compensation. There was a little additional bookkeeping involved, but no complications. A simple method of numbering the sections was adopted, by means of which each man could keep track of the sections excavated by him, and the location of each section could be quickly determined if its number was given. The engineer's record was kept in the ordinary field book, and as there would be no embankment that column was used for entering the compensation for that section computed on the earth excavation basis. As the timekeeper's reports came in, the name of the one excavating a section was entered under the head of "Remarks." In this way complications were rendered impossible and omissions were quickly run down.

As fast as the classifications reports came in from the engineers they were entered on the same book and the proper compensation correction for each section was entered in red ink. The credits shown on the field book were transferred to a single-entry ledger and payments made bi-weekly. We found that though the accounting took a little more time than the day wage system, it was negligible as compared with the advantages that were found to accrue from the new plan.

We had very little data from which to determine what would be a fair scale of prices. Taking what we had, because of it being something of an experiment at best, preferring to be liberal in our prices, we fixed the following scale: Excavation per cubic yard: Earth 15 cents, hardpan 30 cents, loose rock 60 cents. What solid rock we encountered was excavated by day labor men. The amount was small. As it was a little doubtful whether we would be able to secure as many men as we needed for the trenches at these prices, it was announced that if, after a two weeks' trial it was found that the prices were too low to enable the average man to earn ordinary wages, then we would either increase the schedule or return to day wages. With this encouragement enough men were secured to begin operations, and before the first week ended the success of the plan was assured. In fact, the trenchers were able to earn such wages that we were forced to increase our day wage scale in order to hold the men we wanted on the other work. While at first glance this might seem to be a disadvantage, in actual practice it proved to be the reverse.

It gave us the advantage of a sliding scale in place of an arbitrary one. Our minimum wage was $2.50 per eight-hour day. When a day wage man wanted to go in the trenches we had this option. If he was a poor or indifferent worker we would let him go, but if he was a desirable man we would increase his wages to a price that would hold him. If a man was found shirking or slighting his work we would manage to get him in a position where there would be nothing for him to do just then except to go ahead into the trenches, and once in the trench, he would not get on the day wage force again. On the other hand, if there was a man in the trench that we wanted on the day force we could usually secure him. In this way we were able to keep a force of select men, and there was practically no complaint of unfairness or favoritism.

There was much less of this than we expected, and, as they had but two grounds for complaint, yardage and classification, it was very easy to get rid of them. As a whole, the trench men were perfectly satisfied with the deal we gave them. We were very liberal in our classification, were not unnecessarily insistent on having the sides of the trenches trimmed to line, and when unusual difficulties or obstructions were encountered we either gave them extra pay or took over the section to be excavated by the day men. There were a certain number of the trench men who were kept there throughout the entire job. They were worth more there than anywhere else, both to themselves and the city. These men averaged $4.00 a day or more, one of them averaging $5.00. Their example was a stimulus to the entire trenching force. To watch the twenty or more men we had in the trenches for one day was one of the best object lessons on the relative efficiency of common laborers that I ever received. The incentive for efficient work was the same in each individual case. Each man knew that he would get full pay for what he accomplished, and no more. And yet the variation in the amount of the day's work was astonishing. It ranged from 16 to 35 yards of earth in an eight-hour day.

So great a variation must have some reason for its existence. As a rule, the ordinary foreman would not see enough difference to warrant a remark. To all appearances the men were working equally hard, and on the whole with equal diligence. Jones was a husky specimen of the laboring class, above the average in intelligence, especially shrewd and quick to catch on to short cuts and ways of saving his muscle at the expense of his brains. As a day-wage man he was the most persistent, unscrupulous and shrewd hand at "soldiering" that we had in the city. Working in the trenches by the yard, he drew down the largest pay checks of any man in the crew. He worked no harder than other men, but he knew how to make every move count, and, having no incentive for shirking, he kept his shovel in motion. He spent no time talking, looking around or loafing on the job. He

simply worked intelligently and persistently. The only chance to get ahead of the job was in the width of the trench, and these he dug as narrow as he dared. Sometimes he overstepped the limit and had to be called back to trim up, and he always did so cheerfully. He was never a "kicker."

Brown was another husky man. He was the equal of Jones in intelligence, but was less shrewd and more conscientious. He knew how to take advantage of his work, and could, for a short time, move dirt as rapidly as Jones could. The trouble with him was that he could not keep from talking, and could not talk and work. As a result, he spent but little more than half of his time in actual work, and though his pay check was up to the average, it was not what it ought to have been if he had only been reasonably diligent.

Davis was probably the best man of the three, physically and intellectually, but he was inherently so abominably lazy that he had never learned to work and was the despair of all foremen. He was kept in the trenches because he was not worth his salt in any other place and we did not want to actually discharge him. Placed where he had to earn his money, he did make an effort to hold his own, but though to all appearances he worked harder than either of the other men, he was barely able to make minimum day wages. He had plenty of strength, but did not know how to apply it. He failed because he had no system, failed to give any thought to the way he was trying to do the work, and was actually too lazy to use his brain to save his muscle. The same condition existed all along the line.

The Results of the Experiment.—The first marked advantage was that noted above, the opportunity that it gave us of weeding out the undesirable workers from the day-wage forces. The next and undoubtedly most important feature was the marked esprit-du-corps that grew up rapidly in the entire force. It started with the emulation among the trenchers and extended rapidly back through the day-wage men. The knowledge that every man would be expected to "make good" or lose his position was very soon disseminated throughout the force, together with the further certainty that each man would be paid according to what he was able to accomplish, whether he worked in the trenches or by day wage, at least so far as we were able to adjust the compensation under the system pursued. This spirit was so marked and the stimulation that it exerted over the entire force was so great that we would have been decided gainers financially even if the actual cost of the trenching had been more than it could have been contracted for. As a matter of fact, the cost was about four cents per yard below what we could have hoped to get it done by contract.

Where Piecework Payment is Practicable.—The unanimous verdict was that the experiment had proved an unqualified success, and the only regret was that we had not applied it farther than we did. It is very evident that it would be impracticable to attempt to put all of the city forces on the piecework basis, but it was the consensus of opinion that, so far as it was practicable to apply the system, it should be done. The city will on the whole get better work for this reason. The foreman or inspector is anxious to keep the unit cost down, and will frequently pass up shabby work rather than put the city to the expense of making it good when it has been done by day-wage men, but if it was done by piecework he would insist on having it made good before certifying the job up for payment. Then the men themselves are much better satisfied. They get pay for what they accomplish. If there are any strikes under such a system it is because the employer is trying to squeeze out that last penny. The unit price should be such that the poorest man in the crew could make average wages. The cost would then be little, if any, more than under the day-wage plan, while the men would be getting so much more that there would be no incentive for a strike, and the indirect gains to the employer would be ample to warrant the adoption of the plan.

METHODS OF HANDLING LIGHT EARTHWORK.

MR. H. C. LANDON, general manager of the Watauga and Yadkin River Railroad Company, in North Carolina, writing in the *Railway Age Gazette*, makes some very useful observations from experience gained in the moving of 330,000 cu. yds. of earth, on 14 miles of his company's line. He includes details bearing upon labor employed and cost of work that should be of value. The article, as it appears, is as follows:—

The equipment necessary to grade a railroad depends largely on its location with reference to connections with other roads, the characteristics of the profile and the yardage to be moved in the several cuts to make the fills. In the construction of the Watauga and Yadkin River Railroad, which is building from North Wilkesboro, N.C., westward toward Boone, the fills are generally light and the cuts are not very heavy, although there are some comparatively heavy side hill cuts with a large percentage of rock. The difficulty of moving steam shovels far into this country on account of the very poor roads and lack of bridges, eliminate them from consideration, and a study of the profile therefore determined that the greater portion of the earth and rock must be moved with drag scrapers, wheel scrapers and explosives.

Scrapers.—The drag scraper can be used for very short hauls, but it was soon found that wheelers should be used for hauls over 60 ft., except in special locations where it is desired to move earth quickly and the distance is very short. A motion study developed the fact that with drag scrapers the speed of the mules was not over 7,200 ft. per hour, with a haul of 150 ft. on account of the frequent stopping to load the drag, and with a scraper force of six teams and a plow team the cost was about $0.20 per cu. yd. When the distance was not greater than 50 to 70 ft. the cost of moving by drag scrapers was not more than $0.12 per cu. yd., and earth has been moved for about $0.11 per cu. yd., where little or no plowing was necessary. Observations made on 110 ft. hauls with drag scrapers indicated that under the best conditions 25½ trips were made per hour, giving a speed of 5,600 ft. per hour and approximately 25 yds. per team at a cost of $0.17 per cu. yd.

As a general proposition the drag scraper is expensive in moving earth and should not be considered. A few drags on the job, however, are valuable and convenient, especially for special purposes. In one instance it was questionable whether it would not be cheaper to make a fill with drag scrapers from a borrow pit alongside and waste earth from a cut approximately 600 ft. away. It developed that the cost to make the fill from the adjoining borrow pit was approximately $0.12 per cu. yd., while the cost of hauling the material from the cut with wheelers was only $0.14 per cu. yd. To waste the cut and make the fill with drag scrapers would have cost not less than $0.24 per yd.

Observations of the wheeler forces showed that the speed of the wheelers with the above haul was about 133 ft. per min., or about 1.5 miles per hour. An average of 300 yds. per day was handled with this wheeler force of one foreman, nine wheelers, one plowman, one loader, one dumper, one snatch team and one four-mule plow team, at a total cost of approximately $34 per day. This force, therefore, handled 300 cu. yds. at an approximate cost of $0.146 per yd., and the amount handled could probably be increased if some system of premiums were devised. The low cost per team is due to the fact that the company owns its own teams and that $3 per day is considered a high price for teams in the locality in which this road is being constructed.

Careful observation showed that with a haul of 300 ft., nine wheelers averaged 55 cu. yd. per day per wheeler at a cost per cu. yd. very little above $0.09. The material handled was river bottom material, which is easily plowed and not difficult to handle, or a side hill cut with a subsoil of a reddish clay not much more expensive to handle than river bottom soil. Thirteen wheelers with 800 ft. average haul handled 300 cu. yds. per day at a cost of $0.168 per cu. yd. With this haul it was cheaper to move the material out of the cut into a fill that attempt to make the fill from the side ditch alongside, provided it was necessary to waste the material in the cut.

The advantage of the wheeler is in its capacity. The drag scraper requires from eight to ten loads per yd., while a No. 2½ wheeler requires but little more than two loads. The average speed of the teams operating wheelers in general is about 1.5 to 1.9 miles per hour, and on long hauls where there is no delay in loading, teams will make an average speed of 2.3 miles. On December 31, 1912, observation was made of two wheeler forces, both handling stiff red clay on side hill work. In the first instance, the force consisting of one plow team, one snatch team and six wheelers, with an average haul of 415 ft., made four trips in exactly 20 min., travelling through some mud, or at a speed of 9,960 ft., or 1.9 miles per hour. The second wheeler force using nine wheelers, one plow team, one snatch team and with an average haul of 510 ft., made seven trips in 48 min., equal to 1.7 miles per hour. Each wheeler in the first force should, therefore, make approximately 12 trips per hour, or 120 trips per day and handle nearly 60 yds. of material. In checking the record of one-half day this was approximately what the teams were doing. The longer haul should have been made with greater speed per hour, but the condition of the ground over which the material was deposited made the movement somewhat slower than that of the other force. Even at this rate the labor cost per cubic yard would not very much exceed $0.10, and under these conditions each team would handle 89 loads per day, or nearly 44 yds. per team.

With good teams and careful arrangement of the work the cost of wheeler work, even with hauls of 600 or 800 ft., can be kept down to a moderate price, provided the material is earth and can be plowed without much difficulty. The handling of material with drag scrapers where there is much rock is not very successful, although cuts have been handled successfully where material had to be blasted.

Dump Cars.—Four small dump cars of 2 yds. capacity were used in the work. As it was difficult to get light steel rails, wooden rails made of 4-in. x 4-in. timbers were provided. These cars were used to move rock at a tunnel approach and in short cuts where most of the material was rock, which was required for the fills. The cars were loaded by hand and the hauls averaged about 250 ft. The cost per cubic yard with this haul did not exceed $0.17. Where the haul was over 100 ft. the average gang loading cars, including drillers, was 14 men. This force would move about 150 yds., largely rock, at a cost of about $25.

Dump cars for short hauls, of approximately 100 cu. ft. capacity, have proved very convenient for disposing of earth, where the haul was short and speed was not a requirement. The average gang employed loading carts was about ten men, and such a gang would handle 75 cu. yds. per day at a cost of approximately $19.50.

Powder and Explosives.—The location of the line being largely on side hills and in places where there was little or no danger in moving earth and rock with powder, it was decided to move a large portion of the side hill cuts by this means. Up to this date approximately 5,000 kegs of powder have been used, moving approximately 50,000 cu. yds. At first it was difficult to get the foremen to use the powder, but we finally succeeded in arranging the work so that the entire section lying between the small runs on the hillside was drilled with the proper number of holes; about on the centre line, if in soft rock, or near the ditch line, if in hard rock, and from 10 to 17 ft. apart, depending upon the depth of the cut. These side hill sections were usually from 300 to 400 ft. in length, requiring from 30 to 40 holes. A No. 3 blasting machine was ordinarily ample to handle the shots. The first order of powder was for only 400 kegs, which was used in small units, but to very good advantage, moving approximately one yard of rock to every 2 lbs. of powder used.

One 80-ft. cut offered a serious problem. After a study of the situation it was decided that it might be possible to construct powder tunnels and blow off the top of the hill, thereby making an open cut. The line crossed a narrow ridge on a sharp skew which would enable the powder if properly used to throw the material away from the line. The first attempt was made at the west end of the cut, tunnels being driven at right angles to the line to the ditch line, and then both ways on the ditch line approximately 25 ft. above grade. It was supposed that a thorough study had been made of the material, which was generally stiff, hard clay or rotten rock, but it developed that a very hard rock existed on the west end of the tunnel parallel to the line. This disturbed the calculations somewhat. Only 400 kegs of powder were used to make the blast, the powder being placed in paper flour sacks and loaded in a compact manner in the tunnel, approximately filling it, the tunnel being 4 ft. wide and 5½ ft. high. Electric exploders attached to five or six sticks of dynamite were placed in the tunnel at intervals of approximately 25 ft. on the connecting wire lines. The end of the tunnel was tamped very thoroughly. The explosion which followed moved a large amount of earth, and earth which would have had to be removed finally to get to the mouth of a tunnel, which is now being constructed. However, while about 8,000 cu. yds. of material was moved the blast did not do the work expected. The hard rock west of the main tunnel proved of such great resistance that scarcely any material was moved at the summit of the cut, indicating that not enough powder had been used at any point in the tunnel and that the powder tunnels were not properly loaded to move the earth above and beyond the tunnels. The tunnel at the east end was then more carefully planned. Small tunnels were extended out 25 ft. at right angles to the main bore so as to reach approximately the north ditch line. The powder tunnel in-

dicated that most of the material was rotten granite rock, not very difficult to move. It was estimated that about 15,000 yds. were to be moved and it was decided to use only 20,000 lbs. of powder. This powder was loaded in the tunnel in paper sacks as in the previous case. The exploders and the line were placed in the tunnel at approximately the same intervals as in the first instance and were all carefully tested. The total length of this tunnel was 245 ft., the powder filling all but 30 ft. of it. This blast moved approximately 14,000 yds. of earth.

Several other large blasts have been successfully made along the route in side hill cuts on different sections of the line, moving almost one-half yard of material for every pound of powder used. In one cut, estimated at 8,000 yds., 95 per cent. of which was solid rock, 33 holes were driven in two rows, the upper row being approximately 20 ft. deep and extending 2 ft. below grade, while the lower holes were 16 ft. deep, extending 6 ft. below grade. The holes were expanded twice; first by using five or six sticks of dynamite, and then by using 25 or 30 sticks. This material was all rock, and the second expansion of the holes was necessary, although it is believed that one expansion of the holes, using 10 or 12 sticks of dynamite would have given better results, as the second expansion tended to fill the holes rather than open them up to sufficient size. An average of 11 kegs of powder was used in expanding the upper holes and 13 in the lower holes. The results of this blast were very satisfactory, 378 kegs of powder being used, moving fully 7,000 cu. yds. of rock. A No. 3 push down battery was used in this explosion, although this was overloading the battery slightly.

In all the smaller shots that are being made, the foremen are instructed to use powder judiciously, and they are getting good results with a minimum amount of powder. The holes made on the centre line to a point about 2 ft. below the grade line and are spaced a distance apart equal to the depth of the holes. It is found that the holes drilled on the centre line and to this depth below the grade will ordinarily pull down the grade about the amount desired, and will not move the earth too far back of the slope line where soft rock is handled. In some locations where we have encountered a very hard granite the upper holes are placed on the ditch line. Steam drills are used with hard rock, while a large percentage of the other holes are put down by hand and churn drills.

The total yardage in grading 14 miles of the road is 330,000 cu. yds., 20 per cent. of which is rock. This was moved with an average of 72 teams, 200 men, 150,000 lbs. of powder and ten tons of dynamite in less than six months. The average labor cost of moving earth was $0.15, and rock, $0.36. The wages paid for common labor were $1.40 per day, drillers $1.60, and hired teams $3 per day.

DRYING PEAT FOR GAS PRODUCERS.

A recently issued French patent describes a process whereby disintegrated peat is pressed into a thin cake between two endless filtering bands which pass between perforated metal supporting plates or over a metal pulley and are suitably tensioned. The moisture in the peat is thus reduced 60 to 80 per cent. The peat is then further dried by exposure to hot air or to the heat of the sun. A suitable hot-air dryer comprises a chamber through which large quantities of hot air are blown in the upward direction, whilst the peat cake, in small pieces, travels from the top downwards in a zig-zag path on a series of endless bands.

SHOP TRANSPORTATION SYSTEMS.

By Henry Grattan Tyrrell.
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ALMOST all industrial works are now provided with shop cranes for lifting heavy weights, but many are lacking in facilities for the economic handling of small parts. It is still a common sight to see slow-moving cranes of large capacity lifting pieces that are just too heavy for loading on trucks by hand.

The principle must be maintained that materials in process of construction should pass through the works in the most direct course, with the fewest side detours and no backward movements. The production from a shop may be compared to the discharge of water through a pipe. In the latter case, the volume of discharge depends on two factors: (1) the size of the pipe, and (2) the rate at which the water moves. The size of the pipe corresponds to the proportions of the buildings and the number of employees and machines, and the velocity to the rate at which the men can perform their work. With the plant limitations fixed in reference to its equipment, the rate of performing work is, perhaps, the chief factor in production. Much has been written in reference to human efficiency, and the best methods of securing a full day's service from the workmen, and too little about assisting him with convenient appliances. A man's producing power in a factory is limited by his tools, and the lifting and transporting systems are among the most important. As every hour of a workman's time is a definite expense, he should have enough assistance that no time need be wasted.

The subject of "Shop Cranes" is so large that little or no attention can be given to it here, for it is thoroughly covered in several comprehensive volumes. The other transportation facilities include: (1) locomotives, (2) hand-cars, trucks and carts, (3) trolleys on mono-rails, (4) conveyers, moving platforms, transfer tables, etc.

At a first glance it might seem best to install a single lifting appliance large enough to meet the maximum requirements of size and weight. But further thought will show that principle to be erroneous, the economic arrangement being to handle large pieces with heavy machines and smaller pieces with lighter ones. The principle corresponds with the well-known one on railroads, that smaller cars are preferable to larger ones for small loads and frequent stops. Neither is it economical to invest so much money in handling appliances, that the whole needs of the plant in this direction can be served in a small portion of the day and then remain idle, for a large proportion of capital invested is then unproductive for much of the time. Between a lack and a surplus of transportation system there is a mean where only enough money is expended to just suit the regular needs.

Trolley Systems.—Overhead trolleys carry their loads in suspension from an elevated track, and in this way differ from floor transportation. They are appropriate when a floor is covered with litter where trucks would be obstructed in their movements. They are cheaper than travelling cranes, and most efficient for continuous service. In crossing a stream between buildings the trolley may run on a wire rope. They are suitable for handling weights up to a maximum of five or six tons, though they have occasionally been used up to ten tons. Out of doors they can hang either from a light trestle or from brackets on the side of buildings, and they can turn corners of small radius. For continuous service, the loaded trolley on a down grade will haul back the empty one, and for passing from one story to another the trolleys move on an incline, though for intermittent ser-

vice they can be taken on an elevator. They are suitable when only a simple arrangement of trolley tracks are needed, and not when the tracks would be numerous or complicated. They have the advantage of turning sharp corners easily, and in winter are free from obstruction from snow and ice when yard tracks on the ground would be blocked up. For conveying small parts, they may be supplied with a metal basket carrier, similar to those commonly used in stores, and for heavy loads of a ton or more they should have a motor. In some cases it will be economy to use a "man trolley," with an operator's cage and a man aboard for controlling all movements, as in some of the modern coal and ore-handling machines, where the trolleys travel at the rate of 1,000 feet per minute.

The best form of track is that of curved metal in inverted U form, with treads for double wheels, with the weight suspended between them. It is similar to a common form of track used for large rolling doors. Flat bars on edge are also used with a single line of wheels, and rolled steel beams with double wheels running on the lower flange. They can have switches and crossovers, but, after all, trolley systems serve only the floor directly beneath them.

Conveyer Systems.—Shop conveyers are of many kinds, including those of chain and belts, with fingers or boxes attached for carrying packages. Plain belts, held in a grooved position by side rollers, are good for certain purposes, and are often preferable to those with baskets. Table conveyers, or moving platforms, are used for carrying boxes or lumber, and circular conveyers are often convenient in foundries for sand and moulds. Multi-story shops should have elevators or moving stairs, especially where women are employed, for the energy wasted in stair-climbing could better be spent in useful work. Electric elevators with automatic floor signals, which need no operator, but which stop at the floor indicated by the button which the occupant presses, are now a favorite for workshops, but should be often and carefully inspected.

Where the floor is clear enough to permit the movement of floor trucks, these are often very convenient, as they can be shoved about anywhere. For cement or granite floors, they should have a slightly rounded tire, preferably covered with hard rubber.

Pneumatic tubes, like those in department stores, may be installed for the transfer of mail or small goods, and speaking-tubes are convenient between adjoining floors or rooms. A private telephone system connecting all departments is a great economy, and it should have branches wherever time can be saved thereby.

Yards and Tracks.—The arrangement of the yards includes the driveways, pavements, tracks, switches, yard-cranes, scales, car and locomotive sheds, watchhouses, fencing, etc. Brick pavement around works is easy to walk on and gives horses a good foothold, though preserved wood blocks are often preferred.

The track arrangement will require careful study, and the best plan will depend on the plant. A small manufactory with only very light products can, perhaps, be well enough served by a stub-end track or spur, while a works where many cars are handled must have a better system. A loop arrangement may then be the best, on which cars can move continuously in one direction and avoid much switching. Yards should generally have a system of narrow service tracks, but a broad gauge for receiving, storing and shipping is of the first importance. None but very small plants can afford to be without a railroad connection, three or four cars per month being reason enough for installing at least a spur track. Large plants should, to avoid congestion, either have a loop system, as mentioned above, or a double connection to the main line, with enough track for storing the maximum number of cars. Unless material moves freely and without useless switching, there will be loss of time.

In choosing between circuits and stub-ends switches, the latter may be good enough, though continuous track is better. The economic arrangement of yards is more difficult to plan in an old plant than a new one, where space is unlimited and unobstructed. Parallel tracks can be arranged in the form of "ladders," with switches, on which cars can be sorted. Wide-gauge curves should have a radius of not less than 235 feet, and the cost may be roughly estimated at $1.50 to $2 per lineal foot.

Narrow-gauge tracks should usually connect all buildings and yards, and they should be freely used about the plant wherever goods are carried. They are, in fact, a necessary supplement to the broad-gauge lines, which cannot be generally used because of the long radius required at the turns. Double lines should not be closer together than about six feet on centres, and if turntables are used at the junctions, their base should be down below the frost line. The gauge of these narrow tracks may be anywhere from 15 inches up to the standard width of 4 feet 8½ inches, though 30 inches is about the best. The minimum radius for curves is 12 feet for 21-inch gauge, and 40 feet for 30-inch gauge. Rails weighing 40 pound per yard are heavy enough for ties 24 inches apart, though in some places I have prescribed lighter rails. Their tops should never stand above the shop floors, and wheel flanges on the trucks should not be flat, but slightly tapered as on steam railroad cars.

Yard Motors and Hoists.—Yard motors include locomotives, propelled either by steam, electricity or compressed air. Where electric power is available, the electric locomotive is usually the cheapest, cleanest and most convenient, but the steam railroads often object to electric locomotives using their tracks. Where much inflammable material is piled about, such as in lumber yards, a steam engine is dangerous, and electric or compressed air motors are then preferred, though the latter requires the installation of expensive compressors especially for this purpose. When tracks enter buildings, steam engines are not desirable because of their smoke and gas.

Where the overhead trolley wires would interfere with cranes or other appliances, electric locomotives can have a connection through a continuous floor slot, or when entering a building, the trolley wire may be made to uncoil in advance of the car and furnish it with power, and coil up again as the car is withdrawn. A combination of electric motor car and derrick is a very convenient yard machine.

Yard cranes covering the whole storage and loading space are economical in many places, and for heavy goods gantry cranes need no obstructing ways, and in this respect are desirable. They may be of either the bridge or cantilever type, the load capacity in the latter case being limited by the resistance to overturning on the central track. In many large works, such as steel plants, material in course of manufacture is never touched by hand, all operations being mechanical from receiving the raw material to shipping the finished product. Shop cranes may be arranged to run outside of the buildings and connect with the yard system.

The rule generally in installing shop transportation systems is to use mechanical appliances wherever the saving of time and labor would more than pay the interest on the money invested in such extra equipment.

CANADIAN PACIFIC RAILWAY BARGE FOR NELSON, B.C.

The car transfer barge which is being built by the Polson Iron Works, Limited, Toronto, for the Canadian Pacific Railway will be used for transferring cars on the Kootenay Lakes. Its length over all is 224 feet, beam 42 feet 6 inches, and 8 feet in depth. The accompanying figure shows general plan, longitudinal bulkhead and bracing.

The frames for the bottom of the barge are 7 x 3½ x 3½ x ½" channels. The sides are 5 x 3 x ⅜" angles, and brackets 18 x 18 x ⅜", and to the side framing at bilge by 30 x 36 x ⅜" flange brackets.

The decking consists of ⅜-inch steel throughout. The shell plating is also to be ⅜ inch in thickness, while the sheer strake and keel plate will be of 7/16-inch steel.

The fender channel will be of 8-inch shipbuilding section. It will be provided with bosom plate of 7/16-inch steel, and flush riveted holes in the channel web for receiving the wooden fenders.

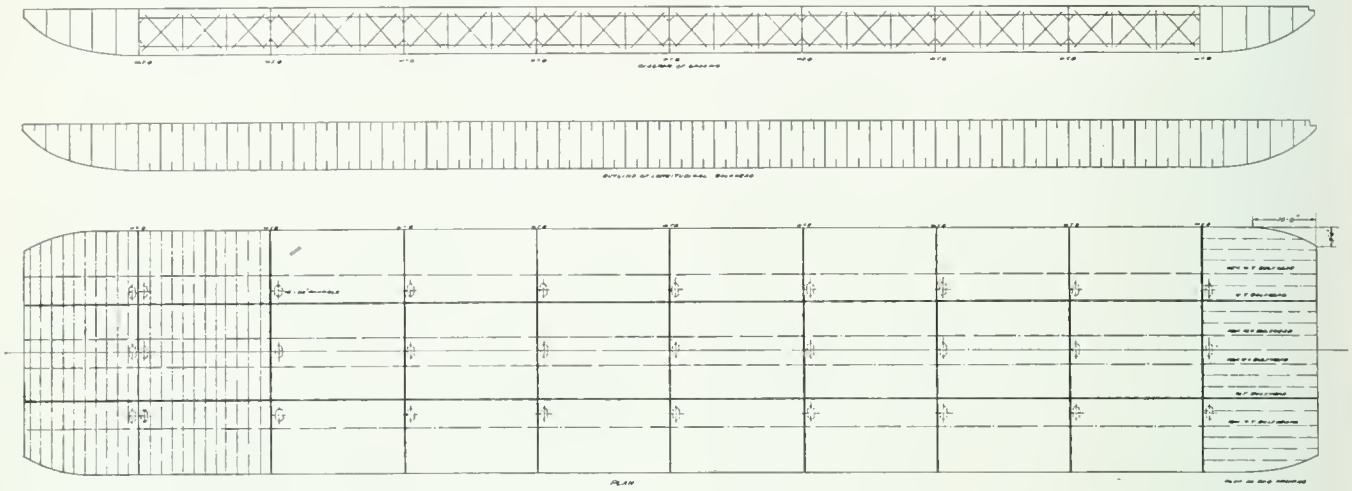

Fig. 1.—Plan and Sections of C.P.R. Transfer Barge.

scarphed for 18 inches to the channels. They are spaced 23 inches between end bulkheads. The frames in the fore and aft compartments are to be 5 x 3 x ⅜" between tracks and increased to 6 x 3½ x 7/16" in the way of the tracks, as shown on plan. It will be noticed that they are placed fore and aft instead of athwartships. The vertical side framing will also consist of 5 x 3 x ⅜" angles placed 24 inches apart. In the end compartment the framing will be bracketed at the end to the end bulkhead and deck with 5/16-inch bracket. The channel frames themselves are to be bracketed to the longitudinal bulkhead by

The barge will have nine transverse bulkheads of ¼-inch plate and six longitudinal bulkheads, each 5/16 inch in thickness. They will be extra heavily stiffened and braced with plates, channels and angles.

The barge when completed will be capable of handling fifteen loaded cars at a time. It will be provided with three tracks upon deck for this accommodation.

The hull is being erected at the contractor's yard in Toronto. After completion it will be taken down, shipped to Nelson, B.C., and there re-erected and riveted. It is expected that the delivery will be made this fall.

CEMENT PRODUCTION FROM RAW MATERIALS.

Covering a period of fifteen years, the following table shows the United States production of Portland cement in barrels, and the percentage of total output, for each type of raw material used in its manufacture, as prepared for the United States Geological Survey report on the United States mineral resources for 1912:—

Year.	Cement rock and pure limestone.		Limestone and clay or shale.		Marl and clay.		Blast-furnace slag and limestone.	
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage	Quantity.	Percentage.
1898	2,764,694	74.9	365,408	9.9	562,092	15.2	.....	....
1899	4,010,132	70.9	546,200	9.7	1,095,934	19.4	.....	....
1900	5,960,739	70.3	1,034,041	12.2	1,454,797	17.1	32,443	0.4
1901	8,503,500	66.9	2,042,200	16.1	2,001,200	15.7	164,316	1.3
1902	10,953,178	63.6	3,738,303	21.7	2,220,453	12.9	318,710	1.8
1903	12,493,694	55.9	6,333,403	28.3	3,052,946	13.7	462,930	2.1
1904	15,173,391	57.2	7,526,323	28.4	3,332,873	12.6	473,294	1.8
1905	18,454,902	52.4	11,172,389	31.7	3,884,178	11.0	1,735,343	4.9
1906	23,896,951	51.4	16,532,212	35.6	3,958,201	8.5	2,076,000	4.5
1907	25,859,095	53.0	17,190,697	35.2	3,606,598	7.4	2,129,000	4.4
1908	20,678,693	40.6	23,047,707	45.0	2,811,212	5.5	4,535,300	8.9
1909	24,274 047	37.3	32,219,365	49.6	2,711,219	4.2	5,786,800	8.9
1910	26,520,911	34.6	39,720,320	51.9	3,307,220	4.3	7,001,500	9.2
1911	26,812,129	34.1	40,665,332	51.8	3,314,176	4.2	7,737,000	9.9
1912	24,712,780	30.0	44,607,776	54.1	2,467,368	3.0	10,650,172	12.9

The Canadian Engineer

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CONTENTS OF THIS ISSUE.

Editorial:	PAGE
Municipal Engineering and Public Health	373
Organization Among Municipal Engineers	373
Leading Articles:	
Science in the Design of Streets	357
A 150-Foot Archbridge with Suspended Roadway in Reinforced Concrete	361
The Tor Hill Reservoir, Regina	363
Piece Work System Applied to City Forces	367
Methods of Handling Light Earthwork	368
Shop Transportation Systems	370
The Canadian Pacific Railway Barge for Nelson, B.C.	372
Quantitative Estimation of Ground Waters for Public Supplies	375
Town Planning	377
Engineers' Library	382
Coast to Coast	386
Personals	388
Coming Meetings	388
Railway Orders	75
Construction News	76
Market Conditions	92-94
Technical and Municipal Societies	94

MUNICIPAL ENGINEERING AND PUBLIC HEALTH.

At the convention of the Public Health Association in Regina, September 18th, 19th and 20th, the municipal engineers of Canada should have a strong representation, this branch of the profession being so closely associated with the health and development of communities. A special section has been arranged for engineers and architects and, in glancing over the list of papers to be read to this section, as appearing in last issue of *The Canadian Engineer*, the proceedings of the meeting will be carried on largely by and for the benefit of municipal engineers, which should be an incentive for them to attend. Papers to be read at other sections have a similar bearing upon the development work of municipalities, and, taken altogether, city and town engineers should turn out from quite a distance to this three-days' convention. The fact that some of them are not overburdened with development work at present is another argument in favor of their participation.

A suggestion has been made that those municipal engineers who attend this convention should hold an informal meeting at some convenient hour during its progress to discuss the feasibility of forming an organization primarily for municipal engineers. The idea of an association has certainly met with favor as many engineers have taken the time to write approving of the suggestions made in discussing the subject in our issue of July 10th. The opportunity, then, for exchanging views on the proposed organization will be welcomed, and should act as an added incentive for all to attend the Regina convention who possibly can. Although the gathering will not be sufficiently representative of Canadian municipal engineers to take any inaugural steps, the wisdom of collection of as many valuable suggestions as possible is apparent. Further, those who contemplate being present should signify this intention so as to add weight and make the proposed informal gathering a surety and a success.

ORGANIZATION AMONG MUNICIPAL ENGINEERS.

There seems to be unanimity of opinion among municipal engineers in Canada with regard to the lack of an official body as exists in other branches of engineering. Doubtless the municipal engineer, in his isolated position, needs an organization whereby his branch of the profession can stand alone. Municipal engineering is one of the younger branches of the profession, and like it, is an evolution of the artisan rather than of the early scientist. The engineer's work is becoming more scientific because of his relations and associations with the scientific world. These relations must become closer for the more direct application of science, through the municipal engineer, to the growth, health and general development of his municipality. He stands between a scientist and the work-a-day world with a keen appreciation of the value of the work of the one, and a ready understanding of the needs of the other; and his work consists in transforming the abstract results of the former into practical usefulness for the latter. His number is increasing and the intricacies associated with his professional duties will probably never subside. He is an indispensable member of the learned profession of civil engineering, whose growth during

the past decade would support claim to being a veritable profession of progress. As the larger portion of the immense material advancement of the world during the past century is due primarily and pre-eminently to its engineers, so has the tendency towards concentration of population, devolving from this advancement, necessitated the employment everywhere of the municipal engineer.

Again, the function of the municipal engineer appears to include everything but boundary. Civil engineering, as the term is understood generally, includes so many phases of useful construction that the ordinary citizen unfamiliar with the scope of municipal work, is disposed to consider this a very specialized branch. Yet it is scarcely practicable to draw a line between the profession, as a whole, and the duties of the municipal engineer. The former includes the design and construction of bridges, viaducts, wharves, piers, docks, canals, dams, irrigation works, retaining walls and other heavy masonry; tunnelling and extensive and difficult foundations; river improvements, harbors and waterways; water supply, sewerage, filtration and treatment of refuse; highway construction, surveying; railways (steam and electric); the general design and construction of power plants (steam, electric and hydraulic); of lighting plants (electric and gaseous); the heavier structural features of office and industrial buildings; the general problems of transportation, etc., etc. Has not the municipal engineer to be equipped with an up-to-date working knowledge of practically every item that one may classify under the heading of "Civil Engineering?"

Further the term "Civil Engineer," as upheld by the Canadian Society of Civil Engineers, the American Society of Civil Engineers and the Institution of Civil Engineers, covers thoroughly the field of the municipal engineer.

This brings us back to the opinion we expressed in July 10th issue of *The Canadian Engineer*, concerning the contiguity that would exist between the two if an association of municipal engineers were formed as a body separate from the Canadian Society of Civil Engineers. We believe that the existing Society will be more useful to a man engaged in municipal work, in establishing for him an association with engineers who, like himself, must keep in touch with the activities of all branches of engineering, and with the newer methods of scientific investigation, than would an institution, newly formed expressly for municipal engineers, many of whom are now members of the Canadian Society. The assertion is made with a belief that there are too many engineering and technical societies now existing in Canada, and also that among them there is none with a membership more difficult to build than that of the prospective organization.

A municipal engineers' section in the Canadian Society of Civil Engineers will give its members the best opportunity of forming for themselves a strong institution, coherent in itself and bearing directly upon all engineering applied to municipal development. It will have a strong organization behind it, and will continue to add strength to that organization as its membership increases.

Once formed, the establishment of sub-sections in the present branches of the Society throughout the Dominion and of other advantages, as for instance, a circulating library among these sections, equipped with the latest works on subjects allied to municipal engineering, will not be long in elevating that branch of the profession to what it should be, viz., one of the most inviting, from its present status, one of the least.

LEAGUE OF AMERICAN MUNICIPALITIES.

The seventeenth annual convention of the League of American Municipalities held recently in Winnipeg, brought forth a number of addresses and discussions on topics of more than usual importance. Mayor Deacon opened the convention with an address of welcome, responded to by Mr. John J. Ryder, superintendent of police, sanitation and public safety, Omaha, Neb., as president of the League.

Among the addresses made and topics discussed were the following:

C. J. Driscoll of the Bureau of Municipal Research, New York, formerly a police commissioner of that city, spoke of "Municipal Efficiency" with particular reference to the police departments. Mr. Driscoll's paper was a consistent argument for the expert in municipal affairs, mainly on the ground that municipal business is like any other business and requires long study and the application of scientific principles, if it is to reach the state of efficiency to which the people as ratepayers are entitled.

W. A. Larkin, street commissioner, Baltimore, read a paper on "Baltimore Street Cleaning and Garbage Removal." He mentioned particularly the good work of washing machines in keeping down the dust. In the discussion following, C. L. Willert said that Buffalo is one of the cleanest cities in the country.

Ossian Lang, Mt. Vernon, N.Y., president of the board of aldermen, read a paper on "Popular vs. Expert Government," in which he argued strongly for the popular representative form on the ground that the people themselves are nearly always right and that they have an unerring faculty for disposing of the man who has not proved his worth or efficiency. He described the professional expert as a man who thinks more of his job or his profession than of the interests of the community he may happen to be serving, and who is always ready to move along to any place that offers him more money.

In speaking on "Municipal Finance," W. Sanford ex-mayor of Winnipeg, reviewed briefly the history of municipal loans, noting that they were unknown two hundred years ago. Drawing from his own experience, Mr. Evans said that Winnipeg had found London to be the best market for the sale of its securities. The demand in London was for listed securities regularly dealt with in the stock market. Winnipeg is now issuing 1943-63 stock, that is, securities redeemable in that period. A large volume of securities was a benefit and a large list of holders as tending to make transfers possible without loss.

Charles L. Willert, councilman, Buffalo, N.Y., spoke on "Small Parks." He said that large parks chiefly benefited the owners of carriages and automobiles. Small parks attract the common people.

John B. Martin, election commissioner, Boston, Mass., spoke on "New Charter and Election Laws." The paper dealt principally with the new charter of the city of Boston and other local conditions.

Col. H. N. Ruttan, city engineer of Winnipeg, presented a paper on "Physical Construction of Cities," which brought out a lengthy discussion. "Municipal Light and Power" by J. W. Cockburn, controller, Winnipeg, and "Recent Development in Municipal Administration in Canada," by T. A. Hunter, K.C., corporation counsel, Winnipeg, were among the papers presented by Canadians at the convention.

QUANTITATIVE ESTIMATION OF GROUND WATERS FOR PUBLIC SUPPLIES.*

By Myron L. Fuller, Consulting Engineer, Boston, Mass.

THE development of water supplies from surface sources has long received the careful consideration of hundreds of engineers, including many of the most prominent in the country. The questions involved have been earnestly attacked, thoughtfully considered, carefully weighed, and painstakingly solved, not only for the large cities, but for the smaller municipalities, towns, and villages as well. The best thought of our best men has been freely given to the subject.

Ground-water supplies, on the other hand, with a few exceptions, have rarely received more than the passing attention of engineers. The problems, lying, as they do, outside the usual limits of the engineer's training and experience, have seldom been studied with anything like the same degree of thoroughness as the surface supplies. Too often, he has assumed, because they have been obscure to him, that the occurrence and movements of ground waters follow no definite laws, and that the securing of adequate supplies is, in most cases, a mere matter of luck.

In reality, the principles controlling the collection, absorption, storage, motions, and recovery of the waters within the ground are as definite as those governing upon the surface, and are worthy of the same serious consideration that has been given to the latter. If this is given them, their problems are equally open to solution, and the prediction of supplies will become a matter of comparative certainty rather than a mere conjecture.

Factors in Ground Water Estimates.—In any attempt to estimate available ground waters, a certain number of factors common to all localities must be carefully considered if the deductions are to be of value. These may be stated as follows: 1. Nature of water-bearing materials. 2. Storage capacities of water-bearing formations. 3. Availability of supply. 4. Area tributary to wells. 5. Velocity of underflow. 6. Rate of replenishment.

In the vast majority of cases the knowledge of the foregoing factors is practically confined to the first. In not more than one out of ten wells is there an adequate knowledge of storage capacity, rate of yield, or tributary area, while in hardly one in a thousand is the velocity or rate of replenishment seriously investigated. All the factors enumerated are susceptible of approximate determination and, when known, greatly restrict the range of errors of estimation.

Determination of Water-Bearing Materials.—The determination of the character of materials to be encountered in a well is not simple. In many instances the surface affords little indication of what lies beneath. The glacial deposits which overlie the rock in New England are highly variable in character and may range from loose sand to dense hardpan within an interval of a few feet. The depth of such deposits is subject to abrupt changes within short distances.

The character of the solid rock lying beneath the surface deposits is often even more difficult to determine, for although some formations are of nearly uniform character over wide areas, others change rapidly. In a large number of cases the changes occur beneath valleys where the rock is deeply buried.

The determination of the character of the rocks at considerable depths below the surface is seldom an impossible task; it may usually be made with a reasonable degree of accuracy. This work is properly that of the geologist, and the judgment of the engineer will ordinarily be of little value if the conditions are at all complicated. Too often he does not even know whether they are complicated or not.

An accurate determination of the character of the water-bearing materials is important, for upon it will depend the storage, the rate of yield, and the quality of the supply. The best information obtainable should be secured before drilling is begun.

Storage Capacities of Water-Bearing Formations.—The volume of the ground water depends directly upon the containing material, and if a quantitative estimate is to be made, the nature of the water-bearing bed must be accurately known, for upon it depends the character of the storage—whether in pores, in joints or fissures, in cleavage or schistosity plains, in solution passages or cavities, etc.

An intimate knowledge of the occurrence of ground water is again indispensable. Open cavities are encountered in rocks, but such openings are found only in limestones; in granites, sandstones and slates, there is no possibility of encountering such a passage. The supposed openings in the latter rocks, assumed to exist because of the sudden dropping of the tools while drilling, are simply soft streaks, consisting of clayey products of decomposition through which the drill penetrates at a single stroke. They are the result of the circulation of water within the rock, and will afford considerable water to wells. Water is found in the joints or fissures of granites, but the width of these is seldom more than 1/20 in. and is often less than 1/50 in., and few of them extend more than a few hundred feet, thus cutting off the possibility of a distant supply. These and other similar factors are of vital importance in the estimation of the yield of proposed wells.

Availability of Supply.—The availability of ground waters, or the quantity yielded to wells, has no relation to the storage capacity of the materials in which they occur. Often the formations containing the largest supplies will yield the least. In Table I. the first column indicates the volume of water actually contained in rocks and soils of various types, while the second shows the usual yield from the pores.

Table I. does not tell the whole story. For instance while clays will yield practically nothing to wells, they are of great value as feeders to underlying rocks, to which they slowly give up their water. In many instances the capacities of rock wells are probably doubled by the presence of their clay covering. Again, while the sandstones may show an ultimate yield of from 1 to 15 per cent. of their total supplies, the water often enters a well too slowly to be of value as a source of supply.

In fact, there are so many modifying conditions that the determination of the probable quantity of a proposed supply demands a thorough knowledge of ground waters and a careful study of local conditions.

Area Tributary to Wells.—The ultimate quantity to be derived from wells at a given point will be, other things being equal, proportional to the extent of the tributary area. It is not always a simple matter to determine the distance from which water will find its way

*From an address delivered March 12th, 1913, to the New England Waterworks Association, and appearing in the Journal of the association for June, 1913.

to a well, and a separate determination based on a careful examination, must be made at each locality. There are, however, certain general facts regarding the distances traversed by ground waters. Some of these are summarized in Table II.

The wide variations in the areas tributary to different sets of wells will be appreciated from an examination of Table II. The problems of source and tributary area are, naturally, geological in their nature and will require the services of a geologist for their solution. To one trained in this line they will ordinarily present few difficulties.

The Velocity of Underflow.—As in the case of a surface stream, the quantity of available ground water at a given point is determined by multiplying the cross-section of the moving water body by the velocity of its movement. This will give us the normal underflow, or, in other words, the maximum available supply; for, although it is possible to pump for a time from the reservoir (accumulated storage) within the ground, no more water can be obtained in the long run than is normally flowing within the limits of the area tributary to the wells.

Only in a very few cases has the velocity of underflow been determined in connection with the development of municipal supplies, although it is perfectly practicable where the water occurrs in unconsolidated material of reasonable uniformity and would undoubtedly prevent the waste of large sums in injudicious prospecting or unwarranted development.

TABLE I.

Porosities and Yield of Rocks and Unconsolidated Materials.

Material	Storage Capacity or Porosity Per Cent. of Volume	Normal Yield to Drilled Wells from Pores.* Per Cent. of Volume
Quartzites (average)	½	None
Granites (average)	1	None
Slate and shale (average) ...	4	None
Limestone and marbles (average	5	None
Sandstones	5 to 25	1 to 15
Gravel (mixed with sand)	20 to 30	10 to 20
Sand (medium to coarse)	30 to 40	10 to 25
Sand (fine)	30 to 40	5 to 20
Clay	40 to 70	None
Till or bowlder-clay	20 to 60	0 to 20

* The figures in this column do not include the yield from fissures, joints or cleavage planes Water remaining in rock is largely residual moisture held by capillarity.

The most successful process of measuring underflow is the Slichter method, described in the succeeding article. It can be applied by any mechanical or other engineer, but for the interpretation of results and more especially the determination of the extent of the tributary area, usually demands considerable geological knowledge and experience.

Rate of Replenishment.—An accurate determination of the rate of replenishment is of the first importance, for, no matter how great the storage and how large the tributary area, a large permanent supply will be obtainable only when the average absorption is at least equal to the quantity of water withdrawn.

In New England, the determination of the rate of replenishment is a comparatively easy matter, for we are here dealing with an area of abundant and well-distributed rainfall, relatively low evaporation and fairly simple absorptive conditions. In the western arid and semi-arid regions, on the other hand, the problems are more complex. There, the rainfall and evaporation are very irregular and it takes but little to disturb the balance and change a net gain to a net loss. When the loss by evaporation becomes greater than the rainfall, the replenishment can take place only by absorption of water from the streams, which often pour down more or less transient floods after heavy rainfalls. In such instances careful field observations, supplemented by laboratory tests to determine porosities and rates of percolation, are necessary to determine the rate of absorption and additions to the ground-water reservoir.

In the East, the problem requires a careful computation of the rainfall and an analysis of its seasonal distribution, together with a similar investigation of seasonal evaporation and plant transpiration and an accurate determination of the porosity, size of grain, rate of percolation, nature of vegetation and other minor factors regulating absorption.

TABLE II.

Distances Traversed by Ground Waters.

Material	Usual Distance of Source from Well	Ordinary Maximum Limit of Transmission in United States
Surface sands and gravels	Less than 1 mile	25 miles
Deep sands and gravels beneath clay or other confining layers	Several miles	100 to 200 miles
Sandstones near surface..	½ to 1 mile	5 to 10 miles
Deeper sandstones	Several miles	100 to 300 miles
Limestones near surface..	½ to 1 mile	10 to 20 miles
Deeper limestones	Several miles	100 to 200 miles
Slate or shale near surface	Less than 500 ft.	Rarely over 1 mile
Deeper slates or shales ..	Possibly several miles	Rarely over 10 miles
Granites	Less than 1,000 ft.	Rarely over 2 or 3 miles

NOTE —Some rocks are water-bearing at greater distances from the outcrop than is indicated in the table, but it seems probable that the water has been absorbed by capillarity from overlying materials rather than derived by transmission from remote catchment areas.

Limited Value of Test Wells and Pumping Tests.—Engineers have frequently remarked that the only way to tell whether or not one has a supply is to put down a test well and make a pumping test.

With this view the writer does not at all concur, for it may be readily shown that pumping tests come far from furnishing complete data as to the availability of permanent supplies. What a pumping test shows and what it does not show is concisely summarized in Table III.

That a knowledge of the materials at the well is insufficient is indicated by the fact that it is the average section for the whole area and not its character at a single point that determines both storage and movement of the ground water. This is not furnished by a single test well.

The pump may deliver during a test very large volumes of water, but, except where the supply is very limited and hence readily depleted, the test shows nothing as to the supply permanently available. Many wells tap groundwater reservoirs containing the accumulated supplies of long periods, but the fact that half a million gallons may be withdrawn daily for a few days is no indication that the permanent yield will be more than a small fraction of this amount.

When the water table stands high in the ground, the entrance of the water into a well is relatively rapid, but the rate of entrance declines as the water table becomes lowered. The extent to which the supply will be affected can be determined only by a study of the tributary area, velocity of underflow and rate of replenishment, no indications of which are afforded by pumping tests.

It is well known that in heavily pumped wells the quality of the ground-water supply often deteriorates with the passage of time, although possibly not for some months or years, but the nature and extent of the change is to be predicted from a study of the character of the materials and of the geological structure rather than from a necessarily brief pumping test.

TABLE III.—DATA FROM PUMPING TESTS.

Pumping tests show—

1. Character of material at well.
2. Presence or absence of water at time of test.
3. Rate of delivery when water is at maximum height.
4. Quality of water at start.

Pumping tests do not show—

1. Average character of material of tributary area.
2. Permanency of the supply.
3. Rate of delivery from depleted reservoir.
4. Quality of water after continued pumping.
5. Direction of movement of ground water.
6. Velocity of ground-water movement.
7. Source of water.
8. Extent of tributary area.
9. Rate of replenishment.

The direction of movement of the ground waters is of considerable moment in determining the liability of pollution by contaminating matter from the surface, or of the likelihood of the penetration of sea water or other mineralized waters from clays, shales, bog iron ores, peats, etc., but is not usually indicated by the pumping test.

Notwithstanding the limitations of the data furnished by pumping tests, they are of much value when their limitations are understood. They should, however, be regarded as adjuncts to ground-water investigations rather than as final in themselves.

WATER POWERS OF ICELAND.

The undeveloped water-power of Iceland is receiving attention this season. The Delbi Falls, 35 miles from the coast, have been acquired by an English concern, engaged in the manufacture of nitrogen products, and with 410,000 horsepower at its command, the company will move all its factories from Peru and Chile to Iceland. Big factories are to be built in the vicinity of the falls and a railroad constructed to the coast. The ownership of the falls was purchased for the sum of $60,000.

What is claimed to be the largest bascule bridge in the world has just been completed at Portland, Oregon. This new bridge, which is 4,800 feet long, crosses the Willamette River, connecting Broadway Street on the west side with Broadway on the east side. It provided an easy grade thoroughfare from the business district to the large residence district on the west side. This type of bridge allows practically unobstructed water traffic up and down the river. It was built by the city at a cost of about $1,300,000. The bridge is lighted at night by 250 5-light and 2-light fixtures, together with an outline scheme of 7,000 lamps spaced 18 inches apart. One hundred-watt tungstens are used in the pole fixtures and 32-candle power lamps on the outline system. Current is supplied to the lamps over more than 12 miles of wire in metal conduit.

TOWN PLANNING.*

By Christopher J. Yorath, A.M. Inst. C.E. (Eng.), City Commissioner, Saskatoon.

GREAT BRITAIN, by the passing of the Town Planning Act of 1909, took the first step towards the undoing of mistakes of centuries, and hopes by planning the future growth of existing and new cities to avoid the enormous expense occasioned through the lack of planning.

Until recent years it was thought that the checkboard system of planning was all that could be desired, but anyone who has studied the subject of town planning will realize at once that it is a failure, and has necessitated even in what are known as the New World cities large expenditure to rectify some of its many defects. How can a system be called a plan which does not take into consideration local characteristics, such as the undulation of the ground, a winding river, thickly-wooded spots and other amenities?

If Great Britain realizes the necessity of passing a Town Planning Act, surely such an Act would be of infinitely more use to Canada, which at present has only a population of about eight millions, or slightly more than that of London, while its area is 3½ million square miles compared to 112,000 square miles comprising Great Britain.

A careful study of what wise town planning, the liberal provision of attractive amenities can do, and has done, for some of the cities of Europe will convince the greatest anti-town planner of the wisdom of looking well ahead.

It invariably happens that town planning is not thought of or put into operation until a certain amount of development has taken place. In Great Britain this does not interfere to any great extent with the planning for the future, as the undeveloped land is not staked out into lots and held by numerous land-holders, but is usually in possession of a few; whereas in Canada, owing to the checkboard system and the selling of outlying plots far in advance of the time when the land is ripe for development, the proper planning of the future is rendered far more difficult, and probably in many cases the difficulties will be so great as likely to make a scheme impracticable without special legislation.

A city attractive by its beauty, by its artistic symmetry and design and convenience which it offers will gain a reputation and an individuality which not only its council and its landowners, but also its citizens, may be proud.

What, then, should be the aim of every city? and to answer that question we are at once thrown back upon the question of what should be the individuality by which the city should be marked and known. Bacon says in his "Essay of Gardens": "God Almighty first planted a garden. And, indeed, it is the purest of human pleasures, it is the greatest refreshment to the spirits of men, without which buildings and palaces are but gross handiwork." Surely, then, the aim should be the one implied by the term "Garden City," beautiful, well planted, and finely laid out, known and characterized by the charm and amenities which it can offer to those who seek a residence or dwelling removed from the turmoil, stress and discomforts of a manufacturing district.

The various systems of planning which have been adopted in the past are rectangular, radial and circumferential, and curvilineal, but the latest schemes for town

* Extracted from paper read at the Convention of the Union of Canadian Municipalities in Saskatoon, July 15th, 1913.

planning are generally a combination of all three, which allows for the best fulfilment of town planning ideals.

The problem, then, for the town planner is to consider his scheme in respect to:—

(a) The configuration and undulations of the site.
(b) Direction of main radial and circumferential avenues and boulevards.
(c) The layout and construction of avenues and boulevards.
(d) Open spaces, parks and recreation grounds.
(e) Tramways.
(f) Civic centre.
(g) Buildings—The space about the same; the limitation of the number of houses per acre, and the height and character of same.
(h) Restrictions of factories and works to special areas.

The Configuration and Undulations of the Town Site.—The beautiful sites which the Great Architect of the Universe has provided for many of our cities have been wantonly spoilt by the worst form of vandalism and the lack of a proper system of planning instead of providing a setting and vista by which the beauty of monumental and public buildings may be shown.

The first essential preparatory to the drawing up of a town planning scheme is to make a contour map of the site, with contours showing the rise or fall of the ground every five to ten feet. In addition, the map should show existing trees, places of historic or local interest, railways, existing public and industrial buildings, waterways, etc.

This map will enable the town planner to lay down the main avenues with the easiest possible grades; to preserve places of beauty; to establish the sites of the most important buildings so as to be in commanding positions; to design his storm and sanitary sewers so as to obtain the maximum amount of gravity flow, and to arrange his water supply in the most suitable zones to that the whole system of public utilities can be built up of units, which will ultimately become parts of a completed whole.

Direction of Main Radial and Circumferential Avenues and Boulevards.—In London and New York, and many other large cities, great inconvenience and expense is occasioned through not having the most direct means of transit between business, factory and residential districts, and proper connections between these centres and the different railway depots. Again, through the lack of circumferential avenues the traffic in the centre of the city becomes greatly congested.

It is imperative, therefore, in the planning of a city to exercise the greatest care and judgment in fixing the position and direction of main avenues. If possible, they should radiate from the centre towards the principal outlying districts north, south, east and west of the city, and be linked up with inner and outer circumferential avenues. By this means traffic desirous of crossing from one side of the city to the other can avoid the centre and more heavily trafficked streets, and in so doing prevent the congestion which so often occurs in the centre of old cities.

London is at present contemplating the construction of circumferential avenues in order to relieve the congestion which occurs in the centre.

In Vienna the Girdle Linie, or Outer Boulevard, is about eight miles in length; the total width between buildings is 248 feet. A separate strip of the road is set apart for the tramways and fast traffic; a continuous recreation ground or playing space is included in the scheme, well planted with trees to provide shade during the hot season.

Another circumferential avenue in Vienna is the Ring Street, or Hub, 178 feet wide. It has a central carriageway 41½ feet wide, which is principally used by fast and through traffic vehicles. On either side are the tramways on the electric conduit system. A riding track and promenade for foot passengers occupy the spaces between the trees, and slow and stopping vehicles find accommodation on the two outer roads.

These circumferential routes, which connect up the various parks and open spaces, are largely used by residents, motorists and cyclists as circular drives.

The Layout and Construction of Avenues and Boulevards.—It must be borne in mind that all objects in the street, utilitarian or otherwise, are things to be seen, part of an organic whole, each having their respective part and place.

Athens and Rome were each crowded with such objects, arranged for the most part in picturesque association. Although it will be impossible for young cities to expend much money, if any, upon beautification, beyond the planting of trees, a town planning scheme should allow for such improvements at some future date at a minimum of expense.

Long, straight avenues, with buildings of approximately the same height and no object to break the horizon, should be avoided. If natural scenic effect cannot be obtained, then provision should be made for some architectural feature to break the skyline. By careful planning it can generally be arranged to place a church, a public building, or artistically designed residence to break the monotony of long streets.

In Germany this branch of town planning is given careful consideration, and long avenues are usually broken by means of "squares," so that the line of sight will be met by a building, the architecture of which has been previously approved by the local authority.

In planning out the widths of main roads it is difficult to estimate what the future will demand, but in any case it will be better to err on the wide side rather than the narrow.

The various types of streets usually required in a city are:—

(a) Main business avenues, with provision for tramways and boulevards—width from 100 to 200 feet.
(b) Secondary business avenues, without provision for tramways—width from 80 feet to 150 feet.
(c) Semi-residential avenues, with provision for tramways, side and centre boulevards—width from 80 feet to 120 feet.
(d) Semi-residential avenues, without provision for tramways, but with side and centre boulevards—width from 80 feet to 100 feet.
(e) Residential avenues, without provision for tramways, but with side and centre boulevards—width from 60 feet to 80 feet.
(f) Secondary residential avenues, with carriageways to take local traffic only, with side boulevards and an established building line of 30 feet—width from 40 feet to 60 feet.

The main avenues should be laid out with 12-feet sidewalks, slow traffic carriageways next sidewalks, and boulevards on either side of a centre carriageway for fast traffic and tramways.

The secondary business avenues should have sidewalks of a minimum width of 10 feet, with a centre boulevard with wide grass margins, so that the actual paved carriageway can be widened as the business of the city extends.

In main and secondary business thoroughfares provision should be made for laying all sewer, water, electricity and other mains in underground conduits of sufficient size to allow of proper inspection at all times. The advantages of this method are:—

(1) The pipes being open to inspection at all times, leaks can be more easily located and repaired.

(2) The traffic is not inconvenienced by frequent openings for repairs.

(3) The enormous annual expense of opening trenches is saved.

(4) The surface of the carriageway, which soon becomes uneven if many trenches are made, retains an even contour.

The residential avenues can be so formed that the sidewalks have a boulevard on either side, which will provide space for pedestrians in the hot weather.

Railways, usually an ugly feature of every city, should be made less objectionable by boulevarding.

Open Spaces, Parks and Recreation Grounds.—In locating open spaces and parks, special consideration should be given to the preservation of places of natural beauty, such as woods, waterways, etc.

With the checkboard system of planning, a large amount of valuable ground is often wasted in the unnecessary provision of paved streets and passages. By carefully planning the main and secondary avenues, through traffic can be avoided and residential districts can be laid out in a far less costly manner, and part of the space occupied by paved streets being utilized for open spaces, tennis courts, and children's playgrounds.

Where individual gardens are not wanted, part of the land between the houses might be laid out as allotment gardens, or as gravel playgrounds, or as paved playgrounds, to prevent a lot of derelict gardens being attached to the houses.

People's parks are universally provided on the Continent within or close to the city's gates, namely, a large woodland garden or forest, intersected by drives and walks, and interspersed with spinnies and glades typical, as far as possible, of rural country.

It is the duty of every city to provide as early as possible, and before development makes the price of land prohibitive, suitable parks within easy access of the public.

Country life is acknowledged to be more healthful, more restful, more natural and less wearing than that of town. It should, therefore, be the aim of town planners to introduce into the home life of the worker conditions as far as possible which are common to the country, viz., quiet, the absence of distracting sights, sounds and influences and the introduction of works of nature.

It has become a very general rule in making arrangements for the development of land on modern lines in Great Britain to stipulate that one acre in ten shall be set aside as public or semi-public open spaces; this in addition to limiting the number of houses per acre.

Tramways.—The tramway system should follow the main avenues, and, as far as possible, each route should be linked up, one with the other, to form easy and suitable means of transit for the public to and from every part of the town. It should be arranged so that new lines could be constructed as the development of the town in a particular district required, yet be part of what would ultimately become a completed scheme.

The tramway system of Vienna is an admirable one. It has been described as follows: "The trams circle round the Ringstrasse, and the outgoing routes branch off like the spokes of a wheel. It soon becomes an easy matter to know where to leave the hub and take the necessary spoke."

Civic Centre.—The creation of a fitting civic centre is one of the most important matters which should be considered.

It should be dignified, impressive, whilst at the same time in harmony with the characteristics of the town itself and in keeping with the resources of the public.

Its situation should be as near the centre of the city as is possible, so planned that its architectural features and beauty can be seen from many points of vantage.

The buildings usually comprised in such a centre are the town and public halls, offices, sessions courts, museum, and art galleries, which, suitably designed and arranged in relation to each other, can, and should, form a civic centre worthy of the community.

Buildings—The Space about Same; the Limitation of the Number of Buildings per Acre; Their Height and Character.—The regulations with respect to buildings will be one of the most important parts of a town planning scheme, and will need very careful thought on the part of the local authorities.

In order to obviate overcrowding, it is essential that a maximum number of houses per acre should be adopted for different grades of property.

In limiting the number per acre it should be sufficient, in the case of land that is not planned out in detail, if it be stated that the rule should be so many houses to the acre, but that the requirements of the local authority would be satisfied if the average number was obtained over a certain area with due safeguards for the space about each house not being too small. There should also be a maximum number of houses stated, more than which should not be erected on any one acre.

Thus, if the number limited was 12 to the acre, the local authority might be satisfied if on any ten acres no more than 120 houses were built.

In residential areas the height should also be limited. Houses should not be built more than three stories, or more than a maximum height, to be defined.

It would seem desirable in planning an area that certain centres should be fixed where shops, schools, churches, institutes, and such like buildings should be grouped together.

The grading of districts and the planning out of the constituent parts which build up a city is an important consideration. The higher buildings should be fronting on the main arteries, gradually grading back to the residential property. Stores and offices will, of course, be placed along the main thoroughfares, and workmen's dwellings as close as possible to the factories in which the work people are employed.

Restrictions of Factories and Works to Special Areas.—It is very desirable in a town plan that the position of these should be fixed, and the people should not be allowed to place them where they like.

There will nearly always be natural places in a district which will be suitable for factories and workshops. Contiguity to the railway, easy gradients to same, and the position of the rivers, canals and streams should govern this in most cases.

It is usually accepted as an established fact that factories are unsightly, with untidy and dirty surroundings, but in many places, particularly in Bourneville, in England, the headquarters of Cadbury's factory, the reverse is the case. The whole of the surroundings of the factory and the workers' houses adjoining are laid out on garden city lines, and is a model of what can be done to make a factory district more amenable than is generally the case.

BUCKET LADDER EXCAVATORS FOR CANAL CONSTRUCTION.

While bucket ladder excavators are almost unknown in North America, they are extensively and with much success used in other countries for canal building. The canal, Alfons XIII., in Spain, joining Sevilla with the Atlantic, and projected to accommodate ships up to 10,000 tons capacity, is now nearing completion.

Four excavating plants, each consisting of one bucket ladder excavator, with portable water depot, two locomotives and forty square box dump cars, with the necessary track, switches, etc., built and supplied by the Orenstein-Arthur Koppel Company (general offices and plant, Koppel, Pa.), have accomplished the excavation in a surprisingly short time and at low cost.

The four bucket ladder excavators built for the construction of the canal, are designed for an actual capacity of somewhat over 200 cubic yards per working hour, excavating heavy soil. All four excavators are constructed to gauge and template, to make the repairs and the replacing of worn-out parts as easy as possible.

Excavator Working in Gravel Pit.

Bucket ladders of different patterns were supplied with each machine, firstly, for cutting down hills, thus fulfilling the same work as the steam shovel; and further, ladders for digging the bed of the canal to a depth of 50 feet, the digging being performed with buckets of special shape, mounted to a chain, which is supported by a ladder.

Two of the excavators supplied for this contract are fitted with the so-called "flexible" chains, and the others are equipped with "rigid" chains. The flexible chain is only in its upper part supported by the ladder, the lower part is hanging free, which means, that the chain has a fair amount of play in every direction. This is a great advantage should the buckets meet with large rocks, logs, etc., when digging, as on account of the flexibility of the chain, they will be able to jump over such obstacles or pass sideways. These excavators with flexible chains are constructed to dig to a depth of 33 feet below the rail level, and the embankments will have an inclination of 1 to 1.

The ladder is constructed of large dimensioned steel girders, well braced by diagonal and cross stays. The chain links are hand-forged, joined by connections made of a high-grade steel. Every fourth link carries a bucket of about 9 cubic feet capacity, making a total of 33 buckets to a machine.

The two excavators with "rigid" chains are constructed to dig to a depth of about 50 feet. This enormous depth necessitates the use of a bucket ladder of especially strong construction. The chains of this machine are guided all over by rollers working in ball bearings, thus cutting the embankments perfectly straight. The ladder can be set to work at depths of 25, 33, 40 and 45 feet. The adjusting requires a comparatively small amount of labor. The number of buckets furnished with the excavator is 26, of about 7 cubic feet capacity each. If these buckets meet with extraordinary obstacles, as rocks, logs, etc., which they cannot pass on account of the "rigid" chain, an hydraulic clutch automatically stops the movement of the chain, the engine running free until the obstacle is removed.

The lifting and lowering of the ladder on all the machines is effected by pulleys fitted to a double beam, as clearly illustrated on the cut. The transmission of power from the engine to the chains is made by means of tooth and cog wheels; strong springs are provided where it is necessary and advisable to diminish the effect of the shocks occurring during the work.

The excavator is constructed for running on track, the transmission from the engine to the axles being made by means of chains. It runs on 14 wheels, 10 supporting the front part and 4 the rear. The necessary power is provided by a large dimensioned boiler of locomotive type, located at the rear part. A water tank of about 750 gallons capacity, fitted underneath the boiler, supplies the necessary feed-water; further, coal bunkers are placed into this part of the machine, and a space for a counter weight, consisting of scrap rails, stones, etc., the quantity of which has to be increased the deeper the excavator is digging.

On a bridge joining the front and rear part the engine and a platform for the engineer are provided. All levers are worked from this platform, and this arrangement makes it possible to watch all parts of the machine during operation. The engine is of the compound type, having a rating of about 100 horse-power.

The earth lifted drops into a funnel chute when the buckets turn over the top part of the ladder. At the bottom of the chute a flap controls the filling of the dump cars, which are standing on the track, while the excavator travels along by its own power.

For each machine a transportable water car of 2,000 gallons capacity is in attendance. This car, combined with the water tank underneath the boiler, supplies sufficient feed-water for 10 working hours. The boiler is fed by an injector and a steam pump.

A three-rail track is necesssary for carrying the excavator, two rails for the front part, one rail for the four wheels of the rear part. Any 100 to 120-pound relaying rails can be used. Tracks for the dump car trains are running between these rails.

For moving the earth, stones, etc., 8 locomotives and 160 square box dump cars are used. The locomotives have cylinders 13″ x 16″, and work with 176 pounds boiler pressure. They are built with an underslung water tank, following the usual practice of the Koppel locomotives, as this arrangement puts the centre of gravity low and insures a smooth running of the locomotive, even if the track is not laid perfectly level. The tank will carry about 750 gallons of water and the bunkers about 3,000 pounds of coal. The dinkeys weigh about 54,000 pounds. The cars used are five cubic yard square box dump cars.

The track for the excavator is laid down parallel with the axis of the respective canal section. The machines are put to work, and, after digging a stretch of considerable length to the necessary depth, they will work their way back again, now running on a track which has been shifted further away from the edge of the canal, thus excavating another layer of 4 to 5 feet to the depth required. This shifting of the track backwards will be continued until the full profile of the canal is excavated. The earth drops into empty cars standing underneath the delivery chute, as mentioned above; as soon as one train is filled it is shifted away and an empty train is pulled along. A reasonable arrangement of the track will always provide empty cars in good time.

BARGES PROPELLED WITH PRODUCER GAS ENGINES.

A fleet of large self-propelled barges, 15 in number, to ply between New Orleans and the coal fields of Northern Alabama is of peculiar interest in that they are the first craft of their kind in America to be propelled by producer gas engines.

The barges are of steel construction, and are similar in design to those in use on the canals of Holland. Their measurements are as follows:—Length, 240 ft., width on deck, 32 ft., width at bottom, 28 ft., depth, sides, 8ft., depth, centre, 8½ ft. Their capacity is 1,000 tons. Draft, when fully loaded, 7 ft. They are propelled by twin screws driven by twin engines and have a speed of approximately seven miles an hour when fully loaded. The weight of each barge and equipment is close to 240 tons.

The screws are driven at 300 r.p.m., by two 75 h.p. vertical producer gas engines. Gas is furnished by a 150 h.p. producer. The fuel used for the producer is what has heretofore been a waste coke from the ovens of the Birmingham district and which consequently is secured at a very low price. This coke is practically pea size. It has a calorific value of about 11,000 b.t.u., and the consumption is approximately 1 lb. per horse power. Bunkers are provided to hold about 15 tons of fuel. Each producer is equipped with scrubber, gas tank, tar extractor and is fitted with water bottom.

Fig. 1.—First of Fleet of Fifteen Barges, Propelled by Producer Gas Engines.

While the main power plant is of primal interest the auxiliary power equipment of the barge also merits mention. This consists of a 9 h.p. gasoline engine, which drives a centrifugal pump handling the ballast and bilge water, a blower, an air compressor and a 5½ k.w. direct current generator. Current is used for electric lights throughout the boat, fans in cabin and engine room, a 3,200 candle-power search light and a 5 h.p. motor. The arc light is mounted on the roof of pilot house and galley, which are immediately over the engine room. The motor is for operating an anchor winch. The generator is so mounted that when the large engines are running it may be belt driven from one of them. A second 4 in. centrifugal pump is also installed to be driven by one of the large engines through friction wheel contact.

A decided advantage of the self-propelled barge for use in these waters is that they can negotiate the numerous locks on the Warriors and Tombigee Rivers in much less time than if towed. Each lock can be passed in 20 minutes by these vessels, whereas more than an hour would be consumed by the towed fleet system.

The barges will make the trip from the mine region to New Orleans in 72 hours and with all 15 vessels in service, it is estimated that coal will be moved into New Orleans at the rate of 50,000 tons a month. Added revenue will be de-

Fig. 2.—Showing Barge Being Loaded.

rived by the barges carrying freight on the return trip to the coal field. All the power equipment for the barges—engines, gas producers, motors, generators, pumps, air compressors, etc., was designed and furnished by Fairbanks, Morse and Company.

SAWDUST FOR FLOORING.

Floorings are now being made out of sawdust concrete. The cement used consists of a solution of magnesium chloride to which pulverized magnesia is added. The sawdust is then used in any desired quantity. Floors manufactured in this way are more resilient than concrete, and are not good conductors of heat. They wear well, and do not burn, charring under the fire test.

WATER WASTE IN NEW YORK CITY.

During 1911 and 1912, on account of a threatened shortage in the supply, a vigorous campaign to prevent water waste was carried on in New York city. The methods generally employed were as follows:—

(1) The attention of consumers was called to the necessity for checking waste.

(2) A house-to-house inspection was carried on in order to detect and repair leaks.

(3) An examination was carried on with the object of locating and repairing underground leaks.

(4) Connections were metered where the cost of metering and the existing conditions of the supply warranted this measure.

The results obtained were noteworthy in many respects. The estimated daily reduction in consumption in Manhattan and the Bronx reached a maximum of 71 million gallons in August, 1911, averaged 65 million gallons for the last six months of 1911, and almost 50 million gallons for the year 1912. The aggregate value of the water thus saved, if figured at meter rates, $133 per million gallons, would be nearly $6,500,000, while the total cost of the work was only $167,000.

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Book Reviews:
Switches and Switchgear; Reviewed by M. B. Watson, B.A.Ss. 382
The Resistance of the Air and Aviation; Reviewed by J. E. Burns, B.A.Sc. 383
The Gas Engine Handbook 383
Principles of Setting Out; Reviewed by Chester B. Hamilton, B.A.Sc. 384
Concrete Roads and Pavements 384
Manual of Industrials, 1913 384
Industrial Plants, Their Arrangement and Construction 384
Excavating Machinery 385
Publications Received 385
Catalogues Received 385

BOOK REVIEWS.

Switches and Switchgear.—By Prof. R. Elder, translated by P. Laubach, A.M.I.E.E. Publishers, Constable & Company, Limited, London, W.C. 397 pages; 6 x 9 inches; illustrations and tables; cloth. Price, $4.50 net.

Reviewed by M. B. Watson, B.A.Sc.

Ever since electricity became of commercial importance no branch of the art of applying this force has received more attention than the switchgear used for opening, closing and connecting together of circuits; and rightly so, because in the early stages of the science this was the operation which was of necessity performed manually in the control of circuits and the operator's protection was of primary importance; also in the present day of high tension electrical installations it has been found necessary to protect the apparatus in the circuit as well as the operators, hence the necessity for automatic switching devices, and the scientific study of the whole subject of switching.

The volume under discussion treats mostly of present day practice although confined largely to continental European practice touching somewhat on English and slightly on American practice. The subject discussed is one on which there is much variety of opinion as there is variety in the types of apparatus manufactured, and it is a task of no mean proportion to summarize and give intelligent descriptions of practically all types of switches and switchgear on the market. This book is, however, the first really comprehensive work on the subject of switchgear that has been presented in English language.

The opening chapter contains a few general remarks on the requirements of and the materials used in the manufacture of switches. Chapter 2 deals with the materials most commonly used for the manufacture of switches, giving tables and formulæ for the design of bus-bars, cables, cable terminals and switch blades for different allowable rises in temperatures. Chapter 3 gives descriptions, formulæ and tables for the design of the current carrying parts of switches, such as blades, spring clips, and brush contacts with regard to both current carrying capacity and mechanical strength.

In chapter 4 we find a discussion of low and medium voltage switches for small and large currents, also data for the mechanical design of springs for use with quick opening switches. There are also empirical formulæ for the design of the assembled switches, accompanied by tables for use with the formulæ according to European practice. Note is also made of the prevalence of the brush contact switch in Europe in contrast to the multiple blade knife switch in use in America. This chapter is apparently somewhat revised by the translator.

Chapter 5 gives data on high tension switches. A great deal of this chapter is relative to the older types of switches for what is known in American practice as medium voltage, i.e., between 1,000 and 6,000 volts, while there is practically no data of value on switches for voltages above 50,000. However, there are thorough descriptions and discussions of the characteristics and theories of operation of medium voltage switches, including a discussion of oils for use in oil switches, also of the mechanical and electrical properties of porcelain as an insulator. A good discussion of the relative merits and reasons for the use or disuse of the different types of switches is also included.

Chapter 6 treats of fuses, discussing the several materials used in their construction, including formulæ, tables and curves for the design of fuses for different conditions. This part of the chapter is very complete. The descriptions of fuses in use are practically all of European types and a few obsolete types. None of them are used to any great extent in America.

Chapter 7 describes in detail, the construction and operation of automatic and self-acting switches, being well illustrated with cuts and circuit diagrams. The types most fully discussed are overload cut-outs, no-load circuit-breakers and reverse current cut-outs, also combinations of the above at present in use and on the market. The theories of operation and the circuit diagrams are especially valuable, though the types of construction described are wholly according to European standards. Practically no data of value to designers or manufacturers is given.

Chapter 8, which is the part of the book on which the most pains have been spent, begins with a practical analysis of the characteristics of motors during starting, developing examples of designs for starters and controllers to meet the different conditions of starting both A.C. and D.C motors. Data, equations, tables and curves for the design of generator regulators, line voltage regulators and armature and field regulators for variable speed motors are given, also descriptions and operating characteristics of the above. A discussion of designs for resistance feeder regulators is given as are also tables, formulæ and discussions of resistance materials and typical designs of resistances to meet different conditions of load. This subject is quite fully covered with the exception of data on dimensions of the assembled apparatus. A fine analysis of resistances with methods of assembling and mounting same is also included. A good general description of automatic and relay switches is given, also descriptions of starters and controllers of the cylinder type, such as traction controllers.

The final chapter, dealing with accumulator switches, gives diagrams and explanations of hand-operated and automatic end cell switches, constant voltage regulators, charging and booster regulators and remote control and indicating switches, also the anti-arcing devices in use with same.

On the whole the book contains valuable information for erection and lay-out men but little of value to the designer. There are many references to foreign technical papers and books. One item which the translator might have improved considerably is the use of units, which are not at all consistent. English units, or parallel English and metric units should have been used throughout, also in tables of areas of cross-sections of conductors, etc., the square inch, instead of the circular mill, has been taken as the unit.

In many parts of the book the matter is poorly arranged, the continuity being lost in several instances. Some of the cuts used are not of the best, but the line diagrams are both plentiful, intelligible and well produced.

The Resistance of the Air and Aviation.—By G. Eiffel, translated by Jerome C. Hunsaker. Published by Constable & Company, London, Eng. 442 pages, 10 x 12¾ inches; 137 illustrations in the text, 27 plates; cloth. Price, $4.50 net.

Reviewed by J. E. Burns, B.A.Sc.

The aeroplane, like the hydraulic turbine, has been, and is being, developed by two classes of experimenters, who work in very different ways. One is the mechanic, often of consummate skill, who pins his faith to the method of trial and compromise. The other is the engineer, or man of science, whose design is always rational and based on facts; who often suspends operation of a direct nature for years in order to ascertain the facts by which he may proceed. To the latter class belongs M. Eiffel, the author of the work under consideration. As early as 1902 he began experimenting upon the resistance offered by air to moving bodies by means of a "dropping apparatus," and in 1910 published the results of his labor with a review of the subject.

The present work is a description of a method of investigating the resistance offered by air to moving objects which has been developed by M. Eiffel, together with the results obtained by the use of his methods in an immense amount of painstaking experiment carried out in an aerodynamic laboratory established by the author at the Champ de Mars, in Paris, and in a much larger but similar laboratory established later at Auteuil.

The book is divided into two parts, the first of three chapters. The first chapter describes the laboratory and method followed, and presents a complete calculation of the resistance of a given plate. The second chapter presents general results obtained from experiments on plates of various form and on many bodies of different shapes. Chapter III. presents results obtained from model aeroplane wings and complete models of many well-known types of machines The second part is a supplement of the first, containing the numerical results of the experiments described, and the general conclusions of the author.

Much of the work of M. Eiffel is already classical, for he has demonstrated beyond doubt that, to use his own words: "In aeroplane design, careful tests with a model aeroplane, or with model wings, permit the designer to predict the conditions of normal flight."

To those who are interested in aerodynamics or in aviation the book will prove of profound interest, though it is far from easy reading. The experiments recorded give ground for believing that the problem of stability in aeroplanes, the bugbear of the birdman, is capable of solution, and through the consequent safety of flight the future of the art is established. Even at the present date very gratifying results have been obtained in actual flight by designs growing out of the Eiffel experiments. Although the author does not indulge in any mathematical theory, the work is intensely technical, but it is written in a clear and pointed style, and is one of the most pregnant books on the subject in print. We may thank the translator for having so well rendered a valuable work into English.

The Gas Engine Handbook.—By E. W. Roberts, M.E. Published by the Gas Engine Publishing Company, 224 E. 7th Street, Cincinnati, Ohio. 323 pp.; 4½ x 7 inches; 80 line illustrations; bound in limp leather. Price, $2.00.

This little pocket manual appears in its seventh edition, the publishers stating that it is entirely re-written and enlarged. It contains much information that gas and gasoline engine men find indispensible and frequently find difficulty in securing in the form of a book of reference. The text comprises three parts: description, design and points concerning operation, which include installation, testing, troubles, selections, etc. The reading matter is attended by the usual tables on areas and circumferences of circles, strength of materials, specific gravity of metals, etc.

Although the handbook has a fair index, the text is devoid of sub-headings which are generally considered a necessity in engineers' handbooks. When twenty or more pages are devoted to a single chapter without a single sub-heading, such as the chapter on "Testing" on can only infer that the book might have been greatly improved in this respect, if it is to fill the requirements of a handbook. The information, however, is carefully compiled, although little of it is new, and for engineers and designers there are few books in print that contain in better form, with the exception of the deficiency mentioned above, the results that are to be derived from a close study of gas enginery.

In the chapter on design the discussion starts with a chapter on the indicator diagram, and in another chapter shows the method of arriving at the general dimensions of a motor desired to fulfil certain conditions. Then follow chapters on the design of the specific parts such as the cylinder, the piston, rods, shafts, etc. Of special interest, however, is the chapter on frame design in which not only are the formulas given and explained in detail, but a method of design without the use of the general formulas is given. In the chapter on flywheels, the treatment has been brought up-to-date, without being pedantic. Governor design in its especial application to the gas engine has been treated quite fully and to an extent not found in any other work on the subject.

Of more than ordinary interest is the chapter on the design of two-cycle engines, this chapter in many ways tending to lift a veil of mystery from this subject. It gives not only the formulas for design but shows that instead of being an everlasting puzzle, the design of the two-cycle is a very simple matter indeed.

There is a chapter on the design of aeroplane motors in which there is given a few simple rules for the design of engines of the lightweight required in this service. While the author does not go into minute details on this subject as much as might be desired, it is touched upon in the chapters on the design of details.

In the third part a chapter on installation describes the arrangement of the engine room and gives many useful and practical hints on the arrangement of piping, cooling tanks, meters, etc., and goes into the whole matter of engine room fittings in a thorough manner.

The chapter on installation is followed by others on starting and stopping, care of gas engines and a very full and complete chapter on troubles. The latter is arranged under various heads and gives both the cause of the trouble and the remedy.

The next chapter on testing is the most extensive in the book. It describes in detail the method of making a complete test to the extent of a thermal analysis or the determination of a complete heat balance. In this chapter there is described the construction and the operation of the gas calorimeter, the manograph, etc. A form for a test log and an-

other for a test report leaves nothing undone to make the treatment of this important subject, the most complete.

The book ends with a chapter on the selection of a gas engine, which is well worth reading by the intending purchaser of a power plant.

Principles of Setting Out—Securing and Tooling Operations, for Engineering (Machinist) Students and Apprentices, and Students in Manual Training in Metal Work. By Alfred Parr, lecturer on Workshop Practice, University College, Nottingham. Published by Longmans, Green & Company, London. 280 pages; 6 x 9 inches; 250 illustrations, 1913. Price, $1.50 net.

Reviewed by Chester B. Hamilton, B.A.Sc.

The mechanical execution of this book is good. The numerous illustrations, many of them half-tones, are well selected for their purpose. The composition of the book has two large faults, however. In selecting material the author has wandered over almost the length and breadth of machine shop practice. Probably this was intentional, for in the introduction it is said:—

"The man who sets out work must be well acquainted with the construction and use of such appliances, and with the proper tolerance and allowances for various classes of fits, as well as with the best methods of holding work and the proper cutting speeds. No apology is, therefore, needed for the inclusion of such information in a book on setting-out."

Following this train of thought, the author might say that a good setter-out should have some knowledge of elementary mathematics, and proceed to instruct him, and that he should be a sober man, and, therefore, include a temperance lecture. However, it should hardly require argument to prove that information on a specialized subject should apply definitely to that subject.

The other point to be criticized in this book is more serious. There is an absolute and total lack of logical order or arrangement of subject matter. The author flits from one unrelated subject to another with the happy unconcern of a butterfly in a flower garden. The most provoking point is that the material itself is really good, and a little careful editing and arranging in logical form would make the work really valuable.

Broadly speaking, machine work may be divided into three classes by its relation to setting-out: (1) Where various lines and marks are placed on the rough stock and the tool is made to conform to them by the skill of the operator. (2) Where the copying principle is used and the actual form of the finished work is given by the tool used. Examples: Gear-cutting, form-milling, planing or turning with form tools, punch and die work, etc. (3) What is commonly known as jig work, where the stock is held in some fixture, which usually also guides the tool, and by giving tool and work definite relative positions produces work of superior accuracy in an easy way.

In the strictest sense it is only in the first case that the work is set out or marked off. In the second case this is done only on the tools when they are first made, and in the third it is the holding apparatus or jig which was marked off.

Concrete Roads and Pavements.—By E. S. Hanson. Published by the Cement Era Publishing Company, Chicago, Ill. 227 pages and advertising; 4½ x 7½ inches; illustrated; cloth. Price, $1.00, postpaid.

This book opportunely appears in the midst of a season when the construction of roads is receiving the greatest attention in history, and when there is an acute demand for carefully compiled data on road materials, construction and maintenance.

The subject is treated in thirteen chapters, containing general information on concrete as a road and paving material for rural and urban highways, supplemented by examples descriptive of some roads in Michigan that are claimed by road engineers to be deservedly famous for their careful construction, and of similar roads in Illinois, where valuable data pertaining to costs is also given. The theory and practice of joints, problems relating to bridges, culverts, sidewalks and curbs and gutters are admirably dealt with, and Chapter XI., describing tests made on concrete as a paving material, contains results and methods with which every road engineer should be familiar.

The work is supplemented by twelve appendices, dealing with specifications for various pavements, for bridges, culverts, etc., which obtain in the States mentioned above. The book is admirably edited, as one might expect, as the author is the editor of The Cement Era. His presentation of the subject is concise and carefully condensed, and as such will be of great value as an up-to-date treatment on concrete road construction.

Manual of Industrials, 1913.—(Fourth annual number). Published by Poor's Railroad Manual Company, 535 Pearl Street, New York City. 2,268 pages; 6 x 9 inches; 124 pages of index. Price, $7.50, postpaid.

This manual is associated with two other manuals published by the same company, viz., Railroad Manual and Manual of Public Utilities, the one under consideration completing the set for 1913. It refers entirely to manufacturing, mining and miscellaneous corporations. It contains an exhaustive list of new companies, and is particularly valuable for its comparative and analytical statistics.

The Railroad Manual is a well-recognized standard authority on railroad operations, and the present constitutes the forty-sixth year of its existence. The other manuals are more recent publications, but are almost all equally recognized in their respective fields. The Manual of Public Utilities was reviewed in the Engineers' Library of *The Canadian Engineer* in the issue of June 26th, 1913. The publishers claim that the three books contain over 6,000 pages, thereby superceding any other manual in volume of information The price of the three volumes complete is $20.00.

Each of the three volumes for 1913 is a decided advance upon its corresponding predecessor of last year.

Industrial Plants, Their Arrangement and Construction.—By Charles Day. Published by the "Engineering Magazine," New York. 294 pages; 5 x 7 inches; illustrated; cloth. Price, $3.00 net.

This little book in twelve chapters is a product of Mr. Day's wide experience as consulting engineer in the construction of some most successful plants and structures. Chapters I. to VIII. inclusive are founded upon a series of university lectures covering the broad industrial principles upon which the arrangement and the planning of the industrial plant are based. Chapter IX. goes more into the specific problems entering into machine shop practice. Chapter X. depicts the advantages of logical planning by a number of descriptions of plants in operation, illustrative of the trend of modern practice. The two closing chapters admirably supplement the work by a treatment of the relationship between the client and the engineer, dealing from the standpoint of the former, with the value of an engineering organization to a proposed plant layout, and upholding for the latter a considerate and judicious opinion relative to compensation for engineering services, and the preferred basis for reasonable commission.

The book does not guarantee a plant to be successful. It is well known that inefficient management is the governing factor; but the plant that is arranged along the line

of Mr. Day's elucidation of the many factors covering the project and the product from its raw state until the bill of lading is affixed, will prove to be one susceptible to economical management in its own field.

Excavating Machinery.—By A. B. McDaniel, B.S., Assistant Professor of Civil Engineering, University of Ilinois. Published by McGraw-Hill Book Company, New York City. 327 pages; 134 illustrations; 6 x 9 inches; cloth. Price, $3.00 net.

The book is a careful treatise upon all types of excavating machinery and apparatus used in modern practice, and covers its subject in two parts, supplemented by two appendices. Part I. deals with scrapers, graders, and shovels of various kinds, while Part II. takes up the subject of dredges and excavators. A good deal of usahle information concerning costs relating to the operation of excavating machinery has been included and will be of service. Although the condition and circumstances dependent upon such work are so variable that the cost data can be of very general value only, it nevertheless should be serviceable regarding efficient operation of machinery and the systematic arrangement of work.

In his introductory paragraphs the author lays stress upon the importance of closer attention to cost, and advises the keeping of accurate and complete records of cost of all work, by engineers and contractors alike, as valuable data for future use. He has supplemented each section by carefully selected bibliographical references, to which the reader may turn for additional information.

PUBLICATIONS RECEIVED.

Foundry Cupola Gases and Temperatures.—By A. W. Belden, Bulletin No. 54, United States Bureau of Mines, Washington, D.C., 29 pages; illustrated with photographs and drawings.

Elevators and Warehouses.—Eighty-seven page list of licensed elevators and warehouses in the Western Grain Inspection Division. Issued by the Department of Trade and Commerce.

Ontario Land Surveyors.—Annual report of the association and proceedings of the 21st annual meeting, including reports of committees, papers, examinations papers and membership.

Manitoba Department of Public Works.—Report of the Department of Public Works of Manitoba for the fiscal year ending November 30th, 1912, by Colin H. Campbell, Minister of Public Works, Winnipeg, Man.

Summary of United States Commerce and Finance for June, 1913.—Covering the foreign commerce of the United States and its non-contiguous territories. Published by the Department of Commerce, Washington, D.C.

The Canadian Chamber of Commerce, London, England.—First annual report of the Council "for the encouragement and promotion of Anglo-Canadian trade and commerce and the development of Canadian industries by British capital."

The Territory of New Quebec.—Extracts from reports on the district of Ungava, recently added to the province of Quebec. Issued by the Department of Colonization, Mines and Fisheries, Quebec, Que.

Revenues and Expenses of Steam Roads in the United States.—Bulletin No. 54 of the Inter-State Commerce Commission. Prepared by the division of Statistics from the reports of expenses and revenues of steam railway operations during the month of May, 1913. Published by the Commission.

Commission of Conservation, 1913.—Report of fourth annual meeting held at Ottawa, January 21st and 22nd, containing reports of committees on public health, minerals, forests, fisheries, waters and water powers; papers on oyster farming, forest surveys, claybelt conditions of New Ontario, smoke prevention, etc.

Coal and Power Investigation, Sask.—Report by R. O. Wynne-Roberts. 133 pages; 10 plates and maps. A compilation of data and conclusions therefrom resulting from an inquiry into the practicability of producing power at coal centres and distributing it throughout the province. Published by the Board of Highway Commissioners, Regina, Sask.

Portable Electric Mine Lamps.—Technical paper No. 47, Bureau of Mines, United States Department of the Interior. Written by H. H. Clark. Discussing the advantages that such lamps possess and suggesting some characteristic which they ought to have as now designed and constructed, portable electric lamps having been already introduced in a number of mines.

Investigations of Detonators and Electric Detonators.—By Clarence Hall and Spencer P. Howell. Bulletin No. 59 of the United States Bureau of Mines, Washington, D.C, 72 pages; illustrated. Numerous tables. Containing a comprehensive treatise on the theory of detonation of high explosives and the result of tests for determining directly and indirectly the strength of various electric detonators.

Brick Fire Places.—A handsomely illustrated booklet of 32 pages containing suggestions for modern designers of interior woodwork and furnishings, in the matter of brick as a material for fireplaces. The compilers have used Arts and Crafts motifs in their design and by the neat decorative schemes which the booklet displays, much has been added to the architectural effects to which the fireplace lends itself. Published by the Thomas Moulding Company, Chicago, Ill.

Report of Minister of Mines.—Annual report by Mr. F. Robertson of mining operations for gold, coal, etc., for 1912 in the province of British Columbia. Contains statistical tables of mineral output, and shows in detail the actual mineral production of the past year, as based on smelter or mill returns; also a summary of the production of each of the last four years, thus illustrating by comparison the progress made in productive mining during that period. Issued by the Bureau of Mines, Victoria, B.C.

The Nickel Industry, with Special Reference to the Sudbury District, Ont.—By A. P. Coleman, Ph.D. Professor of Geology, University of Toronto.—Issued by the Department of Mines, Ottawa. A book containing 206 pages; 6½ x 10 inches; well illustrated; 53 plates, 14 figures, and 8 geological maps. The development of the nickel industry in the Sudbury district is a prominent feature in the history of Canadian mining industry. Dr. Coleman has made a very thorough investigation extending over a period of three years, and the information gained thereby, together with his own comprehensive knowledge of the geology, has enabled him to produce a very excellent monograph, which covers in every detail the activities of the industry in the Sudbury region. The accompanying maps of the district and of the more important mines, together with the descriptions of all the known nickel ore deposits in Ontario, and concise accounts of methods in vogue for the mining and melting of nickel ores, go to make the publication one of greatest value.

CATALOGUES RECEIVED.

Mechanical Dwarf Signal.—Illustrated catalogue on G. R. S. mechanical dwarf signal and R. S. A. design. Issued by the General Railway Signal Company, Rochester, N.Y.

Train Dispatchers' Telephone Selector System.—Illustrated 35-page catalogue. Issued by the General Railway Signal Company, Rochester, N.Y.

Railway Motor Cars.—Illustrated catalogue dealing with Rockford motor cars. Issued by the Chicago Pneumatic Tool Company, Chicago and New York.

Peebles' Motor Converters.—Illustrated catalogue dealing solely with the company's converters. Issued by Bruce, Peebles & Company, Limited, Edinburgh, Scotland.

Lucal Liquid Fuel Company issues a 24-page illustrated catalogue on Lucal appliances for burning oil. The Lucal Liquid Fuel Company, 203 Hope Street, Glasgow, Scotland.

Fuel Oil Data.—Twenty-page illustrated catalogue on various types of installations and information regarding the burning of fuel oil. Issued by the Tate, Jones & Company Inc., Pittsburg, Pa.

Couplings and Pulleys.—Illustrated catalogue dealing with friction clutches, couplings and wood pulleys. Issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., and Toronto, Ont.

Compressors.—Illustrated catalogue dealing with enclosed, self-oiling, single-stage, steam and belt-driven compressors. Issued by the Chicago Pneumatic Tool Company, Chicago and New York.

General Catalogue.—Water metres, hydrants, sluice valves, tanks, sewerage fittings, pumps, hot water and steam fittings, etc. 272 page catalogue. Illustrated. Beck and Company, Limited, Hydraulic, Sanitary and General Engineers, London, England.

Engineering Instruments.—155-page illustrated catalogue, showing the various types in their wide line of engineering instruments. Issued by Bausch & Lamb Optical Company, Rochester, N.Y., through the Toply Company, their Canadian representatives at Ottawa.

The Squires Steam Trap.—An 8-page folder descriptive of the trap giving directions for connections and operations under various fittings, showing section illustrations and tables of capacity. Representatives in Canada, Canada Allis-Chalmers, Limited, Toronto.

Continuous Current Motors and Dynamos.—Illustrated catalogue dealing with continuous current motors and dynamos, 2 and 3-phase motors and dynamos, continuous current starters, alternating current starters, motor generators, etc. Issued by Wright & Wood, Limited, Century Works, Halifax.

The Foos Pumping Engine.—An illustrated 12-page booklet descriptive of the application of the Foos gas engine for all kinds of pumping service, is Bulletin 89 of the Foos Gas Engine Company, Springfield, Ohio, containing a number of tests from deep-well, irrigation and ordinary water supply systems.

The Monahan Trench Digger.—An illustrated catalogue descriptive of this and other Monahan machines, e.g., back-filler, pipe-laying derrick and steel forms for concrete manholes and catch basins, of which Wm. Heggie, Joliet, Illinois, is the manufacturer and W. B. Louer, 900 Old Colony Building, Chicago, is sales manager.

The Imperial Positive Water Meter.—A twenty-two page catalogue handsomely printed and illustrated in colors dealing with the characteristics, construction, maintenance, of the type, including also price list and shipping particulars. Issued by the Manufacturers, Beck and Company, Limited. 130 Great Suffolk Street, London, S.E.

Ceresit.—A handsomely printed booklet descriptive of the product of the Ceresit Waterproofing Company, and containing information on the waterproofing of concrete. The attractive catalogue covers many topics in an individual manner and will be found a helpful addition to engineers' and contractors' bookshelves. Published by Ceresit Waterproofing Company, 446 Commercial National Bank Building, Chicago.

COAST TO COAST.

Windsor, Ont.—The Hydro-Electric Power Commission has decided on the route of the transmission line to Windsor, and has the location almost completed between Chatham and this city. The foundations have been also placed between Belle River and Chatham for the transmission line towers.

Quebec, Que.—The Canadian Northern Railway has made it known in this city that the company expects to be operating grain trains over its line from the Canadian North-West to Quebec this fall. All connections between Quebec and Ruel, Ont. (384 miles) will be ready for train service early next month, and the road from Sudbury to Port Arthur opened for traffic a month later, which will give the Canadian Northern Railway direct communication from Quebec to the end of its present line in the North-West.

Edmonton, Alta.—Roused by recent discoveries of rich, undeveloped mineral, asphalt, gas and oil resources in various parts of the western provinces, scores of prospectors and experts, known in many camps throughout the United States and Canada and Mexico, are making exhaustive searches in the Peace River country and other northern districts. Central and Southern Alberta are also being prospected. The Dominion and provincial governments likewise have their experts in the field. Seventeen parties are prospecting in the Canadian Rockies, west of Edmonton, but most of the work at present is being carried on in the north country.

Sarnia, Ont.—For some time past Sarnia's water supply has been showing a serious state of pollution, as mentioned in last issue of *The Canadian Engineer*. So much is this in evidence that the provincial health authorities have ordered that double the quantity of chlorine be added to the water supply. This has been done, but in several instances where tests of the water have been made the pollution continues to exist. This leads to the opinion that there must be a break or leak in the intake pipe, through which sewage is being allowed to find its way into the waterworks well, and thence into the waterworks pumps.

Le Pas, Man.—That the Saskatchewan River, working in conjunction with the Hudson's Bay Railway from Le Pas, will prove of immense value to farmers and other shippers as far west as Edmonton, is the opinion of L. A. Voligny, Dominion Government chief engineer, in charge of the surveys and works in connection with the navigability of the Saskatchewan. Work is now completed to Le Pas, and orders have been received to continue to Grand Rapids. A channel ten to twenty feet was found the entire way from Cumberland House, and hardly any extra work was necessary, though some dredging will be required about Moose Lake and Cedar Lake, and this will be started immediately, as will also the construction of a wharf at this point. The government insisted on Prince Albert building a lock at LaColle Falls, and this indicates that the fullest use is to be made of the North Saskatchewan as soon as possible. Mr. Voligny estimates that the entire project can be carried through within five years, and no doubt eventually through Winnipeg. In conjunction with the government road to the Bay this navigable channel, tapping all the northern part of the Canadian prairie west, will go a long way to reducing the cost of marketing grain, and the cheaper water rates should bring freight tariffs of the transportation companies into line. Nor is this all. Mr. Voligny feels confident also about the navigability of the south branch of the Saskatchewan, which, he says, will soon receive attention. All the railway bridges have been built to this end, and all that is required is a demand by cities and towns along its course. Curiously enough, these municipalities appear apathetic as regards navigability of

the south branch, while their neighbors on the north branch have been agitating for a long time, and now get served first.

Calgary, Alta.—Forty-six line elevators will be built in Alberta this year in time to handle this season's crop by the Alberta Farmers' Elevator Company, Limited, authorized under the Farmers' Elevator Bill, passed at the last session of the Alberta legislature. The work of construction of half of these elevators is in progress now, and materials for the others have been purchased and are on the ground at the various locations. For the erection of these elevators, forty-six local companies have been formed, which are under the direction of the parent company. The preliminaries for all this had been arranged by the provisional directors of the Farmers' Elevator Company, and to ratify and confirm the action of those officials and to properly launch the company a meeting of the shareholders of the company was held recently. The necessary confirmation of the work of the provisional directors was accorded, the company was organized upon a permanent basis, and the Minister of Agriculture assured the shareholders that the necessary money to pay for the elevators was ready and waiting their pleasure.

Sault Ste. Marie, Ont.—The installation of the chlorination plant of the Tagona Water and Light Company has just been completed, and was immediately put to work. Inspection showed it to be in excellent order. Its completion dates just twenty-eight days from the issuing of the order for its construction. It was ordered as a result of the investigative work of Dr. Amyot and F. A. Dallyn, C.E., of the Provincial Board of Health. Analyses of the water taken at various intervals across the river, which is the source of the town's supply, showed the presence of bacteria. Up to the present time twenty cases of typhoid have been reported, two of which came from the neighboring municipality of Steelton, and one, it was found, had come from an outside point along the line of the Algoma Central Railway. So far, only one death has occurred.

The two municipalities of Sault Ste. Marie and Steelton are devoting their attention to choosing the most suitable place for a joint intake pipe which will serve the two towns when the present franchise of the Tagona Water and Light Company expires, which will be in 1914.

Ottawa, Ont.—The chief architect's branch of the Public Works Department has issued the conditions for the competitive designs for the new departmental and courts buildings. Not only is there the booklet containing the conditions, but there are also extensive plans of the grounds and a set of beautiful half-tones of the site between Wellington Street and the cliff. One feature of the conditions is that the successful architect will erect the buildings. The conditions state that the successful architect will be allowed regular fees and must maintain an office in Ottawa while the work is in progress. The conditions point out that the work on the new buildings will start very soon after the final award has been made. The final designs entered in the competition will be on exhibition in Ottawa with the author's name on them for seven or more days subsequent to the award. The plan for the treatment of the site prepared by Mr. E. White and Sir Aston Webb is submitted, but the conditions leave the competitors a free hand to develop their designs regardless of that plan. The conditions provide that all plans be delivered to Ottawa by January 2nd, 1914. The award of the preliminary competition will be made as soon as possible afterwards. The assessors will be Messrs. T. E. Collcutt, J. H. G. Russell and J. O. Marchand. The complete scheme is to build a supreme court, exchequer court, railway commissioners' court, and the necessary offices in connection with these courts, also a block or blocks of departmental buildings having 500,000 superficial feet of floor area The competition is restricted to architects who are British subjects practising in the British Empire.

Toronto, Ont.—Acting City Architect G. F. W. Price and Deputy Fire Chief J. C. Noble were very favorably impressed with the new system of fireproof flooring, consisting of gypsum and wood chips, reinforced by wire cables, and capable of carrying a live load of 125 pounds per square foot. It is claimed that the new floor is much lighter and cheaper than reinforced concrete, inasmuch as it does not require such heavy steel reinforcements. Experiments with the material are attracting much attention from engineers and architects, and a specially severe test recently conducted in New York by Messrs. Perrins & Miller, of Columbia University, in which the average temperature maintained for three hours was 1,757° F., the floor sustaining its load and withstanding the test in a most admirable manner.

St. Catharines, Ont.—Port Weller is to be the name of the new townsite at the Lake Ontario entrance to the new Welland Ship Canal, described in *The Canadian Engineer* for August 21st. This decision has been reached by the syndicate that has purchased several acres on each side of the new harbor. It was supposed that the harbor would be called Port McCalla, on account of an old private park there, but the above choice has been made in honor of J. L. Weller, of this city, chief engineer in charge of the canal, who has done all the planning in connection therewith. The syndicate has purchased all the land adjoining the entrance of the canal, the Government is beginning the erection of an office building on part of the land which has been expropriated, houses and stores will be erected without delay to provide for the workmen to be employed on the canal, the owners of the property hope to secure a factory, and expect that before long a thriving town will be springing up where now are only farms.

Vancouver, B.C.—In order to facilitate the driving of the 22 by 30 foot double-track Canadian Pacific Railway tunnel, of five miles long, through Rogers' Pass, at the summit of the Selkirks, Messrs. Foley, Welch & Stewart, the contractors, have decided to adopt a new method, which will be watched with great interest by the engineering world. The expedient consists of first boring a parallel tunnel, 7 by 8 feet, for virtually the same length, and from this tunnel cross-cuts will be made at short intervals to the site of the proposed large tunnel. This will enable gangs of men and machine drills to attack the work simultaneously at scores of points. Incidentlly, the "pioneer" tunnel, as it is called, will also provide ventilation, and will, for a considerable time, provide an exit in removing the rock material. The railway company and the contractors have figured that it would take too many years to construct the large size bore, starting only from the two ends.

Montreal, Que.—Although companies like the Dominion Steel Corporation and the Nova Scotia Steel and Coal Company are experiencing an active demand for their entire output of iron, the situation is somewhat different with the merchant furnaces. Companies such as the former are able to use up in their own finishing departments the greater portion of their output of pig iron. Dominion Steel practically uses its entire output; Scotia has but a small quantity for sale, and has no difficulty in disposing of it. The 300-ton Midland furnace of the Canada Iron Corporation is cold, and will remain so until the situation improves. The 150-ton furnace, however, is kept actively employed. The Deseronto plant is operating full blast, as are probably most other plants throughout the country. At the same time, Canadian plants now have to meet the low prices being made by American furnaces. Buffalo has been selling at $17.25, Toronto, and it is said quite a large tonnage was disposed of. The Steel Company of Canada is reported selling at $17.25, Hamilton, equivalent to $19.25, Montreal.

TRACTION ENGINE COMPETITION IN BELGIUM.

According to its weekly report the Department of Trade and Commerce, Canada, is informed that the Belgian Minister for the Colonies has organized an international competition of traction engines and other ploughing machines. A sum of 70,000 francs will be appropriated for the best machines, and indemnities up to 15,000 francs will be granted to the competitors who have received no orders.

Canadian manufacturers are invited to take part in this competition, which will be held at Chassart, near Fleurus, Belgium, from the 24th to the 27th of September next.

PERSONAL.

FRANK BARBER, C.E., bridge and structural engineer, Toronto, has recovered from an illness extending over several months and is at his office again.

ERNST POENSGEN, general manager of the tube department of the Phœnix Steel Works, Dusseldorf, Germany, arrived this week in New York City. He will make a tour of United States and Canada in his firm's interests.

A. WOODROFFE MANTON, M.I.C.E., B.Sc., resident engineer in Constantinople for the engineering firm of S. Pearson & Son, Limited, with headquarters at London, England, is in Toronto at present forming a Canadian office for his firm.

W. B. STOKES, formerly of London, England, has opened a store on Notre Dame Street, Montreal, for the sale of engineering and surveying instruments. He has the sole Canadian agency for Cassella's instruments, and also for Watson's microscopes.

H. V. HUTCHINSON, of Baldry, Yearberg & Hutchinson, contractors, Westminster, London, England, is visiting Canada to determine the possibilities in this country for profitable contracts for his firm. He is making arrangements for Canadian representation.

WM. GIBBS BAIN, contracting engineer and metallurgist, of Philadelphia, is at present in Toronto. Mr. Bain was a student at the University of Toronto in the early eighties, but has resided since then in the United States. He is making a tour of the Dominion, and is particularly interested in the hydro-electric development

H. T. ROUTLY, B.A.Sc., has this summer severed his connection as engineer of the Township of Coleman, after having had charge of the highway and other engineering work during the past four years. In the course of that time the standard of high-class road construction which he set in Coleman township has been an object lesson for other and older parts of the province. Mr. Routly has established an office in Toronto.

JAMES D. ROBERTSON, formerly sales manager for the Pittsburg Valve, Foundry and Construction Company, has again assumed charge of the sales of this company, returning as second vice-president after two years' absence. Mr. Robertson in the meantime has successfully completed the organization, plant, and launching in business of the Warren Tool and Forge Company, of Warren, Ohio. He began his business career with Atwood & McCaffrey, and when that concern was absorbed by the Pittsburg Valve, Foundry and Construction Company, he continued his services, and up to the time of his withdrawal had completed his twenty-first year with the company.

In last week's "Personal" column we made mention of a trip west of Gustave Kahn, of the "Trust" Concrete Steel Company, of Canada, Limited. The Trussed Concrete Steel Company is so widely known that it seems superfluous to call attention to the typographical slip in the item as it appeared. We mention it, however, just to remind ourselves of its occurrence.

OBITUARY.

JOHN C. BAYLISS, a well-known contractor of Toronto, died at his summer residence at Dixie on August 17th. Mr. Bayliss came to Toronto some twenty years ago from Islington, England, and was engaged in contracting work in this city for the past eighteen years, his firm having built many of Toronto's public schools, the latest one being the Duke of Connaught School. The firm also built St. Anne's Anglican Church, and is at present working on the Church of St. Mary the Virgin. Mr. Bayliss also had charge of construction work in Meaford and Walkerton, Ont.

JACOB SERSON, Provincial Superintendent of Bridges for British Columbia, and a resident of Kootenay, died in Nelson, B.C., on August 12th, at sixty-nine years of age. Mr. Serson joined the construction forces of the Canadian Pacific Railway Company at Pembroke, Ont., thirty-eight years ago, when the first great transcontinental line was in its infancy. A greater part of his connection with the company was in the building of bridges throughout the West. About eight years ago Mr. Serson left the railway service to accept the position which he held with the province at the time of his death.

COMING MEETINGS.

ONTARIO MUNICIPAL ASSOCIATION.—Annual Meeting to be held in Toronto, August 28th and 29th. Secretary-treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.

THE NEW ENGLAND WATERWORKS ASSOCIATION.—Annual Convention to be held in Philadelphia, Pa., September 10th, 11th and 12th, 1913. Secretary, William Kent, Narragansett Pier, R.I.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Third Annual Meeting in Regina, September 18th, 19th and 20th. General Secretary, Major Lorne Drum, Ottawa; Local Secretary, R. H. Murray, C.E., Regina.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

19988—August 11—Authorizing the C.N.O.R., the G.T.R. and C.P.R. to operate their trains over crossing near Ottawa, Ont., without their first being brought to a stop.

19989—August 7—Authorizing the C.N.O.R. to construct its line of railway across the public road on Lot 3, Con. 5, Twp. Crerar, Ont., at station 3294.29.

19990—August 9—Authorizing the C.P.R. to construct, maintain, and operate a spur 1,490 feet in length across Richmond St., and land adjoining, in Chatham, Ont.

19991—August 8—Authorizing the C.P.R. to construct, maintain and operate a branch line of railway or spur for the Canadian Manufacturing Co., Medicine Hat, from a point on existing spur in Block "D," to and into the premises of the Can. Man. Co., in Block "D," Dunmore, Alta.

19992—August 8—Authorizing the C.P.R. to construct, maintain, and operate a branch line of railway or spur for James Murphy on Subdiv. Lots 1, 2, 3, 4, 5 and 6, Front St., and adjoining lots situate at Fort William, Ont.

19993—August 8—Authorizing the C.P.R. to construct, maintain and operate a branch line of railway or spur from a point on the south westerly limit of the Applicant Company's right-of-way, thence in an easterly direction across Lots 24, 25, 26 and 27, in the block of land lying to the north of Vine St., and westerly of Keele St., and to change the alignment of existing spur in Lots 24, 25, 26 and 28 in said block of land lying west of Keele St., West Toronto, Ont., for the Gibson, McCormack and Irvin Co., Ltd., Toronto.

19994—August 11—Approving location of the C.P.R. location of its Gimili to Riverton Branch, from a point in Sec. 17, Tp. 19, Rge. 4, E. P. M., at Gimili, Man., thence in a northerly direction to a point in Sec. 20, Tp. 23, Rge. 4, E. P. M., at Riverton, being from mileage 0.00 (at Gimili) to mileage 26.03; authorizing construction of tracks of Gimili to Riverton Branch across certain highways.

19995—August 8—Authorizing the C.P.R. to construct Bridge No. 109.4 on the Swift Current Subdiv. of its line of railway.

19996—August 12—Authorizing the C.P.R. to construct, by means of grade crossings, additional track across certain highways on its main line of railway between Percival and Broadview.

19997—August 12—Authorizing the C.P.R. to construct, by means of a grade crossing the tracks of its said ballast pit spur, at Carseland, across the highway between Secs. 5 and 6, Twp. 22, Rge. 25, W. 4 M., at mileage 0.98 of said ballast pit spur.

19998—August 13—Approving proposed change in location of C.P.R. station on Lot 3, Con. B, Twp. North Dorchester, Co. Middlesex, Ont., at Putnam.

19999—August 12—Authorizing the C.P.R. to construct road diversion in the N.W. ¼ of Sec. 7, Twp. 22, Rge. 26, W. 4 M., and to construct by means of a grade crossing the tracks of its Gleichen-Shepard Branch across diversion at mileage 24.3.

20000—August 12—Authorizing the C.P.R. to construct, maintain, and operate extensions to the existing sidings for the Dominion Government situated in Lot 20, Con. 10, Twp. of Petewawa, Co. Renfrew, Ont., at Petewawa at mileage 116.47 from Ottawa on the Applicant Co.'s Eastern Div.

20001—August 13—Approving locations of the C.P.R. stations, Portreeve and Sceptre, on its Swift Current N.W. Branch.

20002—August 11—Authorizing the Winnipeg, Selkirk and Lake Winnipeg Railway Company to construct subway at Middlechurch, to carry its Stonewall Branch underneath the West Selkirk Branch of the C.P.R.

20003—July 28—Extending the time within which the half-interlocking plant was to be constructed at Adelaide St., London, until the 15th September, 1913; and authorizing the C.P.R. to operate their cars and trains over said crossing.

20004—August 13—Authorizing the C.N.R. to construct its railway across certain highways on its Alsask Branch, Sask.

20005—August 13—Authorizing the C.P.R. to construct certain bridges on its line of railway.

20006—August 12—Approving location of the C.P.R. station at Shalketon, in the N.W. ¼ of Sec. 8, Twp. 20, Rge. 19, W. 3 M., at mileage 43.18 on its Swift Current N.W. Branch.

20007—August 13—Approving location of the C.P.R. station at Prussia, in the N.W. ¼ of Sec. 21, Twp. 22, Rge. 26, W. 3 M., at mileage 88.00, Swift Current N.W. Branch.

20008—August 13—Approving location of the C.P.R. station at Lancer in the N.Q. ¼ of Sec. 20, Twp. 21, Rge. 21, W. 3 M., at mileage 58.08, Swift Current N.W. Branch.

20009—August 11—Authorizing the G.T.P. Branch Lines Co. to divert Toronto St., between Sixth Ave. and Eighth Ave., Moose Jaw, Sask.

20010—August 11—Refusing application of the Toronto Board of Trade for a reduction of the freight classification ratings on dried fruit.

20011—August 12—Authorizing the Edmonton, Dunvegan and B.C. Ry. to construct its railway across certain highways in the Province of Alberta.

20012—August 8—Authorizing the New Brunswick Coal and Railway Co. to construct bridge No. 33.4 at Cumberland Bay, N.B.

20013—August 9—Authorizing the Edmonton Interurban Railway Co. to operate its cars over the crossing of the tracks of the E. D. and B. C. Ry., (pending the installation of an interlocking plant), for construction purposes only.

20014—August 12—Authorizing the G.T.R. to construct, maintain and operate a branch line of railway, or siding, commencing at a point on its railway on Lot No. 262, Subdiv. Lot 102, Lachine, Que., thence extending northerly to and into the premises occupied by the Railway Signal Co., on subdiv. Lots 103, 104, 105, 106 and 107 of Lot 262, in the city of Lachine.

20015—August 9—Ordering the G.T.R. to construct a subway twenty-four feet wide on Bay Street, village of Callender, Ont.

20016—August 12—Approving location of G.T.P. Branch Lines station at Gorlitz, Sec. 25, Tp. 28, Rge. 24, W. 2 M., mileage 43.3 on its Yorkton Extension.

20017—August 11—Ordering the C.P.R. to install an improved type of illuminated electric bell, within ninety days from this Order, at the Main St. crossing in the village of Shelburne, Ont.

20018—August 14—Amending Order No. 18705 by providing that the cost of the maintenance of the watchman at Anderson St. crossing, west of station building at Grenfell, Sask., be divided equally between the C.P.R. and the municipality.

20019—August 15—Approving location of C.P.R. proposed station on road allowance between Secs. 8 and 9, Twp. 13, Rge. 12, W. 4 M., at Ronolane, Alta., at mileage 22.5, Suffield to Blackie Branch.

20020—August 13—Approving portion of location of C.P.R. Snowflake westerly branch from mile 0, a point in Sec. 18, Tp. 1, Rge. 9, W. P. M., thence in a westerly direction to a point in Sec. 14, Tp. 1, Rge. 11, W. P. M., at mile 9.10.

20021—August 13—Authorizing the Toronto, Hamilton and Buffalo Ry. to construct and maintain bridge across the Welland River at Coyle, Ont.

(Continued on Page 86.)

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

PLANS AND SPECIFICATIONS ON FILE.

The Canadian Engineer, 820 Union Bank Building, Winnipeg:—

ISSUE CLOSE
28-8—Supplying power house machinery, Neepawa, Man. 1-9

The Canadian Engineer, 62 Church Street, Toronto:—
28-8—Supplying power house machinery, Neepawa, Man. 1-9

The Canadian Engineer, 628 Transportation Building, Montreal:—
28-8—Supplying power house machinery, Neepawa, Man. 1-9

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Albert County, N.B., extension of breakwater	Sept. 2.	Aug. 14.	80
Annapolis County, N.S., ice piers	Sept. 3.	Aug. 21.	80
Brantford, Ont., sidewalk	Aug. 30.	Aug. 21.	76
Calgary, Alta., lamps	Sept. 3.	Aug. 21.	78
Cascades Point, Que., rebuilding head of Guard Pier	Aug. 29.	Aug. 14.	78
Cayuga, Ont., macadam road	Sept. 16.	Aug. 7.	88
Fort William, Ont., drill hall	Sept. 4.	Aug. 21.	78
Fraser River, B.C., jetty and dredging	Sept. 30.	Aug. 21.	80
Hamilton, Ont., conduit system	Aug. 28.	Aug. 14.	78
Listowel, Ont., drill hall	Sept. 16.	Aug. 21.	80
London, Ont., bridge	Sept. 11.	Aug. 21.	76
Moose Jaw, Sask., elevator	Sept. 8.	Aug. 21.	80
Ottawa, Ont., concrete foundation and floor	Sept. 2.	Aug. 21.	82
Ottawa Ont., double tracking	Sept. 8.	Aug. 21.	76
Ottawa, Ont., substructure of bridge at Smith Falls	Sept. 6.	Aug. 14.	76
Ottawa, Ont., steel steamer	Aug. 28.	July 24.	80
Pembroke, Ont., drill hall	Sept. 2.	Aug. 21.	82
Poupore, Que., training pier and revetment wall	Sept. 2.	Aug. 7.	80
Prescott, Ont., steamer	Aug. 28.	Aug. 21.	82
Regina, Sask., coal bunkers	Oct. 1.	Aug. 21.	82
Saskatoon, Sask., elevator	Sept. 8.	Aug. 21.	80
Steelton, Ont., public building	Sept. 9.	Aug. 14.	82
St. Malo, Que., locomotive and car shops	Sept. 2.	Aug. 14.	76
Toronto, Ont. harbor works	Sept. 2.	Aug. 7.	86
Victoria Harbor, Ont., wharf	Sept. 8.	Aug. 14.	80
Winnipeg, Man., drill hall	Sept. 3.	Aug. 7.	82

RAILWAYS—STEAM AND ELECTRIC.

Ottawa, Ont.—Tenders will be received up till the 8th of September, 1913, for the double tracking of the line between St. Romuald and Chaudiere curve. Plans and specifications may be obtained from the Chief Engineers's office, Moncton and the Department of Railways and Canals. L. K. Jones, Deputy Minister and secretary.

Sussex, N.B.—Tenders will be received up till the 3rd of September, 1913, for the construction of a passenger station. Plans and specifications may be obtained from Chief Engineer, Moncton, N.B. and the Department of Railways and Canals. L. K. Jones, Deputy Minister and secretary.

BRIDGES, ROADS AND PAVEMENTS.

Barrie, Ont.—MESSRS. CURRAN & CLEMENT, Orillia, Ont., have been awarded the contract for paving work.

Calgary, Alta.—In anticipation that the deal for an extra million dollars offered by Stimson and Company, of Toronto, to the city, will be negotiated, plans for enlarging on the paving programme of the city for this season are being laid in order to be ready to go ahead with the work without losing any time when the money is assured.

▲—Cayuga, Ont.—Tenders will be received up till the 16th of September, 1913, for the construction of 26½ miles of stone macadam road. Plans and specifications may be obtained from T. A. Snyder, County Clerk,

▲—Kingston, Ont.—Tenders will be received up till the 5th of September, 1913, for the construction of 4,250 square yards of asphalt block pavement, 1,330 lineal feet of concrete curb and gutter, 1,040 lineal feet of cement gutter and 2,000 square feet of cement walks. Plans and specifications may be obtained from R. J. McCallum, City Engineer.

▲—London, Ont.—Tenders will be received up till the 11th of September, 1913, for the supply and erection of three 130 feet spans riveted truss steel highway bridges over the Thames River. Plans and specifications may be obtained from Wm. N. Ashplant, City Engineer.

+—London, Ont.—The City Council has awarded MESSRS. FOLEY AND GLEESON the contract for the construction of 1,900 feet of sheet asphalt paving, including curbs and gutters. The contract price is $12,240.

London, Ont.—New cement walks will be laid on Bathurst Street from Waterloo to Colborne, and also on York from Wellington to Colborne. Tenders will be called for shortly.

London, Ont.—Tenders will be called shortly for the construction of 1⅛ mile of asphaltic concrete paving. W. N. Ashplant, City Engineer.

+—Montreal, Que.—MESSRS. QUINLAN & ROBERTSON have been awarded the contract for laying of granite blocks on Cote St. Paul Road at $1.80 per square yard. The blocks are to be supplied by the city.

+—Montreal, Que.—The City Council has awarded the SICILY ASPHALTUM COMPANY the contract for the construction of a special pavement with a wearing surface of 2 inches on two streets. The contract prices were for the first street, $2.91 per square yard or $9,079.20 for the whole, and for the second, $2.79 per square yard or $3,878.12 for the whole.

+—Montreal, Que.—The City Council has awarded the CANADA CREOSOTING COMPANY Ltd., the contract for resurfacing with wooden blocks St. Sulpice and Bonsecours Streets. The contract price was $3.09 per square yard.

+—Peterborough, Ont.—The Board of Works has awarded MESSRS. FOLEY AND GLEESON the contract for the paving of George Street. The tenders for the work were as follows:—Warren Bituminous Paving Company.—Bitulithic and stone blocks, $73,082.50; bitulithic and paving blocks, $71,188.43; asphaltic concrete and stone blocks, $65,785.22; asphaltic concrete and paving blocks, $63,810.62. Foley and Gleeson.—Asphaltic concrete, $63,827.57; asphaltic concrete and paving blocks, $63,810.62. If the bitulithic pavement

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had been decided upon, it would have cost the city between $9,000 and $10,000 more than it is costing for the asphaltic pavement, and according to City Engineer Parsons, as good a material is being obtained for that much less money. The asphaltic pavement has been guaranteed for a term of five years by Messrs. Foley and Gleeson, with the Bond Company, and if the board are willing to accept a personal bond, they will guarantee it for a further five years.

Peterborough, Ont.—Toronto firms have tendered for paving work here as follows:—From the Warner Paving Company, Toronto.—For bitulithic pavement, $2.46 per square yard; asphaltic concrete, $2.14 per square yard; stone block, $4.28 per square yard; brick, $3.25 per square yard; straight concrete curb, 28 cents per lineal foot; curved concrete curb, with Wainwright steel bars, 82 cents per lineal foot; curved concrete curb, without bar, 32 cents per lineal foot; concrete gutter, 27 cents per square foot; concrete sidewalk, 15½ cents square foot; headers, 38 cents per lineal foot. From Clark and Monds, Toronto.—For concrete pavement, $1.28 per square yard; for concrete straight and curved curb, 30 cents per lineal foot; concrete gutter, 15 cents per square foot.

Regina, Sask.—Some of the wholesale houses in the civic wholesale section at Regina have decided to have reinforced concrete roads lead into their premises from the city streets. The Cockshutt Plow Company and the H. G. Smith Company, Limited, have decided to have such roadways built.

+—St. Amicet, Que.—MESSRS. ROUTLEY & SUMMERS, Toronto and Haileybury, Ont., have been awarded the contract for 13½ miles of macadam roadway.

Vernon, B.C.—Mr. Hamilton Long, road superintendent of the Okanagan electoral district, estimates that it will cost $1,026,000 to standardize the roads of the Okanagan and to convert a hundred miles of trail into the wagon roads that the rapid development of the district will make imperative in the near future.

Victoria, B.C.—An arrangement has been arrived at with the Canadian Mineral Rubber Company, which will permit the immediate commencement of operations on the paving of the Gorge Road between Douglas Street and Manchester Road. This work has been delayed for some time. Payment will be made from general revenue, to be returned out of the usual local improvement assessments when these can be levied.

Victoria, B.C.—Final action has been taken by the municipal Council of Saanich in regard to the paving problem. The council authorize the Worswick Paving Company and Warren Brothers to do the work.

Welland, Ont.—Tenders will be received up till August 26th, 1913, for the construction of a thirty-foot concrete arch bridge over Lyons Creek, on the Town Line Road, between the Townships of Humberstone and Crowland. Plans and specifications may be obtained from George Ross, County Engineer, Welland, Ontario.

LIGHT, HEAT AND POWER.

Calgary, Alta.—Tenders will be received up till the 3rd of September, 1913, for supplying 75 luminous arc lamps standards. Plans and specifications may be obtained from J. M. Miller, City Clerk.

+—Montreal, Que.—The City Council has awarded Mr. G. M. GUEST the contract for the laying of underground wire conduits on St. Catherine Street and in Park Avenue and Bleury Street. The contract price is, for the first-named street, $45,969 and the second-named, $128,000. The Bell Telephone will pay $10,496 towards the work on Bleury Street.

+—Montreal, Que.—The City Council has awarded the SAYER ELECTRIC COMPANY the contract for the electric lighting of Bonsecours Market. The contract price is $2,542.

Regina, Sask.—The new 1,500 k.w. unit, for the power house, ordered from Quillans and Robertson, of Birmingham, England, has arrived. The boilers which have also arrived were purchased from the Babcock-Wilcox Company. Each boiler has a capacity of 500 horse-power and a pressure of 200 pounds.

▲—Regina, Sask.—Tenders will be received up till the 1st of October, 1913, for supplying power-house equipment. Plans and specifications may be obtained from E. W. Bull, Superintendent of Light and Power Commission.

Saskatoon, Sask.—Following upon the discussion in Prince Albert regarding the power scheme undertaken there, at a public meeting the announcement was given out that during the winter the flow of water would be more than was counted upon. City Commissioner Yoarth made a statement regarding the question of river power at Saskatoon. He stated that from data he possessed, a flow of only 1,382 cubic feet of water per second could be counted upon, whereas in previous estimates of power schemes 3,000 had been the amount considered possible. He considers that it is impracticable to generate power from the South Saskatchewan River sufficient for the requirements of Saskatoon, but believes that it is worth an investigation to inquire into the possibilities of a power development scheme at the junction of the north and south branches.

Victoria, B.C.—A basis for the lighting of Saanich municipality at a cost of $27,000 for installation was submitted to the municipal council recently by the British Columbia Electric Railway Company, and laid over for consideration by the works committee. Two constant current regulators with switchboard complete, with a capacity of 500 of 80 watt lamps, or 450 of 94.4 watt lamps, were proposed, and a map attached to the report suggested 250 locations, with 200 to be added later. Payment was proposed to be spread over five years with interest at 6 per cent. on unpaid amounts. The municipality was to provide suitable accommodation for the housing of regulators, and to arrange for turning on and off the lights. The rate for current was set at 3½ cents per k.w.h., with a minimum of 500, or 3 cents per k.w.h., with a minimum of 1,000. Lamps and renewals were to be a charge on the municipality.

+—Winnipeg, Man.—The Winnipeg Electric Railway Company, a Mackenzie-Mann enterprise, are up against a big problem in connection with their present power plant at Lac Du Bonnet on the Winnipeg River, forty miles east of the city. After it was first put in, at a cost of millions, the company three years ago found it necessary to spend another large sum in blasting to secure a greater flow over the falls. Still it is not sufficient and frequently the company has to fall back on its auxiliary steam plant to supply its demands. Ice in the spring and fall is also a big drawback. It is now announced that the company will build another big plant twelve miles farther down the river towards Lake Winnipeg. The new site is forty-five miles from Point du Bois, the civic plant's location. J. G. WHITE AND COMPANY, New York contractors, have been awarded the contract for the construction of the plant, which will cost four or five millions. The location is Grand Bonnett Falls. Two falls will be blown out. It is not thought it will effect detrimentally the civic plant.

Winnipeg, Man.—Tenders will be received up till the 20th of September, 1913, for the supply of labor and materials necessary for or incidental to the erection of a duplicate transmission system. Plans and specifications may be obtained from the Board of Control. M. Peterson, secretary.

GARBAGE, SEWAGE AND WATER.

Calgary, Alta.—Dr. Mahood, city health officer, has received the report from the provincial analyst on the monthly test of the Calgary city water. Samples were taken from both the chlorinated supply from the Bow and the untreated supply from the Elbow. The report shows that both samples were very low in nitrates, nitrites and free ammonia, and absolutely free from colon bacilli.

Chelsea, Ont.—At a meeting of Chesley Council it was decided to buy an oil engine for the waterworks plant. Apparently the gas producer has seen its best days, and it is the council's intention to repair the old producer and use it as an auxiliary plant.

Edmonton, Alta.—City Engineer Latornell has submitted a report to the Commissioners of the proposed sewage purification works to be erected on Ross flats. An appropriation of $30,000 was made in 1912 for this work.

Montreal, Que.—At a recent meeting of the Board of Control, the filter contract matter was settled. Mr. Norman M. McLeod, the contractor is given an extension of time for fifteen months. The city agrees to remit the fine of $100 a day, beginning with September 1, for the non-finishing of

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the work by that date, and not to impose it till December 1, 1914. Mr. J. W. McConnell, financial broker, gives his joint guarantee with Mr. McLeod for the finishing of the work. Twelve thousand dollars are advanced to Mr. McLeod. He assumes responsibility for the damages caused by the frosts of last winter. The contractor agrees to forfeit one hundred dollars a day if the works are abandoned till they are finished.

Newmarket, Ont.—The town of Newmarket is extending its water supply by artesian wells, which are being done by Mr. Harvey. The work will be started shortly.

Regina, Sask.—Ten machines are employed in Regina laying mains for sewer and water. Three and one-half miles of sewers were laid during the month of July and six acres of paving.

Toronto, Ont.—The J. H. McKNIGHT CONSTRUCTION CO. were awarded the contract for the Balsam Avenue sewer. Their tender to do the work for the sum of $45,900 was accepted a few days ago.

+—Toronto, Ont.—The contract has been awarded to MORAN & CO., Ottawa, for the construction of one of the large western outlets of the trunk sewer, the price being $89,416.

+—Toronto, Ont.—MESSRS. DONNELLY, GRAHAM & GEROW, of Cleveland, Ohio, have been awarded the contract for the construction of 5,800 feet of sewer on Woodville Avenue. The course of the tunnelling runs through sand, clay and quicksand requiring the use of compressed air and extreme care in construction. The contract price amounts to $63 a foot.

+—Toronto, Ont.—The following contracts for sewers have just been let by the city. One for Woodville Avenue, West Toronto, amounts to $366,000. The others are as follows: Balsam Avenue, Queen Street to Kingston Road, $45,900; Carlaw Avenue, storm overflow, $28,580; outlet at East Toronto, $86,000; Earlscourt drainage system, $45,838; Midway outlet, $89,416.

▲—Toronto, Ont.—Tenders will be received up till the 2nd of September, 1913, for the construction of a number of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

Winnipeg, Man.—Consulting Engineers F. P. Stearns, Rudolph Hering and James A. Fuertes, of New York, have submitted their report upon the proposal to use Shoal Lake as the source of water supply for the Greater Winnipeg water district. The report was considered by the Mayor and controllers immediately on receipt. It is favorable to the project and recommends that the work be undertaken with as little delay as possible. It states that the cost at which the water can be brought to Winnipeg is a very moderate one and they estimate that it would be lower than had been expected. No treatment of the water will be necessary at any part of the year.

INDUSTRIAL WORKS.

+—Calgary, Alta.—The City Council has awarded the GENERAL SUPPLIES COMPANY, a local concern, the contract for supplying valves and steam pipes. The contract price was $26,000, $900 less than the tender, and in the event that the pipe is delivered in the time specified the company be given a bonus of the remainder of the amount of the tender, or $900, the idea being to hold back the $900 as a penalty against delay. The motion further provided that if the general supplies declined to accept the action of the council, the contract go to the Pittsburg Valve Company.

Canoe, B.C.—Tenders will be received up till the 11th of September, 1913, for the construction of a public wharf. Plans and specifications may be obtained from F. W. Aylmer, District Engineer, Chase, B.C.; J. S. McLachlan, District Engineer, Victoria; and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Fort William, Ont.—The THUNDER BAY CONTRACTING CO. have been awarded the contract for a new pump house. The contract price is $12,995.

Gillies Bay, B.C.—Tenders will be received up till the 15th of September, 1913, for the construction of a wharf at Shelter Point. Plans and specifications may be obtained from C. C. Worsfield, District Engineer, New Westminster and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Laprairie, Que.—Tenders will be received up till the 23rd of September, 1913, for the construction of a protection dyke. Plans and specifications may be obtained from District Engineers, J. L. Micnaud, Montreal, Charles Chapais, Quebec and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Main Duck Island, Ont.—Tenders will be received up till the 16th of Septembr, 1913, for the construction of a reinforced concrete tower, wooden dwelling, boathouse and oil store. Plans and specifications may be obtained from the Department of Marine and Fisheries, Ottawa. Alex Johnson, Deputy Minister.

Montreal, Que.—Tenders will be received up till the 4th of September, 1913, for supplying the office fittings and furniture for the central post-office. Plans and specifications may be obtained from Mr. R. L. Deschamps, Montreal and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Montreal, Que.—Tenders will be received up till the 8th of September, 1913, for the alterations and additions to fittings for postal station "B." Plans and specifications may be obtained from Mr. R. L. Deschamps, Montreal and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

▲—Neepawa, Man.—Tenders will be received up till the 1st of September, 1913, for supplying machinery for additions to the power plant. Plans and specifications may be obtained from *The Canadian Engineer's* offices at Winnipeg, Toronto, and Montreal; W. E. Skinner, Limited, Consulting Engineers, Winnipeg, and J. W. Bradley, Secretary-Treasurer.

▲—Ottawa, Ont.—Sketch designs in a preliminary competition for the erection of departments and courts buildings, will be received up till the 2nd of January, 1914. Conditions for both competitions may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Ottawa, Ont.—Tenders will be received up till the 4th of September, 1913, for timber on the Dokis Reserve. Plans and specifications may be obtained from the Department of Indian Affairs, Ottawa. J. D. McLean, secretary.

Ottawa, Ont.—Tenders will be called for shortly for the largest of Canadian ice-breakers. The vote was granted last session, and the plans since under preparation by Naval Architect Duguid, of the Marine Department, are nearing completion. The ship will operate between Montreal and Quebec to facilitate the early opening of navigation in conjunction with the Montcalm and the Lady Grey. It will be 275 feet long, 57 feet wide, 32 feet deep, and will have a draught of 20 feet and 9,000 indicated horse-power.

Regina, Sask.—The Gutta Percha Rubber Company, have through their manager, Mr. Candee, signified their intention of establishing a branch of the business at Regina. The city has been requested to reserve the spur track sites in the city warehouse section, where it is proposed to erect the building.

+—Saskatoon, Sask.—The City Council has awarded the H. G. BAKER COMPANY, Ltd., the contract for supplying the public schools with wood for the winter at $5.95 delivered. J. H. STEWART COMPANY was awarded the contract for the coal at $9.40 per ton, or 30 cents a ton more than last year.

+—Saskatoon, Sask.—The school board has awarded the CHARETTE KIRK COMPANY, Winnipeg, the contract for the plumbing, heating and ventilating of the Buena Vista school. The tenders were as follows:—Cotta Brothers, Winnipeg, $35,214; James Brandon, Saskatoon, $29,625; General Fire Extinguisher Company, Montreal, $26,039; Charette Kirk Company, Winnipeg, $24,900.

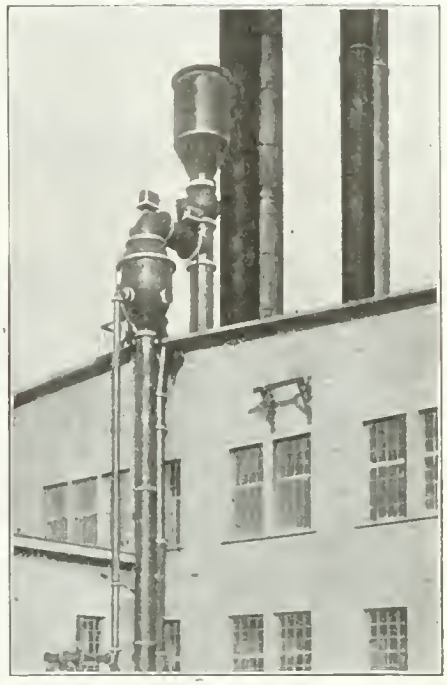
Toronto, Ont.—Three firms, one in Montreal, one in Pittsburgh, and the third in New York, will tender jointly for the big contract in connection with the projected improvements of Toronto Harbor. The tender will be presented under the name of the Montreal company. The companies are:—Messrs. Lauren and Leach, Montreal; Booth and Flynn, Pittsburg; and T. A. Gillespie and Company, New York. For some weeks engineers representing these firms have been in the city gathering information and recently the principals arrived to further negotiations.

+—Vancouver, B.C.—The Dominion Government has awarded HENRY McFEE AND McDONALD the contract

CONDENSING APPARATUS

specially designed to secure

GREATER STEAM ECONOMY



WORKS: WILLIAM and SEIGNEURS STREETS, MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants.

The Hampton Sedimentation Tank

Used in connection with an electrolytic hypochlorite treatment, the process is **ABSOLUTELY ODORLESS** and the effluent is free from disease germs.

Nine years of operation in large and important installations in England have demonstrated that an effluent exceptionally low in suspended solids and as free from odor as the entering sewage may be obtained with The Hampton Tank.

The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction of the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

Sterilization Co.

Union Building, Clinton Street

NEWARK, N.J.

Also engineers for the electrolytic treatment of water.

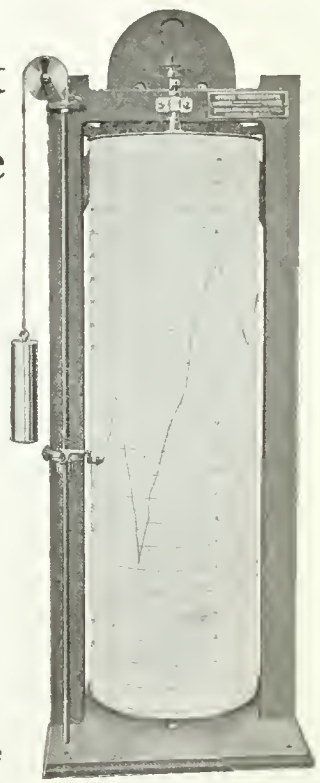
A Perfect Weir Gage

Carries an unusually large card and will register without any reduction through a variation of two feet or on a two to one reduction through a variation of four feet.

Can be applied anywhere where fluctuation is within limit named and where great accuracy is desired.

In use on weirs, sewage disposal plants, irrigation and stream gaging.

Write for Catalogue



Hydro Chronograph Weir Gage.

Hydro Manufacturing Co.

700 BULLITT BUILDING, PHILADELPHIA, Pa.

for the construction of a wharf to handle the largest ocean steamers. The contract price is $1,250,000.

Yarmouth, N.S.—Tenders will be received up till the 4th of September, 1913, for dredging required here. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Yorkton, Sask.—MESSRS. LOGAN & BLACK, of Yorkton, Sask., have been awarded the contract for the construction of a new telephone building. Parrott & Byers, Yorkton, Sask., have been awarded the contract for the plumbing of the building.

MISCELLANEOUS.

Alexandria, Ont.—Tenders will be received up till the 2nd of September, 1913, for the construction of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

Athabasca, Alta.—The town council have decided to erect a new town hall.

Chilliwack, B.C.—Tenders will be received up till September 8th, 1913, for the erection of a frame school building. Plans and specifications may be seen at the offices of the Inspectors of Indian Agencies at Vancouver and Victoria, the Indian Agent, New Westminster, and the postoffices at Chilliwack and Nelson. J. D. McLean, Assistant Deputy and Secretary.

+—Cobalt, Ont.—The Town Council has awarded MESSRS. HILL-CLARK-FRANCIS Ltd., New Liskeard, the contract for the erection of the mnnicipal buildings.

+—Fort William, Ont.—Mr. P. J. DOURHUE has been awarded the contract for the erection of the Fort William car barns. The contract price is $34,600. Mr. JAS. TONKIN was awarded the contract for the excavation.

+—Fort William, Ont.—The Fife Hardware Company has awarded Mr. A. C. STEWART the contract for the erection of a wholesale warehouse. The contract price is $40,000.

+—Indian Head, Sask.—The Dominion Government has awarded JAMES McDIARMID AND COMPANY, Winnipeg, the contract for the erection of a drill hall. The contract price is $13,700.

+—Lethbridge, Alta.—The contract was let this week by Industrials Limited, for the construction of a $7,000 macaroni factory on the city industrial site off 13th Street. The contract went to a Blairmore builder and thus the first home industry under the city's new $6,000 commissioner disburses this local capital among outsiders.

+—Medicine Hat, Alta.—The Salvation Army has awarded MESSRS. SACKRIDGE AND TURNER, local contractors, the contract for the erection of a citadel. The contract price is $20,000.

Merritt, B.C.—Tenders will be received up till September 11th, 1913, for the construction of a new drill hall. Plans and specifications may be obtained from the offices of the District Officer Commanding the Military District No. 11, Victoria, B.C.; the Town Clerk, Merritt, B.C., and the Director General of Engineer Services, Headquarters, Ottawa. Eugene Fiset, Deputy-Minister, Ottawa, Ont.

Montreal, Que.—Tenders will be received up till the 2nd of September, 1913, for renewing roofs of boilerhouses and pump-house. Plans and specifications may be obtained from the Board of Commissioners. L. N. Senecal, secretary.

New Westminster, B.C.—The city council are considering the expenditure of $2,000,000 on a new Union depot.

+—Port Arthur, Ont.—The Molsons Bank has awarded MESSRS. SEAMEN AND PENNIMEN the contract for the reconstruction of their new building.

Regina, Sask.—The W. G. Downing, Limited, has had plans prepared of a factory to cost $50,000, the erection of which will be commenced as soon as tenders have been received. Storey and VanEgmond, architects, of Regina, have charge of the plans. The building will be four stories in height, and of the ground dimensions of 50 feet by 113 feet. It will be of brick construction.

Regina, Sask.—The tender of the R. J. LECKY CO. for the construction of the new wing of the Regina General Hospital, has been accepted by the Hospital Board. The contract price is $88,107.

Regina, Sask.—The contract for the erection of the isolation hospital has been let to MINKLEY & TRAUB, their tender for the work being $77,600.

Rosetown, Sask.—Tenders will be received up till September 1st, 1913, for the erection of a building. Plans and specifications may be obtained from Builders' Exchange, Moose Jaw, Regina and Saskatoon. C. E. Coulin, Mayor.

Saskatoon, Sask.—The City Health Department is compelling contractors to keep all excavations free from stagnant water, such water having in several cases became exceedingly offensive and consequently undesirable. After each rain, contractors are now compelled to pump out all such excavations.

Sault Ste. Marie, Ont.—A new $60,000 coal unloader, of double tramway type, one of the most up-to-date in Canada, and only recently completed, was completely demolished by windstorms on August 21st.

+—Sudbury, Ont.—MESSRS. DORAN AND DEVLIN, Ottawa, have been awarded the contract for a public building. The contract price is $98,200.

+—Toronto, Ont.—MR. W. R. PERRIN, consulting architect and engineer of the civic abattoir, has been awarded the contract for supplying the interior fittings and machinery. The contract price is $108,376.

+—Vancouver, B.C.—The Alaska Bedding Company has awarded Mr. F. T. SHERBORNE the contract for the erection of a four-story factory. The contract price is $30,000.

+—Vancouver, B.C.—Mr. R. J. McLean has awarded the DOMINION CONSTRUCTION COMPANY the contract for the erection of the new Commercial Drive Theatre. The contract price is $30,000.

Vanguard, Sask.—Mr. Duckett, of the Sask. Co-operative Elevator Company, Ltd., has been in Vanguard for the last few days arranging the final details of the organization to enable the company to establish their new 30,000 bushel elevator at this point. The company tried to negotiate the purchase of one of the existing elevators but failed to put through a deal, and as the necessary capital has been subscribed by the farmers the company will build an entirely new elevator.

Victoria, B.C.—Tenders will be received up till the 9th of September, 1913, for the erection of the Robson school. Plans and specifications may be obtained from the Department of Pubic Works, Victoria. J. E. Griffith, Public Works Engineer.

Victoria, B.C.—Tenders will be received up till the 10th of September, 1913, for the erection of the Salmo lock-up. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffiths, Public Works Engineer.

+—Winnipeg, Man.—The Dominion Government has awarded MESSRS. RUTHERFORD AND BONOGH the contract for the erection of a fish hatchery in Lake Winnipeg. The contract price is $11,000.

+—Winnipeg, Man.—Mr. D. H. Beadley has awarded the WINNIPEG STONE COMPANY the contract for the erection of an apartment block. The contract price is $65,000.

CURRENT NEWS.

Montreal, Que.—The Raymond Concrete Pile Company, whose chief offices in Canada are in the New Birks Building, Montreal, have opened a branch office at Buffalo, N.Y., in the Ellicott Square Building, in charge of Mr. Edward Phelan.

Vancouver, B.C.—By virtue of an agreement signed in Victoria recently by William Young, Provincial Controller of Water Rights, representing the Provincial Government, and J. B. Challies, chief engineer of the Hydrographic Survey Branch of the Interior Department, Ottawa, representing the Dominion Government, the latter government agrees to extend the hydrographic work now in progress in the Dominion railway belt to all other districts of British Columbia. Dominion Government water rights in the Canadian Pacific Railway belt in British Columbia has been transferred to the Provincial Government, which gives local jurisdiction over every important water power plant and scheme adjacent to Vancouver and Kamloops.

Triple Expansion Pumping Engine

FOR WATER WORKS, MINE SERVICE, ETC.

THE Fairbanks-Morse Triple Expansion Duplex Outside Centre Packed Plunger Pumping Engine shown here is very economical in the consumption of steam. The economy of operation makes this Pump preferable to all others in many situations.

¶ The steam end is fitted with semi-rotative valves. The plungers being externally packed are always in sight and any leakage can be at once detected. All parts are easy of access. The stuffing boxes are large and deep, so that an ample allowance of packing may be used.

¶ This type of pump is heavily proportioned throughout in order to meet the demands of heavy service. It is designed to give long and satisfactory service at a minimum cost. It has a 24-inch stroke and a capacity of 2,500,000 gallons per 24 hours.

Complete detail specification sent on request. *Address our nearest Branch.*

The Canadian FAIRBANKS-MORSE Co., Limited

MONTREAL	ST. JOHN	OTTAWA
TORONTO	WINNIPEG	CALGARY
SASKATOON		VANCOUVER

TENDERS CALLED FOR

PLANS AND SPECIFICATIONS ON FILE.

The Canadian Engineer, 820 Union Bank Building, Winnipeg:—

ISSUE CLOSE

28-8—Supplying power house machinery, Neepawa, Man. 1-9

The Canadian Engineer, 62 Church Street, Toronto:—

28-8—Supplying power house Machinery, Neepawa, Man. 1-9

The Canadian Engineer, 628 Transportation Building, Montreal:—

28-8—Supplying power house Machinery, Neepawa, Man. 1-9

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, September 2nd, 1913, for the construction of the following sewers:—

Turner Road, from Davenport Road to Tyrell Avenue.

Kingston Road, from Main Street to Victoria Park Avenue.

Conrad Avenue, from Hillcrest Drive to Tyrell Avenue.

Orchard Park Avenue, from Queen Street to North End.

Frichot Street, from Yonge Street to E. S. McMurrich St.

Frank Crescent, from Hillcrest Drive to Bracondale Hill Road.

Hillcrest Drive, from Christie Street to Tyrell Avenue.

St. Mathias Place, from Claremont Street to Bellwoods Avenue.

Lane 1st N. Bloor Street, from Euclid Avenue to Manning Avenue.

Lane 1st S. Adelaide Street, from Charlotte Street, to Lane 1st W. Peter Street.

Lane 1st S. Humberside Avenue, from Keele Street, to 144′ East.

Lane 1st W. Euclid Avenue, from Lane 1st N. Bloor Street to London Street.

Lane 1st N. King Street, from Charlotte Street to East End.

Lane 1st W. Sherbourne Street, from Duchess Street to 142′ Sonth.

Lane 1st N. St. James Avenue, from Rose Avenue to Parliament Street.

Midway Drainage System, viz. Felstead, Lamb and Danforth Avenues.

Divisions No. 1 and 2, West Toronto, Bloor Street.

Lane 1st W. Peter Street, from Adelaide Street to Lane 1st N. of King Street.

Lane 1st W. Berkeley Street, from Lane 1st N. Wilton to Lane 1st S. Gerrard St.

Envelopes containing tenders must be plainly marked on the ontside as to contents.

Specifications may be seen and forms of tender obtained at the office of the Commissioner of Works, Toronto.

Tenders shall submit with their tender, the names of two sureties (approved of by the City Treasurer, not members of the City Council, or officers of the Corporation of the City of Toronto), or in lieu of said sureties, the bond of a Guarantee Company approved of as aforesaid.

The usual conditions relating to tendering as prescribed by the City By-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN, (Mayor),
Chairman, Board of Control.

Toronto, August 20th, 1913.

CITY OF KINGSTON.

TENDERS FOR PAVEMENT.

Sealed tenders will be received by the undersigned up to 3 o'clock p.m., Friday, September 5th, 1913, for the construction of approximately 4,250 square yards of asphalt block pavement, 1,330 lineal feet of concrete curb and gutter, 1,040 lineal feet of concrete gutter and 2,000 square feet of concrete walk (widening walk).

Plans and specifications may be seen and all other information obtained at the office of the undersigned.

A marked cheque for five per cent. of the amount of the tender must accompany each bid.

The lowest or any tender not necessarily accepted.

R. J. McCLELLAND,
City Engineer.

City Buildings,
Kingston, Ont., August 26th, 1913.

CITY OF LONDON.

TENDERS FOR STEELWORK.

Sealed proposals addressed to the Chairman and Members No. 2 Committee will be received at the office of the City Clerk up to 5 p.m. on Thursday, 11th day of September, 1913, for the supply and erection of three 130 feet spans rivetted truss steel highway bridge over the River Thames, the substructure for which is already under construction.

Plans, specifications and all particulars can be had at the office of the City Engineer.

No tenders will be considered unless accompanied by a deposit cheque for 5 per cent. amount of the bid.

The lowest or any tender not necessarily accepted.

B. W. BENNETT, Chairman No. 2 Committee. Wm. N. ASHPLANT, City Engineer.

PROPOSED GOVERNMENT BUILDINGS, OTTAWA, ONT.

Architects are invited to submit sketch designs in a preliminary competition for the erection of departmental and courts buildings.

From the designs submitted in this preliminary competition, six will be chosen by the Assessors, the authors of which will be invited to submit more matured designs in a final competition, for which the five unsuccessful competitors shall each receive an honorarium of three thousand dollars ($3,000).

The author of the design placed first by the Assessors will be entrusted with the work which the Government intends carrying ont at once.

The competition is limited to British subjects practising in the British empire.

The Government has appointed Mr. T. E. Collcut, Mr. J H. G. Russell and Mr. J. O. Marchand, as Assessors to act in its behalf.

The designs in the first competition must be delivered in Ottawa (carriage paid) not later than 12 o'clock noon, 2nd January, 1914, addressed to the undersigned.

Conditions for both competitions may be had on application to the undersigned, and at the office of the High Commissioner for Canada, 17 Victoria Street, London, England.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, August 18, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—44890.

(For further Tenders see page 86.)

When designing

structures do you pay sufficient attention to the various matters that govern insurance ratings?

Not only can you add greatly to the fireproofness of buildings by adopting our suggestions, but it is very likely that you can do so without the improvements costing anything ultimately. They will be paid for by the lower insurance rates.

Correspondence solicited. We have a staff of engineers and inspectors trained in this highly specialized line. Make use of our services.

E. M. SELLON & CO.
LIMITED

INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

In making sewer pipe

many pieces come from the kilns with imperfections. They are rendered imperfect by having pieces broken out of the socket or spigot end, or having fire cracks at either end or extending partly through the body of the pipe. Or they may be imperfect in shape, out of round or not straight; not thoroughly vitrified or glazed; or with blisters or scales blown off the outside. Such pieces cannot be classed as strictly first-class pipe. When buying pipe from us one can rest assured that we will never deliver pipe with imperfections such as above unless "seconds" are particularly asked for by the purchaser.

Round Pipe and Square Dealings *Write for 1913 Catalogue*

The Ontario Sewer Pipe Co.
LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

RENOUF PUBLISHING CO.

25 McGill College Ave.

MONTREAL

Building Stones and Clay Products.

A Handbook for Architects.

By HEINRICH RIES, Ph.D., Professor of Economic Geology, Cornell University. 8vo, xiii+415 pages, 59 plates, including full-page half-tones and maps. 20 figures in the text. Cloth, $3.00 net.

Gives the fundamentally important facts and takes up the more important occurrences of building stone. The author has also included a list of structures in which the more important building stones have been placed.

Practical Methods of Sewage Disposal

For Residences, Hotels and Institutions.

By HENRY N. OGDEN, M. Am. Soc. C.E., Professor of Sanitary Engineering, Cornell University, and H. BURDETT CLEVELAND, Assoc. M. Am. Soc. C.E., Principal Assistant Engineer, New York State Department of Health. 8vo, vi + 132 pages, 52 figures. Cloth, $1.50 net.

Contains tables for use in constructing the different types of plants, together with the necessary plans, sections, views, etc.

SECOND EDITION, Rewritten and Enlarged

Engineering for Land Drainage.

By CHARLES GLEASON ELLIOTT, C.E. 12mo, xvi+339 pages, 60 figures. Cloth, $2.00.

A manual for the reclamation of lands injured by water.

Applied Methods of Scientific Management.

By FREDERIC A. PARKHURST, M.E., Assoc. Am. Soc. M.E. 8vo, xii + 325 pages, 48 figures and 9 plates. Cloth, $2 00 net.

This book will appeal strongly to the manager or superintendent of a plant, as it contains valuable suggestions and outlines the routine which should be assigned to almost every employee.

Gas Power.

By Professor C. F. HIRSHFELD, M.M.E., and T. C. ULBRICHT, M.M.E., Cornell University. Small 8vo, viii+198 pages, 60 figures. Cloth, $1.25 net.

Gives the reader such knowledge of the methods and facts of gas power as may enable him to appreciate the present commercial status of this branch of engineering.

Tenders Called For

CAYUGA, ONT.

Sealed tenders will be received up to noon on the 16th day of September, 1913, by the undersigned at Cayuga, Ontario, for the construction of twenty-six and one-half miles of stone macadam road in the county of Haldimand.

The work will be let in three separate and distinct contracts, not necessarily to the same individual.

Tenderers are required to examine the localities of the work and are requested to be present at the opening of the tenders at 2 p.m., on Wednesday, the 17th day of September, 1913.

Plans and specifications may be seen at the office of the County Engineers, Messrs. Jackson and Kyd, Dunnville, or may be had from them on the payment of $10, which sum will be refunded on return of the documents.

Lowest or any tender not necessarily accepted.

T. A. SNIDER, K.C.,
County Clerk,
County of Haldimand,
Cayuga, Ont.

TENDERS FOR MACHINERY.

TOWN OF NEEPAWA, MAN.

Sealed tenders will be received up to noon September 1st, 1913, for machinery for additions to the power plant at Neepawa, as follows:—

Specification Section No. 1— 2 72 ft. by 18 ft. boilers.

Specification Section No. 2—1 187½ h.p. engine.

Specification Section No. 3—1 150 K. V. A. generator exciter and switchboard.

Specification may be obtained by applying to W. E. Skinner, Limited, Consulting Engineers, 204 Sterling Bank Building, Winnipeg, or to the undersigned, or may be seen at the offices of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg; 62 Church Street, Toronto, or 628 Transportation Building, Montreal.

J. W. BRADLEY,
Secretary-Treasurer, Neepawa, Man.

CITY OF REGINA, SASK.

Sealed tenders, registered and clearly marked on the outside of the envelope "Tender for Power-House Equipment," and addressed to the City Commissioners at Regina, Sask., will be received up till noon of October 1st, 1913, for the supply of:—

Coal bunkers, ash hoppers, coal and ash conveyers and crushers.

Price to be on equipment erected on foundation built by the City of Regina according to contractor's requirements.

A marked cheque for 5 per cent. of the amount of the bid, and made payable to the City Treasurer, City of Regina, must accompany each tender.

Specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

The City Commissioners reserve the right to reject any or all tenders.

(For Further Tenders see page 84.)

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES—IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

(Continued from Page 75.)

20022—August 14—Approving proposed alteration in C. L. O. and W. Ry. Co.'s railway so as to include the extra lands required for station grounds in Lots 9 and 10, Con. Broken Front, Tp. Clarke, Co. Durham, Ont., at mileage 137.2 from Glen Tay; and approving location of C. L. O. and W. Ry. station building in Lot 9, Con. B. F.

20023—August 14—Authorizing the C.P.R. to construct its tracks across the roadway in Lot 1088, Kootenay District, B.C., at mileage 48.69, from Golden, by means of a grade crossing.

20024—August 13—Authorizing C.P.R. to construct bridge No. 92.7 on the Toronto Subdivision, Ontario Division, Don Viaduct, near Donlands, Co. York, and Province of Ontario.

20025—August 11—Recommending to the Governor-in Council for approval, By-law No. 40, and the Rules and Regulations for the Government of Employees of the Hull Electric Co.; and rescinding Order No. 19938.

20026—August 13—Granting leave to R. H. Edgar, Bowling Green, Ont., to erect, place and maintain telephone line across the tracks of the C.P.R. at Lot 3, Con. 4, Twp. Amaranth, Co. Dufferin, Ont.

20027—August 14—Authorizing the Dom. Atlantic R. to construct bridge No. 125.9 at the Jordantown Road crossing, N.S.

20028—August 13—Further extending for a period of six months from date of this Order, the time within which the Esquimalt and Nanaimo Ry. Co. was required to file Standard Tariff of maximum freight tolls for the approval of the Board.

20029—August 13—Authorizing the C.P.R. to construct bridge No. 39.4, Toronto Subdivision, Ontario Division of its railway.

20030—August 14—Authorizing the C.P.R. to construct for and on behalf of the municipality, subways at Scotia, Parkside, and Main (Kildonan Road) Streets, and East Kildonan Road, Man.

20031—August 14—Authorizing the C.P.R. to make alterations in the foot bridge at Wallace Avenue to carry it over the third track which the C.P.R. is now constructing from Parkdale to West Toronto.

20032—August 14—Authorizing the C.N.O.R. to construct a subway over the public road on Lots 81 and 82, Parish of Ste. Dorothee, Co. Laval.

20033—August 13—Approving location of the C.N.R. station grounds at Amable, Twp. Pentland, District of Nipissing, Ont., at mileage 188.5 from Ottawa.

20034—Authorizing the Canadian Northern Railway to open for the carriage of traffic portion of its diverted line, Oak Point Branch, from a point in Sec. 21, Tp. 11, Rge. 2, E. P. M., a distance of 3.27 miles.

20035—August 14—Authorizing G.T.P. to cross highway at mileage 210.4, Rural Municipality of Ellice, Dist. of Shoal Lake.

20036—August 15—Approving location G.T.P. Prince Rupert westerly line, from mileage 2.25 (Seal Cove), to mileage 3.23, in the Province of British Columbia.

20037—August 14—Authorizing G.T.P. to construct spur for C. S. Hyman and Company, Calgary, Alta.

20038—August 14—Authorizing G.T.P. B.L. Co. to construct Third Street under this railway at mileage 46.8, in the town of Battleford, Sask.

20039—August 13—Relieving G.T.R. from providing further protection at Brant House Crossing, east of Burlington Station.

20040—August 8—Authorizing certain changes or alterations in C.L.O. & W.'s line so as to provide station grounds in the town of Bowmanville.

20041—August 13—Extending until Nov. 1st, 1913, time for completion of spur for Coquitlam Terminal Company, Limited, Vancouver, across Dominion, 5th, 6th, and 7th Avenues, by C.P.R.

20042—August 9th.—Authorizing C.P.R. to construct branch line to premises of General Fire Extinguisher Company, Montreal.

MEXICAN EAGLE ASPHALT

TRADE MARK

When big paving companies

like the Warner-Quinlan Company use MEXICAN EAGLE ASPHALT *exclusively for all their work in Canada, there must be high merit in that asphalt. If their pavements don't "stand up," the Warner-Quinlan Co. are the ones who lose. The guarantees required are long; repair work is expensive. The best of asphalt must be used. For six years Mexican Eagle Asphalt has "won the pennant" for quality.*

INTERIOR VIEW OF ONE OF THE BUILDINGS OF OUR TEHUANTEPEC PLANT, MEXICO

Our principals, The Mexican Eagle Oil Co., Ltd. (Lord Cowdray, Chairman), have $25,000,000 working capital. They guarantee EVERY BARREL to be uniform and according to analysis. This plant has sufficient capacity to supply Canada with 75,000 tons a year of the world's finest asphalt if that much is required.

DOW & SMITH say that we have a very high quality of refined asphalt; that it is excellent in every respect for pavements. Their reports show that Mexican Eagle Asphalt is especially adapted to our Canadian climate as it will not "mark up" in the warmest weather, nor has extreme cold any bad effect on it. It is the ideal asphalt for paving purposes. Analyses show 99% pure bitumen. Lays between 85 and 90 square yards to the ton.

Refined to definite standards

For prices, samples and full particulars, please address

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

SECOND-HAND MACHINERY

FOR SALE

Plant of the Alberta Engineering Company, Limited, in Manchester Sub-division, Calgary, Alberta; building 96 x 34, equipped with electric power, complete machinery with individual motors for structural steel plant, made up as follows:—

High-speed Friction Saw, 40 inch blade, electric drive.
Rock River Power Shear, belt driven, 32 inch gap.
Rock River Punching Machine, belt driven 30 inch gap.
Stewart Drill Press, belt driven, up to 1⅛ inch dia. drill.
Landis Bolt Cutter, belt driven, up to 1½ inch bolt.
Power Hack Saw.
Jib-boom Derrick, 40 foot boom.
Allan Squeeze Rivetter, 18 inch gap, compressed air.
Blaisdell Air Compressor, belt driven, 8 x 8, with receiver and cooling tank.
Gardner Air Compressor, 6 x 6, mounted on truck, with motor drive.
Grinder, 24 inch mandrill, double head, belt drive.
Two 10 H.P., 3 phase, 60 cycle, 220 volt motors.
One 15 H.P., 3 phase, 60 cycle, 220 volt motor.
Two 5 H.P., 3 phase, 60 cycle, 220 volt motors.
One 2 H P., 3 phase, 60 cycle, 220 volt motor.
All with starting boxes.
Two 3 ton "Cyclone" Chain Blocks.
One 2 ton Chain Block.
Boyer Air Hammer, 8 inch stroke.
Cleveland Pneumatic Hammer, size 9.
Cleveland Pneumatic Hammer, size 6, with snaps and hose complete.

The foregoing may be inspected at the plant of the Alberta Engineering Company, located as above, at any time, any working day, and will be offered for sale as a going concern or in individual units.

E. A. CUNNINGHAM,
Liquidator,
Alberta Engineering Company, Ltd.

Contractors' Machinery For Sale

We have in stock for immediate delivery:—

6½"x8", 6"x12", 7"x12", 8"x12", Beatty hoists
5"x6", builders' reversible hoist
1 yd. "Faivrette" clam bucket
No. 2, boom swinger
No. 2, Ransome concrete mixer
No. 3, Ransome concrete mixer
No. 2 Austin portable stone crusher
10" x 10" x 10", steam driven air compressor
4", 5" and 6", centrifugal pumps direct connected to vertical engines
5, 8 and 12 ton, stiff-leg derrick irons

WRITE FOR PRICES

SELLING AGENTS FOR M. Beatty & Sons

H. W. PETRIE, Limited
TORONTO, ONT.

20 H.P. CASOLINE or KEROSENE I.H.C. Tractor; nearly new; perfect condition; $1,450. Arnold Forster, Newcastle, Ont.

FOR SALE at a snap: 60-H.P. Cowan and Co. engine and 80-H.P. Cowan and Co. boiler. Write for particulars, J. F. Barnard and Son, Spencerville, Ont.

FOR SALE.—One second-hand Marion steam shovel; model 20; has seen very little service and is in fine repair. Also one second-hand Marion shovel; model 30; revolving; in good repair. Low price for immediate sale. Address, R. B. Stewart, Whitby, Ont.

FOR SALE.—Complete Sewer and Water Contractor's outfit, including one Parsons' Trench Excavator, Trench Braces, Fire Pots, Pumps, etc. For price and terms apply to Navin Bros., Contractors, Moose Jaw, Sask.

GAS ENGINE, 8 h.p., for sale cheap; in first-class condition. M. Pullan and Sons, Bay and Wellington Streets, Toronto.

PATENTS.

August 18th, 1913.

The following is a list of patents recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Canada.—Jas. R. Hoyle and A. W. Brearley, casting ingots; Thomas Newton, stair tread coverings; George Evans, detachable heals; Thomas Gill, turbines, turbine pumps and turbine compressors; Ernest Buchholtz, liquid fuel burners and furnaces; George Norman, bolt action rifles; John G. Robinson, pressure release valves.

United States.—Richard C. Quin, feeding systems for oil burners; William Park, tellurians.

Russia.—Frederick L. H. Sims, key bolts.

Australia.—H. E. T. Haultain, weighing apparatus.

France.—Louis Huffman, variable speed mechanism.

CURRENT NEWS.

Calgary, Alta.—The question as to whether all the 18 money by-laws now ready to go before the ratepayers be submitted on one day, or divided up and submitted on different days, was decided by the City Council recently. Assistant City Clerk James Barnes asked for a decision, and, after some consultation, a motion was adopted directing that they be submitted on separate days, and that the matter as to the dates and what by-laws should be submitted together, be left to the city commissioners, with power to act.

MONTREAL MARKET LETTER.

Montreal, August 25th.

Considerable interest has been displayed in the announcement that the Canada Iron Corporation had gone into the hands of a receiver. From all that can be learned, this will not mean that the plants of the company will have to be closed down and the statement has been made that operations will be continued, though not on the authority of those at the head of the company.

It will be recalled that the company some time since, closed down its big Midland furnace. The statement is made that the company was unable to compete with the offerings from the United States.

With the exception of the above, no change of consequence has taken place in the iron and steel markets. Prices are generally steady and trade is undoubtedly lighter than it has been at this time of year during the past few years. The reports of employees being laid off on the railways and in other industries, is naturally not very encouraging, but the general view is that as soon as the money market gets into shape again, building and construction will once more go ahead, inasmuch as so much of it is needed to keep up with the requirements of the country.

CANADA Portland CEMENT

SOME men ask for so many bags of "cement"—

Others, more careful, say they want "Portland Cement"—

But the man who does the best work insists upon getting "Canada" Portland Cement—

And he looks to see that every bag bears this label

To specify Canada Portland Cement, is to introduce an additional safety factor into your calculations. Architects, contractors and engineers know the value of "making assurance doubly sure."

Canada Cement Company Limited

Head Office, - - - - MONTREAL

Sales Offices at

MONTREAL TORONTO CALGARY WINNIPEG

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

ELECTRICAL AND MECHANICAL ENGINEER,—25 years' experience, desires superintending position. First-class references. Electric lighting, power, mining, or similar line of work preferred. Please address Box 62, *The Canadian Engineer*, Toronto.

EXPERIENCED ENGINEER desires appointment, preferably as municipal or sanitary engineer. Technical education; twenty years' experience in the design and construction of drainage, sewerage and sewage disposal systems; street and road construction. Also limited experience in topographical surveys, water supply, town planning and plumbing design. Member of the American Society of Civil Engineers, and of the Royal Sanitary Institute. Please address replies in first instance to Box 66,, *The Canadian Engineer*, Toronto.

ENGINEERING SALESMAN open for engagement. Excellent experience in selling mill power and mining machinery. Good references. Will be pleased to keep any appointment made through Box 70, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER—Experienced Designer, Cost Estimator and Salesman, Works Supervision, all kinds of steam engines, boilers, hydraulic pumps, air machinery and mining plants, seeks position with Consulting Engineer, Contractor, Manufacturers or agency business. Highest references, some capital. Box 102, *The Canadian Engineer*, Toronto.

SUPERINTENDENT SEEKS re-appointment on heavy work, experienced in big plant, steam shovel work, rock, hardpan, concrete, etc. Highest references. Box 110, *The Canadian Engineer*, Toronto.

YOUNG CANADIAN ENGINEER.—Experience, paper mill, electric substation, hydraulic power plant, field and office, wishes to get in touch with a manufacturing concern requiring the services of a permanent resident engineer or plant chief; superior references. Address Box 112, *The Canadian Engineer*, Toronto.

YOUNG ELECTRICAL ENGINEER desires position either as consulting or plant engineer; first-class character and education; one who will take an interest and make good. Box 114, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

SUPERINTENDING ENGINEER of construction now free to accept appointment. Large experience on public works, with specialty in tunnelling. Unexceptional references. Nine years' U.S.A. experience. Address T. H. D., Bartram & Wadsworth, Bank of Toronto Building, Toronto.

EXPERIENCED MUNICIPAL ENGINEER and Land Surveyor desires position. Ten years' experience in municipal engineering, two years as superintendent of construction; also experience in construction of concrete bridges and buildings, railway and land surveys and drainage works. Toronto graduate; O.L.S. seven years, A.M. Can. Soc. C.E. five years. Engagement of three to six months' duration acceptable; at present in the West. Address Box 122, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

MANUFACTURER of well-known waterproofing is open to receive applications from responsible agents for the sale of his product in Montreal and vicinity. Address Box 118, *The Canadian Engineer*, 617 Transportation Buildings, Montreal.

UNITED STATES MANUFACTURERS of concrete mixers is anxious to make agency arrangement with energetic salesman for the territory in and around Toronto. Address Box 120, *The Canadian Engineer*, Toronto.

PATENT NOTICES.—Any one desiring to obtain the invention covered by Canadian Patent No. 135303 granted on August 29th, 1911, to George O. Squier, of Washington, D.C., for telephony and telegraphy, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Company, 53 Queen Street, Ottawa, Canada, Russel S. Smart, manager.

American Bridge Company's Green Book

of Standards, reproduced in black flexible leather binding, indexed. Price net $7.00 postpaid.

W. H. HUNT, Jr., Structural Books,
150 Nassau Street, NEW YORK CITY, N.Y.

INDUSTRIAL CHEMICAL ENGINEER

with thirteen years' experience in England, holding highest references, is open to accept a position in Industrial or Municipal Plants. References can be seen at *Canadian Engineer* office, Toronto.

Address communications to

CHAS. H. EDMONDS

c/o Canadian Engineer, 62 Church St., Toronto

NEW INCORPORATIONS.

Victoria, B.C.—Olympic Stone Construction Company, $75,000.

Toronto, Ont.—Crystal Lake Mines, $40,000. E. L. Dolson, A. M. Lynch, C. D. Stephen.

Walkerville, Ont.—Fisher Motor Company, $150,000. C. F. Garaghty, Detroit; F. E. Fisher, F. W. Vollans.

Hull, Que.—La Compagnie du Parc de la Montagne, $99,000. J. B. Larose, J. U. Archambault, J. Gratton.

Weedon, Que.—La Compagnie Lavergne, $10,000, (contractors). L. Fontaine, L. Lavergne, C. Fontaine.

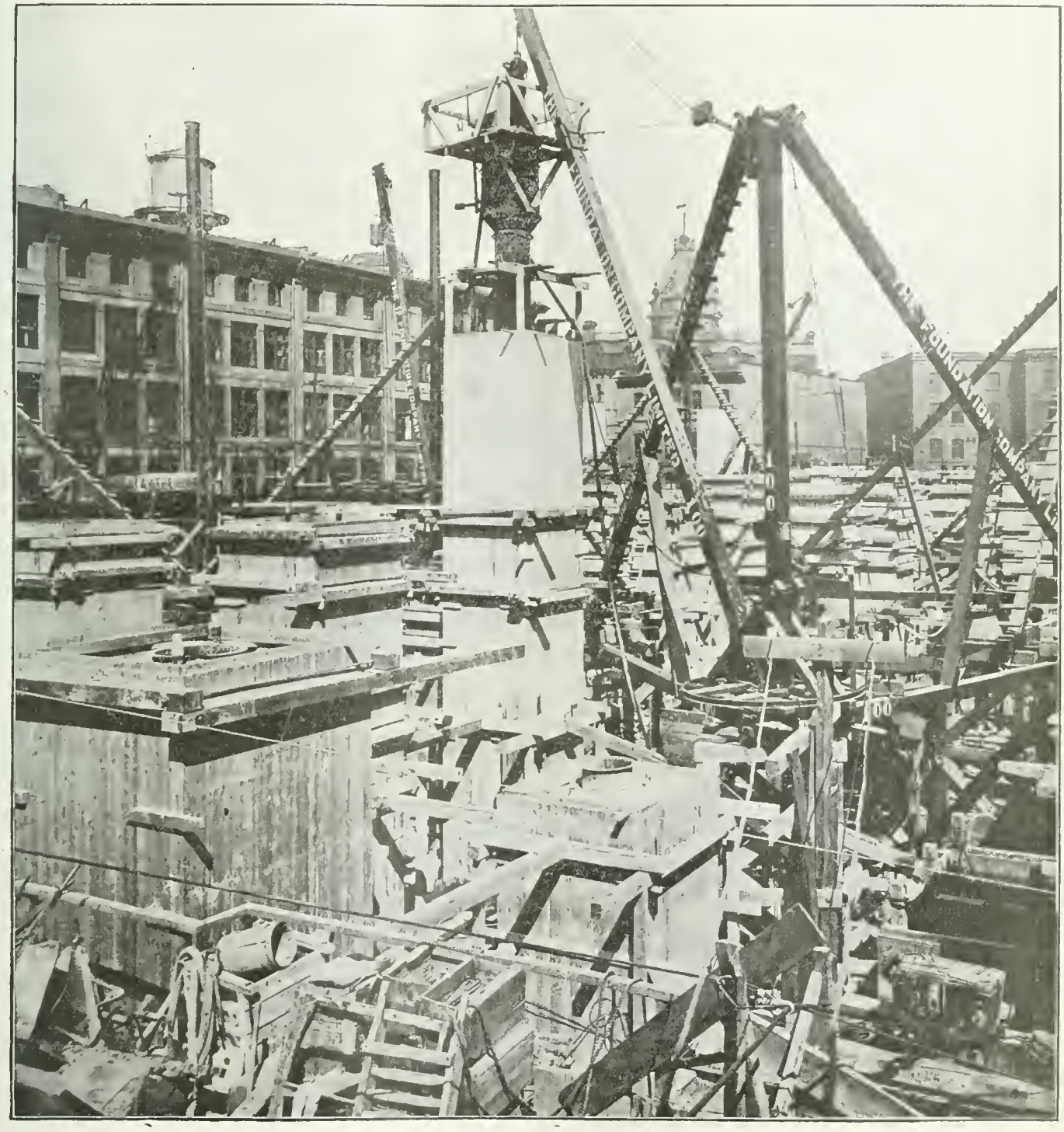
Vancouver, B.C.—Anvil Island Clay Company, $100,000. Ryan-Smith Trading and Contracting Company, $15,000.

Longueuil, Que.—La Compagnie Ouellette, Beaulieu, $45,000 (lumber). J. H. Ouellette, F. Beaulieu, J. R. Dion.

Edmonton, Alta.—Slave Lake Lumber Company, $100,000. Lush-Hartman Cartage Company, $25,000. Rex Motors of Canada, $100,000. Edmonton Ice Company, $10,000. Armstrong Riddell and Company, $200,000. Elrick Concrete Construction Company, $10,000.

THE FOUNDATION COMPANY

MONTREAL LIMITED VANCOUVER



COMPRESSED AIR

Has helped to engineer some of the world's most famous Tunnels, Bridges and Skyscrapers. Under modern methods and organization it has become a speciality. The above shows the foundations for a new building in Montreal with caissons in various stages.

MARKET CONDITIONS

Montreal, August 23rd, 1913

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horsesboe, $2.35; forged iron, $2 25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ¾ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in., $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1 in., $3.05.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus.—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4 30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Laths.—See Lumber, etc

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-loch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 10c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black and 62½ per cent. off for galvanized: ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22 50; 1½-inch, $27. On the following the discount is 72½ per cent for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57 50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. of for galvanized; 3½-inch, $95; 4-inch, $1.08.

Toronto, August 27th 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3¼-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.h., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15⅝ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¾ cents pound, 1 to 0-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ¼ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1⅝ cent.

Fuses.—Electric Blasting. Double strength, $1.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8 inch, $3.55; ¾ inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.10; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.10; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being sleader and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.25 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, August 26th, 1913.

Anvils.—Per pound, 11½ to 13½c.; Buckworth anvils, 80 lbs. and up, 10½ to 10½c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Cail, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5½c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4, 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ⅜-inch, $2.40; ½-inch, $2.55; ¾-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—⅜-inch, $4.35; ½-inch, $5.20; 1-inch, $7.35; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

Volume 25 Toronto, Sept. 4, 1913

Contents of this issue on page 405

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

SPIRAL OR SCREW CONVEYERS

SPECIALLY REQUIRED FOR CONVEYANCE OF CERTAIN MATERIALS —GENERAL DESCRIPTION—CAPACITY UNDER VARIED LOADING HORSE-POWER REQUIRED — NET OPERATING COST.

By REGINALD TRAUTSCHOLD, M.E.,
Consulting Engineer, New York City.

IN many industrial plants, whether power houses, cement mills, or of other types, certain operations frequently require the more or less continuous handling of materials that are often of such nature as not to permit efficient use of carriers of the flight conveyer type or of any type in which the load carried is exposed to possible disarrangement by air currents, etc. Then, too, the required capacity is frequently relatively small, making the installation of a system of large capacity of questionable economy, owing to the intermittent service that would be required from such apparatus. In such cases, a popular and sometimes very desirable equipment is the screw or spiral conveyer, a conveyer that possesses the advantages of relatively low first cost and of extreme compactness. This type of carrier consists of a suitable metal ribbon wound spirally about a shaft to form a screw which, enclosed in a box or trough, pushes the material handled forward as the screw is revolved. At intervals, gates or openings may be made in the bottom of the trough through which the material conveyed is discharged or else the material may be carried to the end of the trough, which is invariably left open, and there dumped out. The diameter of the trough may be only slightly larger than that of the screw, in which case practically all material fed to the conveyer is propelled forward as the screw revolves, or the trough may consist of a relatively large box surrounding the screw, which gradually fills with material until the screw forms its own trough and pushes forward the additional material fed to the conveyer. The first type of trough is usually found in installations for carrying fine coal, grain, small cement clinkers and other "fines," while the latter is almost always limited to installations for handling ashes, etc., which may be temporarily stored in the conveyer trough or box and subsequently removed through gates in the bottom of the storage box. Naturally only fine materials can be efficiently handled by such a conveyer, and while these materials need not be necessarily homogeneous in character they should contain no lumps more than a few inches in size, the maximum allowable size of lump depending somewhat upon the diameter of screw, i.e., size of conveyer. The screw conveyer is at its best when handling fine and light substances, materials that could not be carried by any other type of conveyer without a great deal of spill. This is particularly noticeable in cement mills where screw conveyers are often employed to handle fine cement clinker containing a great deal of air. In such installations the squeezing action of the helical ribbon of the conveyer also tends to compress the clinker and displace much of the air contained on its receipt from the kilns. The efficient length of screw conveyers is also limited for, though the flight is interrupted every few feet to accommodate supporting bearings for the screw shaft, the torsional strain on the screw shaft becomes unduly severe if the conveyer is more than about 100 feet in length, unless the material handled is very light and has a small angle of repose—such as grain.

The size of screw conveyers (diameter of screw) is usually limited to about 24 inches, though conveyers have been built and successfully operated that were upward of 3 feet in diameter, and, as the speed at which they can be efficiently operated is also limited to about 250 revolutions per minute, their carrying capacity must therefore be relatively small. Actually three conditions govern the capacity of screw conveyers; 1st, the diameter of the screw; 2nd, the pitch of the screw; and 3rd, the speed at which it is run, i.e., revolutions of the screw; but the question of mechanical efficiency of the apparatus—the mechanical efficiency being at a maximum with a screw pitch of 45 degrees—has led to the universal practice of making the pitch of the screw about the same as its diameter, so that only speed and size of conveyer need be considered for a standard equipment. The speeds usually employed are from 100 to 250 revolutions per minute, the higher speeds for conveyers of small size, irrespective of either character or weight of material conveyed. Table III. gives the average capacity of various standard sizes of screw conveyers when operated at their respectively most economic speeds, expressed in terms of bushels handled per hour. Table IV. gives similar data expressed in terms of tons of material weighing 100 pounds per cubic foot handled per hour. Material of other weight or carried at different conveyer speeds vary directly proportionally as the weight and speed. The carrying capacity of screw conveyers is further dependent upon the depth of material in the trough, or rather the proportion of the screw that would be submerged in the material should it be possible to push the material forward with no agitation, and this is limited to a depth equivalent to about one-third the diameter of the screw, so it is possible

to evolve a formula for the derivation of carrying capacity of any size of screw conveyer at any speed, expressed in terms of the square of the diameter of the screw, the pitch of the screw and the revolutions made by the screw in a given time. As the pitch and diameter of the screw are usually equal, the variable quantities are simply those of size of conveyer (diameter of screw) and speed of conveyer (revolutions of screw). Such relationship is expressed in Formulæ VI. and VII., the former giving the capacity in terms of bushels per hour and the latter in terms of tons per hour.

Table III.

Capacity of Screw Conveyers, Continuously and Uniformly Loaded.

Diameter of Screw	Speed R.P.M.	Bushels per hour	Diameter of Screw	Speed R.P.M.	Bushels per hour
4″	220	125	12″	150	2,250
5″	205	220	14″	140	3,400
6″	195	370	16″	130	4,700
7″	185	550	18″	120	6,000
8″	175	800	20″	115	8,000
9″	170	1,100	24″	100	12,000
10″	160	1,400			

Table IV.

Capacity of Screw Conveyers, Continuously and Uniformly Loaded.

Handling material weighing 100 lbs. per cu. ft.

Diameter of Screw	Speed R.P.M.	Tons per hour	Diameter of Screw	Speed R.P.M.	Tons per hour.
4″	220	4.5	12″	150	83.3
5″	205	8.3	14″	140	123.5
6″	195	13.5	16″	130	171.0
7″	185	20.4	18″	120	225.0
8″	175	28.8	20″	115	295.0
9″	170	40.0	24″	100	444.0
10″	160	51.4			

$B = 0.0088022\ d^3R$ Formula VI.

$W = 0.000003213\ d^3w'R$ Formula VII.

Where :—

B = Capacity in bushels per hour.
W = Capacity in tons per hour.
d = Diameter of screw in inches—size of Conveyer.
w′ = Weight of material conveyed in pounds per cubic foot.
R = Revolutions of screw per minute.

The consumption of power by screw conveyers is naturally relatively high on account of the low mechanical efficiency of the screw; that is, the power requirements are similar to those of an ordinary flight or scraper conveyer corrected for the inclined plane action of the screw construction to which must be added the loss of power or thrust due to the mechanical inefficiency of the screw. The power consumed in running the empty conveyer is not affected by the pitch of the screw, of course, being virtually that required to revolve the screw at the required speed, but the greater power requirements for propelling the load depend directly upon the pitch of the screw and must be corrected accordingly. Theoretically there is also a difference in power consumption by screw conveyers depending upon the nature of the material handled, its weight, angle of repose, etc. Practically, however, no great variations are found in power requirements of screw conveyers handling different materials as ordinarily installed and subjected to the abuse to which such apparatus is invariably submitted. Though formulæ have been derived which provide for varying power requirements by the substitution of various constants for conveyers destined to carry specific materials, the following formula (Formula VIII.) gives approximately accurate results for ascertaining the power requirements of practically any screw conveyer handling suitable material at advisable speeds. This formula allows for an inclination to the conveyer (elevating the material) which allowance is about equal to the amount that would be required to simply raise the specified weight through a vertical distance equal to the difference in elevation between the two ends of the conveyer. Actually, some additional power might be required, owing to appreciable increase in thrust on conveyer bearings, but the capacity of the conveyer is also somewhat reduced by any inclination so that the derived horse-power is practically accurate for the load actually conveyed. As much of the material that is frequently handled by screw conveyers is customarily measured in bushels rather than in tons, Formula IX. will be found to be of convenience when such unit is the base of measure. Chart II., giving the power requirements for screw conveyers in both terms of tonnage capacity and of capacity in bushels, will also be found to be of decided assistance. The accuracy of chart reading is not as great, of course, as is attainable when relying upon formulæ, but, for all practical purposes, such readings are sufficiently accurate.

Horse-power :

W = Weight of load conveyed in tons per hour = $0.00015065\ d^3R$ (aver.)
V = Velocity (speed) of Conveyer in feet per minute = $0.2618\ dR$
d = Diameter of Conveyer (screw) in inches.
L = Length of Conveyer in feet.
H = Height to which load is elevated in feet.
R = Revolutions of screw per minute.
W_s = Weight of moving parts per foot of Conveyer in pounds.
= $0.1\ d^2$—average value.
W′ = Weight of load conveyed per foot of Conveyer in pounds per minute.

$$= \frac{33\ W}{V}$$

f_s = speed factor = 0.09—from experiment.
f_l = load factor = 0.70—from experiment.
d′ = diameter of screw shaft in inches = 0.15d—average value.
V′ = Velocity of screw shaft in feet per minute = $0.03927\ dR$.

Work in foot pounds per minute required to run Conveyer empty.
= $W_s \times f_s \times V \times L = 0.00035303\ d^3RL = 2.343\ WL$—av. value.

Work in foot pounds per minute required to convey load.
= $W' \times f_l \times V \times L \times 0.3183 = 7.35\ WL$ (neglecting inefficiency).
= 20.1 WL (correcting for inefficiency of screw).

Horsepower required to elevate load (inclined conveyer).

$$= \frac{WH}{1000}$$

Then :—
Total horsepower required.

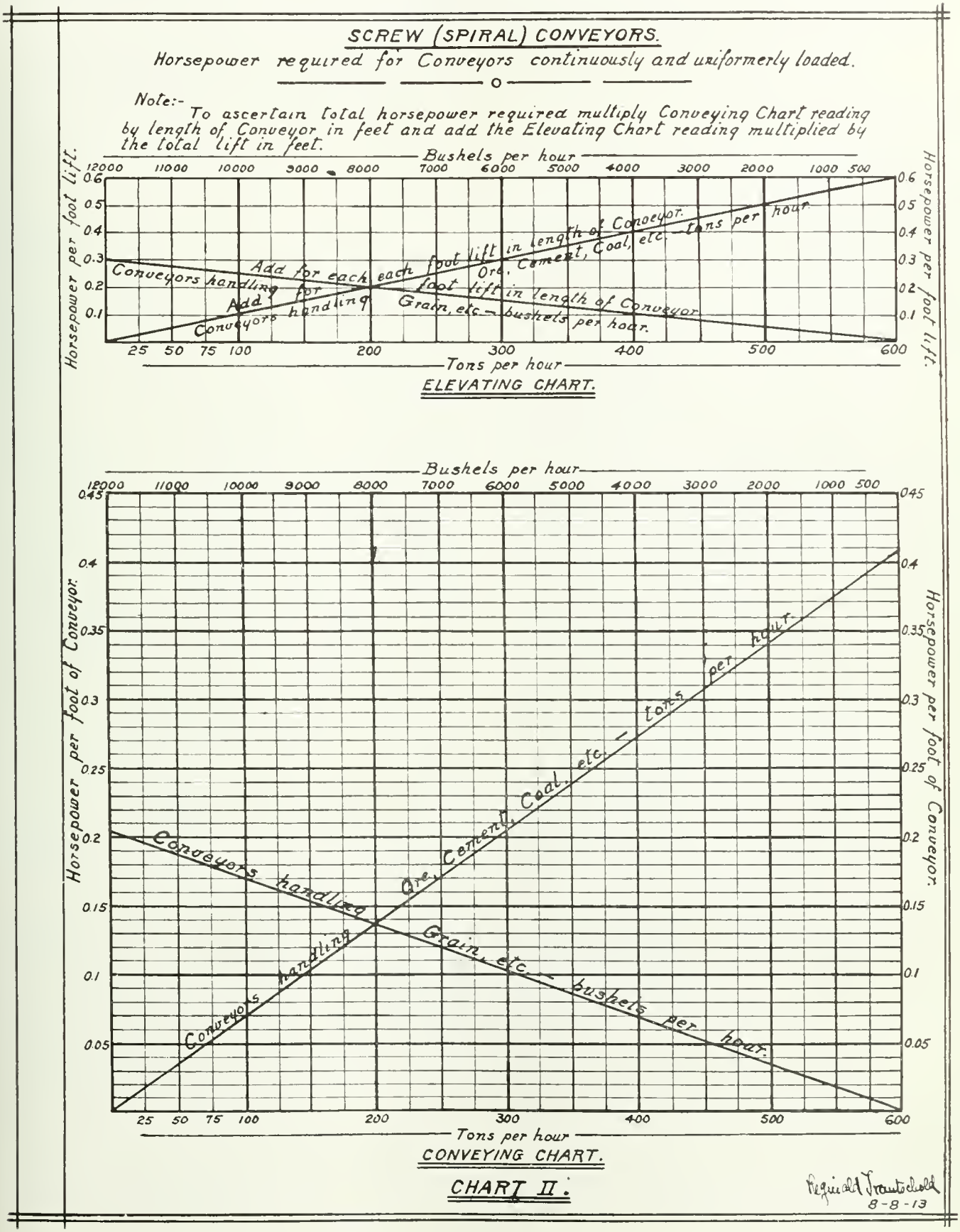
$$HP = \frac{0.68\ WL + WH}{1000}$$ Formula VIII.

$$HP = \frac{0.017\ BL + 0.025\ BH}{1000}$$ Formula IX.

B = Load conveyed in bushels per hour.

The standardization of screw conveyers in the matter of pitch and the large factor of safety that must be used in proportioning the various parts of the screw, etc., in order to permit economical manufacture, has created a close relationship between the weight of the screw, hangers, bearings, driving mechanism, etc., and the size of the conveyer and correspondingly a close relationship between the average cost of such parts and the diameter of the screw, size of conveyer. Likewise, the trough is usually a comparatively heavy casing slightly larger than the screw or a relatively large box with a correspondingly light lining, so that the cost of the stationary parts of a screw conveyer also vary closely with the size of the conveyer. For rough approximations, sufficiently accurate

for conservative estimates of the average burden of interest on investment, depreciation, renewals, insurance, taxes, etc., an equation can be derived for ascertaining the average cost of equipment in which the only variable quantities are those of length of conveyer and diameter of screw, the various items constituting a complete equipment varying directly with the diameter of the screw, except for the ends of the conveyer which vary closely with the square of the diameter of the screw. Such an equation is given as Formula X., and its use gives a fairly accurate estimate of the initial cost of any screw conveyer, including an average allowance for covering cost of erec-


SCREW (SPIRAL) CONVEYORS.
Horsepower required for Conveyors continuously and uniformerly loaded.
Note:- To ascertain total horsepower required multiply Conveying Chart reading by length of Conveyor in feet and add the Elevating Chart reading multiplied by the total lift in feet.
Bushels per hour
12000 11000 10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 500
Horsepower per foot lift.
0.6 0.5 0.4 0.3 0.2 0.1
Conveyors handling Grain, etc — bushels per hour. Add for each foot lift in length of Conveyor.
Add for each foot lift in length of Conveyor. Ore, Cement, Coal, etc — tons per hour. Conveyors handling
25 50 75 100 200 300 400 500 600
Tons per hour
ELEVATING CHART.
Bushels per hour
12000 11000 10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 500
Horsepower per foot of Conveyor.
0.45 0.4 0.35 0.3 0.25 0.2 0.15 0.1 0.05
Conveyors handling Grain, etc — bushels per hour.
Conveyors handling Ore, Cement, Coal, etc — tons per hour.
25 50 75 100 200 300 400 500 600
Tons per hour
CONVEYING CHART.
CHART II.
Reginald Trautschold
8-8-13

tion and of the ordinary supporting structures required—items which should be rightfully charged against initial cost of equipment.

Cost of Equipment:

C = Cost of Screw Conveyer equipment in dollars.
d = diameter of Conveyer (screw) in inches.
L = Length of Conveyer in feet.

Average cost of screw per foot of Conveyer	0.1653 d
hangers, etc., per foot of Conveyer...	0.0107 d
trough and gates per foot of Conveyer	0.0200 d
driving machinery per Conveyer.....	2.3233 d
ends, etc., per Conveyer	0.0700 d^2

Then:—

$C = 0.196\ dL + 2.3233\ d + 0.07\ d^2$ Formula X.

This low cost of machinery is naturally a decided advantage and though the power requirements of screw conveyers are heavy as compared with some other types of conveyers, their compactness and general efficiency in handling comparatively small quantities of material, at a decided saving over the expense that would be entailed if manual labor had to be resorted to, make them very desirable in many installations, besides which their peculiar construction possesses certain advantages that are very desirable for special uses. To form a really reliable opinion as to their true economic value, however, the overhead charges must be taken into consideration. The burden of interest on investment, insurance, taxes, etc., is about constant for any specific size of conveyer, irrespective of the nature or character of the load handled, and, knowing the average cost of equipment, can be proportioned to the carrying capacity of the conveyer—whether the carrying capacity be expressed in bushels or in tons. Depreciation is dependent upon the severity of the service to which the conveyer is subjected, however, being greater in conveyers that handle cement, ore, coals and gritty materials than in the case of grain conveyers. Even in the case of the more trying conditions, depreciation would not be constant if exactly similar conveyers were used for handling the various materials, but this variation is controlled in great measure by the choice of the correct conveyer, i.e., material and strength of component parts. For instance, the screws of conveyers for handling cement, coal, small stone of ordinary hardness, many kinds of ore, etc., are usually of heavy steel construction while the screws of conveyers for handling ashes, more gritty ores, etc., are frequently of cast iron. The difference in material does not have much effect upon the initial cost of equipment—hence, practically none on the percentage or proportional part that represents depreciation—but does equalize the depreciation from abrasive wear. Grain conveyers are usually of lighter steel construction, but this does not materially reduce their cost, though their life is usually considerably in excess of that of conveyers subjected to the more severe conditions of wear. It is advisable, therefore, to differentiate between grain conveyers and those used in the more difficult operations of handling ores, cement, ashes, etc., in considering the net cost of operation. Attendance is about constant for any specific size of conveyer of given length, irrespective of the material handled, while renewals and repairs, like depreciation, are somewhat variable, depending upon the character of the load handled. Power consumption depends nearly entirely, in a well-designed and proportioned conveyer that is properly operated and cared for, upon the quantity of material handled. The expense for lubricants, waste and other incidental supplies also varies approximately with the consumption of power or quantity of material handled. The foregoing relationships being pretty accurately known, it is possible to derive equations for ascertaining the average net cost of operation of screw conveyers upon which a reliable opinion of their economic value can be based. Such equations are given as Formulæ XI. and XII., the former applying to grain conveyers and giving the net operating cost per bushel handled and the latter applicable to screw conveyers handling ores, coal, ashes, cement, etc., etc., giving the average net operating cost per ton of material conveyed.

Net Operating Cost (N.O.C.) of Screw Conveyers:

L = Length of Conveyer in feet, max. distance load is carried.
H = Height (distance) through which load can be elevated in feet.
N = Number of hours (total) Conveyer is in use per year.
P_c = Price (cost) of a horsepower per hour in dollars.

GRAIN CONVEYERS.

B = Bushels conveyed per hour (capacity of Conveyer).

Average cost of equipment:—
$= 0.01703\ BL + 0.02458\ B.$

Fixed Charges:—

Interest.. 6% total cost Insurance 1% Taxes .. 2%—¾ cost	}	$= 0.0014426\ BL + 0.0020893\ B$

Depreciation renewals, etc.:—

On screw	0.001915 BL	
trough, gates, etc.	0.000174 BL	
hangers, etc.....	0.000062 BL	
balance of equipment		+ 0.000819 B
Depreciation account	0.000215 BL	+ 0.000082 B
Total Depreciation, etc. =	0.002366 BL	+ 0.000901 B

Yearly Burden:— $= 0.00381\ BL + 0.00299\ B.$

Horsepower, attendance, supplies, etc.:—

	Horizontal Conveyers (total)	Inclined Conveyers (extra)
Cost of power	0.000017 BLP_c N	0.000025 BHP_c N
Cost of attendance....	0.000002 BLN	negligable
Cost of supplies, etc...	0.000010 BLN	negligable

Burden depending upon use of Conveyer:—
$= (0.000017\ BLP_c + 0.000025\ BHP_c + 0.000012\ BL)N.$

Then:—

NET OPERATING COST (GRAIN CONVEYERS) PER BUSHEL.

$$N.O.C. = \frac{381\ L + 299 + (1.7\ LP_c + 2.5\ HP_c + 1.2\ L)N.}{100{,}000\ N}$$ Formula XI.

CEMENT, ORE, ETC., CONVEYERS.

W = Weight of load conveyed in tons per hour (capacity).

Average cost of equipment:—
$= 0.0005255\ WL + 0.0006161\ W$

Fixed Charges:—

Interest.. 6% total cost Insurance 1% Taxes .. 2%—¾ cost	}	$= 0.00003617\ WL + 0.00006237\ W$

Depreciations, renewals, etc.:—

On screw	0.0001436 WL	
trough, gates, etc. ..	0.0000131 WL	
hangers, etc.	0.0000047 WL	
balance of equipment.		0.0000616 W
Depreciation account ...	0.0000161 WL	+ 0.0000062 W
Total depreciation, etc. =	0.0001775 WL	+ 0.0000678 W

Horsepower, attendance, supplies, etc.:—

	Horizontal Conveyers (total)	Inclined Conveyers (extra)
Cost of power	0.00068 WLP_c N	0.00101 WHP_c N
Cost of attendance	0.00010 WLN	negligable
Cost of supplies, etc...	0.00040 WLN	negligable

Yearly Burden:— $= 0.00021367\ WL + 0.00012017\ W$

Burden depending upon use of Conveyer:—
$= (0.00068\ WLP_c + 0.00101\ WHP_c + 0.0005\ WL)N$

Then:—NET OPERATING COST (N.O.C.) PER TON.

$$N.O.C. = \frac{21.367\ L + 12.017 + (68\ LP_c + 101\ HP_c + 50\ L)N}{100{,}000\ N}$$ Formula XII.

Examples.

1. Conditions:—

Length of Conveyer..	30′ 0″	= L
Material elevated	8′ 0″	= H
Service.....	2400 hours per year	= N
Cost of power... .	$0.02 per horsepower per hour	= P_c

Material handled—Grain

$$\text{N.O.C.} = \frac{11430 + 299 + 89808}{240000000} = \$0.000423 \text{ per bushel.}$$
$$= 42.3 \text{ cents per thousand bushels.}$$
Equivalent to about $0.01692 per ton.

II. Conditions:—
The same as Example I, except that service is 12000 hours per year.

$$\text{N.O.C.} = \frac{11430 + 299 + 44904}{120000000} = \$0.000472 \text{ per bushel.}$$
$$= 47.2 \text{ cents per thousand bushels.}$$
Equivalent to about $0.01888 per ton.

III. Conditions:—
The same as Example I, except that the material handled is fine (small size) coal.

$$\text{N.O.C.} = \frac{641 + 12.017 + 3736704}{240000000} = \$0.01557 + \text{per ton}$$

IV. Conditions:—
The same as Example III, except that service is 1200 hours per year.

$$\text{N.O.C.} = \frac{641 + 12.017 + 1868352}{120000000} = 0.01558\text{—per ton}$$

Assuming conditions that are commonly encountered in practice, the accompanying examples well illustrate the real economic value of the screw conveyer and they also bring out apparently surprising facts. Under the conditions considered, it will be noted that the screw conveyer is not relatively as economical a method of handling grain as it is for handling heavier materials such as coal, ore or cement—that is, when measured by weight of material conveyed. This is true even though the depreciation, renewals, repairs and similar expenses are only about one-third as great in a grain conveyer as in a conveyer subjected to the more severe operations of handling the heavier materials. The reason for this is that proportionally to the weights of the materials the capacity of a screw conveyer is very much less when handling the relative light grain and, as less power is also required for the operation of any given size of conveyer of specified length carrying grain, the burden represented by interest on investment, insurance and taxes, which amounts to a more or less constant sum per year, irrespective of the nature of the material handled or the number of hours the equipment is in operation, is, in the case of the relatively light grain, considerably greater per weight of material handled. The average weight of grain, etc., is from 25 to 50 per cent. lighter than the weight of a similar quantity of ore, cement, etc., and though the economic value of a screw conveyer as a carrier for the two classes of materials does not vary to quite such an extent, still, an appreciable difference does exist. Another interesting point brought out by the examples is that the economic value of the equipment is not affected as much by the hours of operation when handling the heavier materials as when carrying the lighter grains. This is also due to the fact that for the more severe work the item of power is very much greater proportionally than when the working conditions of the conveyer present less difficulty. Nevertheless, screw conveyers are frequently employed in the handling of grain and of materials of similar nature and are decidedly economical at such service; particularly when they are long, as then the overhead burden is somewhat lessened.

A modification of the standard type of screw conveyer that has been considered is extensively used in the mixing of several materials while they are, at the same time, being conveyed from one location to another. For instance, in the mixing and delivery of concrete. Such conveyers usually have the spiral flight in the form of succeeding paddles in place of a continuous ribbon, or else have double flights, one a ribbon flight for conveying and the other a system of paddles for agitating and mixing the ingredients. These adaptations, however, although they are examples of apparatus for mechanically handling materials, should not be classed with standard types of conveying machinery, the principal subject of the present discussion.

[Note.—This is the second of a series of articles bearing upon the Mechanical Handling of Materials written for *The Canadian Engineer*. A third article will follow in an early issue.—Ed.]

WATERPROOFING OF CONCRETE.

Although it did not arrive at sufficiently definite conclusions to enable it to formulate specifications for the making of concrete structures waterproof, or for materials to be used in such work, the Committee on Waterproofing Materials, of the American Society of Testing Materials, reached certain conclusions which will be of assistance in securing impermeable concrete. These formed the basis of the committee's report at the convention in Atlantic City in June.

The work was found to subdivide naturally into three branches:

1. The determination of causes of the permeability of concrete, and the best methods of avoiding these causes.

2. The rendering of concrete more waterproof by adding other substances.

3. The treatment of exposed surfaces after the concrete or mortar has been put in place, either by penetrative, void-filling or repellent liquids, making the concrete itself less permeable; or by extraneous protective coatings, preventing water having access to the concrete.

These several subdivisions were considered separately:

Causes of Permeability of Concrete.—In the laboratory and under test conditions using properly graded and sized coarse and fine aggregates, in mixtures ranging from 1 cement, 2 sand and 4 stone to 1 cement, 3 sand and 6 stone, impermeable concrete can invariably be produced. Even with sand of poor granulometric composition, with mixtures as rich as 1 cement, 2 sand and 4 stone, permeable concrete is seldom, if ever, found and is a rare occurrence with mixtures of 1 cement, 3 sand and 6 stone. But the fact remains, nevertheless, that the reverse often obtains in actual construction, permeable concretes being encountered even with 1 cement, 2 sand and 4 stone mixtures, and are of frequent occurrence where the quantity of the aggregate is increased. This the committee attributed to:

(a) Defective workmanship, resulting from improper proportioning, lack of thorough mixing, separation of the coarse aggregate from the fine aggregate and cement in transporting and placing the mixed concrete, lack of density through insufficient tamping or spading, and improper bonding of the work joints, etc.

(b) The use of imperfectly sized and graded aggregates.

(c) The use of excessive water, causing shrinkage cracks and formation of laitance seams.

(d) The lack of proper provision to take care of expansion and contraction, causing subsequent cracking.

Properly graded sands and coarse aggregates are rarely, if ever, found in nature in sufficient quantities to be available for large construction, and the effect of poorly graded aggregates in producing permeable con-

crete is aggravated by poor and inefficient field work. Even if the added expense could be afforded of screening and remixing the aggregates so as to secure proper granulometric composition to give the density required to make untreated concretes impermeable, it is seemingly often a commercial impossibility on large construction to obtain workmanship even approximating that found in laboratory work.

Addition of Foreign Substances.—The committee found that, in consequence of the conditions outlined above, substances calculated to make the concrete more impermeable, either incorporated in the cement or added to the concrete during mixing, are often used.

The committee had investigated a sufficient number of the special waterproofing compounds on the market, as well as the use of certain very finely divided mineral products, such as finely ground sand, colloidal clays, hydrated lime, etc., to form a general idea of the value of the different types. It reported that:

(a) The majority of patented and proprietory integral compounds tested have little or no immediate or permanent effect on the permeability of concrete and that some of these even have an injurious effect on the strength of mortar and concrete in which they are incorporated.

(b) The permanent effect of such integral waterproofing additions, if dependent on the action of organic compounds, is very doubtful.

(c) In view of their possible effect, not only upon the early strength, but also upon the durability of concrete after considerable periods, no integral waterproofing material should be used unless it has been subjected to long-time practical tests under proper observation to demonstrate its value, and unless its ingredients and the proportion in which they are present are known.

(d) In general more desirable results are obtainable from inert compounds acting mechanically than from active chemical compounds whose efficiency depends on change of form through chemical action after addition to the concrete.

(e) Void-filling substances are more to be relied upon than those whose value depends on repellent action.

(f) Assuming average quality as to size of aggregates and reasonably good workmanship in the mixing and placing of the concretes, the addition of from 10 to 20 per cent. of very finely divided void-filling mineral substances may be expected to result in the production of concrete which under ordinary conditions of exposure will be found impermeable, provided the work joints are properly bonded, and cracks do not develop on drying, or through change in volume due to atmospheric changes, or by settlement.

External Treatment.—While external treatment of concrete would be necessary if the concrete itself, either naturally or by the addition of waterproofing material, was impermeable, it was found in practice that in large construction, no matter how carefully the concrete itself has been made, cracks are apt to develop, due to shrinking in drying out, expansion and contraction under change of temperature and moisture content, and through settlement.

It is, therefore, often advisable on important construction to anticipate and provide for the possible occurrence of such cracks by external treatment with protective coatings. Such coating must be sufficiently elastic and cohesive to prevent the cracks extending through the coating itself. The application of merely penetrative void-filling liquid washes will not prevent the passage of water due to cracking of the concrete. The committee therefore, divided surface treatment into two heads:

(a) Penetrative void-filling liquid washes.

(b) Protective coatings, including all surface applications intended to prevent water from coming in contact with the concrete.

While some penetrative washes may be efficient in rendering concrete waterproof for limited periods, their efficiency may decrease with time, and it may be necessary to repeat such treatment. The committee, expressed its belief that the first effort should be made to secure a concrete that is impermeable in itself and that penetrative, void-filling washes should only be resorted to as a corrective measure.

While protective extraneous bituminous or asphaltic coatings are unnecessary, so far as the major portion of the concrete surface is concerned, provided the concrete is impermeable, they are valuable as a protection where cracks develop in a structure. It therefore recommended that combination of inert void-filling substances and extraneous waterproofing be adopted in especially difficult or important work.

Bituminous or Asphaltic Coatings.—Considering the use of bituminous or asphaltic coatings, the committee found that:

(a) Such protective coatings are often subject to more or less deterioration with time, and may be attacked by injurious vapors, or deleterious substances in solution in the water, coming in contact with them.

(b) The most effective method for applying such protection is either the setting of a course of impervious brick dipped in bituminous material into a solid bed of bituminous material or the application of a sufficient number of layers of satisfactory membranous material cemented together with hot bitumen.

(c) Their durability and efficiency are very largely dependent on the care with which they are applied.

Such care refers particularly to proper cleaning and preparation of the concrete to insure as dry a surface as possible before application of the protective covering, the lapping of all joints of the membranous layers, and their thorough coating with the protective material. The use of this method of protection is further desirable because proper bituminous coverings offer resistance to stray electrical currents.

Richer Mixtures.—So far the committee had considered only concretes of the usual proportions, namely, those ranging from 1 cement, 2 sand and 4 stone, to 1 cement, 3 sand and 6 stone. It was suggested that impermeable concretes could be assured by using mixtures considerably richer in cement. While such practice would probably result in an immediate impermeable concrete, the advantage is believed to be only temporary, as richer concretes are more subject to check cracking and are less constant in volume under changes of conditions of temperature, moisture, etc. Therefore, the use of more cement in mass concrete would cause increased cracking, unless some means of controlling the expansion and contraction be discovered. With reinforced concretes the objection is not so great, as the tendency to cracking is more or less counteracted by the reinforcement.

It was also suggested that the presence in the cement of a larger percentage of very fine flour might result in the production of a denser and more impermeable con-

crete, through the formation of a larger amount of colloidal cells.

Neither of these suggestion was especially investigated by the committee. Both appealed, however, for the reason that they substitute active cementitious substances for the largely inactive void-filling materials previously recommended, thus increasing the strength of the concrete.

In conclusion, the committee pointed out that no addition of waterproofing compounds or substances could be relied upon to counteract completely the effect of bad workmanship, and that the production of impermeable concrete could only be hoped for where there is determined insistence at all times on good workmanship.

The production of impermeable concrete has assumed greater importance since the appointment of the committee, owing to the well-known injurious action of saline or alkaline waters, and to the suggested possible effect of the moisture in concrete occasioning or aggravating electrical action from stray currents.

Originally the question of waterproofing involved mainly the physical troubles resulting from water passing through the concrete, without any special consideration of its effect on its durability, other than a gradual leaching out of the cement. Recent developments suggest the possibility that owing to the increased conductivity of damp concrete to electrical currents, such currents, if present, may so effect damp concrete as to lessen its integrity seriously, and this possibility further emphasizes the importance of the recommendation that no waterproofing compound of unknown chemical composition be added to concrete, as recent tests seem to show that the action of electrical currents is aggravated by the presence of certain solutions.

THE CANADIAN PUBLIC HEALTH CONGRESS.

The third annual Congress of the Canadian Public Health Association will be held in Regina, September 18th, 19th and 20th. The city hall has been placed at the disposal of the members for the general sessions, while sectional meetings will be held in Regina College, the Board of Governors having granted the use of its buildings for this purpose.

The social functions of the Congress will include a luncheon at the Parliament Buildings on September 18th, tendered by the Government of Saskatchewan, the annual dinner of the Association to take place that evening, when the members will be the guests of the city of Regina; a visit to the city sewage disposal works on the following day, and on the last day of the Convention a trip to Fort Qu'Appelle, one of Saskatchewan's summer resorts, where the new sanitorium buildings are under construction.

The programme for the general session includes seventeen papers. Section I., for Medical Officers of Health; Section II., Medical Inspection of Schools; Section III., Military Hygiene; Section IV., Veterinary Hygiene and Food Inspection; Section V., Sanitary Inspectors; Section VI., Engineers and Architects; Section VII., Laboratory Workers; Section VIII., Social Workers. All have individual lists of papers bearing directly upon the science of public health.

Arrangements have been made with the Eastern and Western Passengers' Association whereby a standard certificate can be obtained at any railway station entitling the holder to reduced return fair, the advice of the committee being to purchase a one-way ticket to Regina, securing at the same time the standard certificate.

THE DETERMINATION OF THE MAGNETIC MERIDIAN.

By J. A. MacDonald.

THERE had not been much done in the way of determination of the magnetic meridian at various points throughout Canada until a short time ago, when the Topographical Surveys Department of which Dr. Deville is at the head, took up this work in connection with Dominion land surveys in the Western provinces. Nothing of much account has yet been done in the older provinces by the Canadian Government, although the United States geogetic surveys branch has done considerable work in various parts of the Dominion in the way of determining magnetic declinations. The writer, a few years ago, determined the magnetic declination, at a point in one of the Maritime Provinces where no observation for magnetic declination had ever been made for the United States Geogetic Surveys. Data has, of course, been furnished by the Marine Department at the various harbors in Canada, for the information of navigators, but this data is of no value to those using compasses on land.

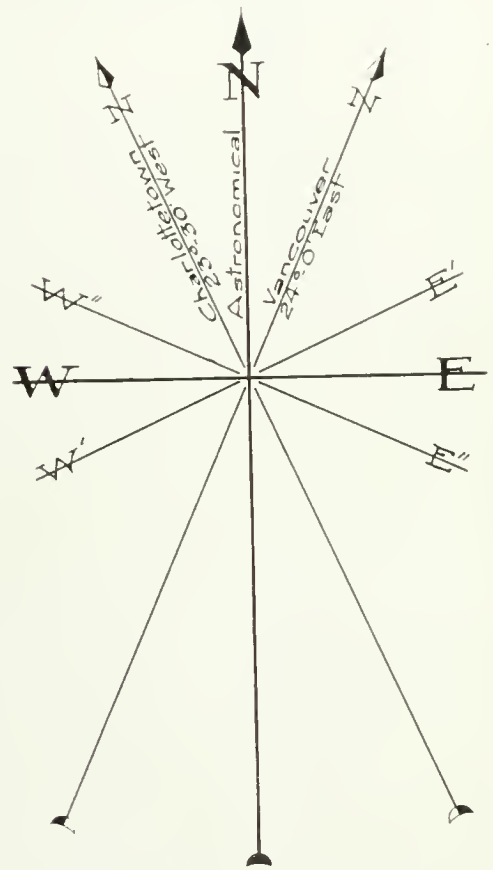


Fig. 1.—Magnetic Declinations.

The Magnetic Needle Still Used for Establishing Lines.—Although the compass is not allowed for establishing lines of Dominion land surveys, it is employed by most of the older provinces, and a knowledge of the direction of the magnetic meridian or of the magnetic declination is of absolute importance. The directions given for obtaining magnetic declinations in the Manual for Dominion Land Surveyors is very explicit.

For the determination of this direction, transit theodolites of the D.L.S. pattern are fitted with especially

sensitive needles. As the observation can be made in a few minutes and with very little trouble, it is desirable that all surveyors should observe when they can do so without inconvenience.

The observation and recording forms are arranged for the determination of the bearing of the magnetic needle instead of the magnetic declination. The arrangement is made for the sake of simplicity in observing and recording, the bearing in question being, subject to instrumental corrections, the angle read on the horizontal circle of the transit. Moreover, it is not liable to errors of sign, as in adding or subtracting the declination.

Directions for Observing.—Place the instrument on a section or other line, defined astronomically, and after adjustment, set the vernier to read the astronomical bearing of the line.

Release the lower clamp, direct the telescope on the line, and fasten the lower clamp.

Release the vernier clamp, and turn the vernier plate until the north end of the magnetic needle observed with a magnifying glass, is seen exactly opposite the zero mark. Tap the trough lightly with the pencil to be sure that the needle has taken the position of rest. Note the reading of the horizontal circle. Take several readings by repeating the operation.

Repeat the third operation for the south end of the needle.

Enter in the notes the place of observation, date, hour of the day, weather and other remarks, if any. It is important to record auroras occurring within 24 hours of the time of observation.

Remarks on Observations.—For saving trouble and calculations, it is suggested that observations be made on any lines of which the bearing is known.

The direction of the magnetic needle is subject to a daily fluctuation called the diurnal variation. During the greater part of the night the direction is not far from normal. In the early morning, the north end of the needle in Canada moves towards the east, reaching its maximum deflection about 7 or 8 a.m. The motion is now reversed, the north end travelling westwards, and crossing the normal direction about 10 or 11 a.m. The extreme western position is reached in the afternoon and then the needle comes back to its normal position at some time after 5 or 6 p.m. This march is subject to wide variations during magnetic storms. The magnitude of the diurnal variation is not constant. In the inhabited parts of Canada, it may exceed 20 minutes. Observations at both eastern and western elongations of the needle on the same day, that is, between 7 and 8 a.m. and between 1 and 2 p.m., give the best results, and it is desirable that when convenient they may be taken then. This gives not only the best value for the declination, but also the diurnal variation which it is most useful to know. Failing this, however, the best time to observe is after 5 p.m., when the needle is about in its normal position. It is true that the normal position is crossed generally between 10 and 11 a.m., but the motion being very rapid and the time of crossing uncertain, the afternoon observation is preferable.

When an instrument is brought from England, where many of the transits and compasses are made, it is usually found that the north end of the needle is dropping. To balance it without injuring the pivot point or cap, proceed as follows:—

Raise the needle with the lifter, unscrew the end of the trough, withdraw the cover glass, take out the needle and shift the small brass counterweight. Then the lifter being still raised, place the needle upon it and lower the lifter gently. If the needle is not yet balanced, raise the lifter again and repeat the operation. The greatest care must be taken not to bend the needle in the slightest degree while shifting the counterweight, because the bending would change the direction of the magnetic axis.

If the needle is sluggish, the observation cannot be accurate. The sluggishness is generally due to a dull pivot or a scratched cap. To keep both in proper condition, the needle must always be lowered gently on its pivot and never be allowed to play, except when actually in use.

OBSERVATION FOR MAGNETIC DECLINATION

Date 19th July 1908 Observer G.J. Lonergan D.L.S.

Place 40 Chs. E of the S.E. Cor. of Sec. 5

Tp. 50 Rge. 20 W. of 4th Mer.

Time 7.15 P.M. Instrument Watts #2216 (Give No.)

Bearing of reference line 89° - 59'

H. C. R. FOR DIRECTION OF MAGNETIC NEEDLE.

	NORTH END.	SOUTH END.
(1)	27 - 15'	27 - 17
(2)	11	16
(3)	12	10
(4)	11	10
(5)	10	12
Mean of North End.	27 - 11.8	Mean of South End. 27° - 13.0'

(a) H. C. R. of compass north	27 - 12.4'
(b) Corr. for convergence	- 1.2
(c) Bearing of compass north	27 - 11.2
(d) Index error	5.8
(e) Bearing of magnetic north	27 - 05.4

REMARKS.

A few clouds Windy

No aurora.

Fig. 2.

Explanation of Specimen Observation.

1. The H.C.R. of compass north is the average of the mean north and south end readings. The transit was adjusted to read correctly the bearing of the section line, so that the horizontal circle reading of compass north is the bearing of compass north referred to the astronomical meridian through the centre of the township. If the transit had not been so adjusted a correction to this reading would have been required.

2. The correction for convergence has for object to refer the bearing read on the horizontal circle to the astronomical meridian of the point of observation. The value of the correction is taken from the diagram in the

Astronomical Field Tables. It is added when the point of observation is in the east half of the township, and subtracted in the other half. The rule of clause 69 of the Manual is inverted, the object in this case being to refer the bearing to the meridian of the point of observation.

3. The bearing of compass north has now been referred to the meridian of the point of observation.

4. The index error is furnished with each instrument after comparison with the unifilar magnetometer.

5. The bearing of magnetic north is the angle formed by the astronomical and magnetic meridians.

There are instances of the polarity of the needle being reversed by transporting an instrument on an electric car. It is difficult to conceive that a needle may be brought into such an intense magnetic field as that of an electric car without its magnetism being effected in some way, therefore, it is preferable to avoid this mode of transportation.

The place of observation must be at least three or four hundred yards away from electric wires carrying direct current. The observer must scrutinize his clothing and make sure that he has no iron or nickel on his person, as there must be no iron near the instrument. Iron is found in buttons, as wire in hat brims, in some forms of neckties, in watches, chains and other articles of jewelry. The pivot in folding reading glasses is frequently made of iron. In case of doubt, the object may be tried close to the compass, measuring the distance at which an appreciable deflection is first produced. If the object during the observation for declination is not brought closer than 15 or twenty times the above distance, the effect on the needle is negligible in observations of this kind.

The needle may be deflected by static electricity developed in cleaning the glass cover of the compass trough or the rubber frame of the reading glass; this electricity is dissipated by breathing on the glass or rubber frame.

There is an index correction for each instrument. This is ascertained by comparison with a standard unafilar magnetometer at the Magnetic Observatory. When possible, it is well to determine the index error both at the beginning and at the end of a survey.

Setting a Transit by Means of the Compass.—In connection with surveys of Dominion lands, the most frequent use of the compass is for checking the courses of a traverse or for setting up the transit to read astronomical bearings.

In the first case, it is sufficient to make sure that there is no abnormal change in the reading of compass north: any sudden change indicates a probable mistake in some of the last courses.

The second case arises when it is desired to observe the pole star in day time at a place where there is no line of known bearing. The problem consists in setting up the transit so that it shall read astronomical bearings. If the surveyor has already ascertained the bearing of compass north with his instrument, he merely sets his vernier to read this bearing, releases the lower clamp, turns the whole instrument till the needle is exactly opposite the zero mark, fastens the lower clamp and releases the vernier clamp. With the instrument used for the specimen observation and anywhere near the place where the observation was taken, the vernier would be set to read 25°, or rather 25° 07′.

It may be, however, that the surveyor has not ascertained the bearing of the compass north with his own instrument and has to resort to the bearing of magnetic north taken from a map or determined by another surveyor. Then the surveyor must, from the bearing of magnetic north, deduce the bearing of compass north by applying the index error of his own instrument after changing the sign. Starting with 25° 01′.1, for bearing of magnetic north in the case already cited, and the index error being—51′.8, the surveyor would add 5′.8 to 25° 01′.1, which would give him 25° 06′.9 for the bearing of the compass north. He would then proceed as already explained.

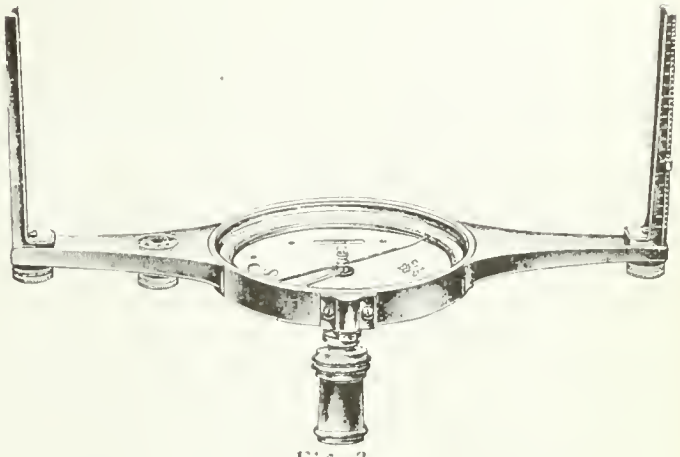


Fig. 3.

All these corrections, it may be observed, are generally small and in practice are frequently disregarded.

Line of no Declination.—The line of no declination, or the line which a needle will indicate a true north and south direction is situated in any imaginary line drawn from Sault Ste. Marie to Charleston, South Carolina. A magnetic needle placed east of this line has a declination to the west, and when placed west of the line a declination to the east; and in both cases it increases as the needle is carried farther from the line of no declination.

Thus, in Vancouver, the declination is twenty-four degrees to the east, at Winnipeg eleven to twelve, to nothing at the Soo; while east of the Soo the declination is west, increasing from nothing, to 23½ degrees, at Charlottetown, Prince Edward Island. The declination is now said to be decreasing.

It is to be noted in determining lines of declination that the needle does not remain constant through an entire day, but reaches its farthest point east about 8 o'clock a.m., and its farthest point west about 2 o'clock p.m. The cause of this daily variation of the needle is not understood, as observations show that it is greater in summer than in winter.

Conditions of temperature, magnetic storms and other causes at times affect the needle and different needles observed at the same time and under the same conditions differ in their directions, but show nearly the same daily change.

Gaspe Bay district has high hopes of oil-producing possibilities. In view of the increasing attention being given to the adoption of oil in the Royal Navy and the decision of the Imperial Government to secure supplies so far as possible within the Empire, there opens up the prospect of another large Canadian industry. The admirable shipping facilities which the district possesses are receiving attention.

ROAD MAINTENANCE AND COST.

By Hector F. Gullan, M. Inst. C.E.,
Superintendent to the Works Department of the City and County Borough of Belfast.

SCIENTIFIC road maintenance is not only the mere continuance of an existing form of road surface by the most approved methods, but should mean the providing of a road surface which is best suited for the traffic it is called upon to bear having regard to (*a*) cost of maintenance and cleansing, (*b*) economy in regard to wear and tear on the traffic using same, (*c*) noiselessness, and (*d*) hygienic qualities.

At the present time the road surfaces most generally in use may be classified as follows: (1) Macadam water consolidated; (2) macadam tar-bound or pitch-grouted; (3) sett paving on existing foundations; (4) sett paving on concrete foundations; (5) natural asphalts on concrete foundations; (6) wood blocks (hard) on concrete foundations; (7) wood blocks (soft) on concrete foundations.

To secure efficient road maintenance the quality of the various materials used and workmanship employed must be carefully determined, and, along with a systematic inspection, records should be kept of the intensity of the traffic, wear and tear and costs, in order to ensure good work and ascertain the relative merits of various methods adopted.

In dealing with the maintenance of a road the first essential is that the road, including the foundation, shall be sufficiently substantial to support the traffic passing over it, and where such is not the case, either in patches or over considerable lengths, it will be found to tend to ultimate economy to go to considerable expense, either in strengthening the roadway generally or renewing the foundations.

Water-consolidated macadam roads, which, at the present time, form by far the greater percentage of the road surfaces of the country, have, on account of the growth of motor traffic of all kinds, proved themselves to be, in spite of the greatest care being exercised in the selection of the material and skilful workmanship, in many cases altogether unsuitable. In several cases the cost of maintenance has increased during the last eight years as much as 100 per cent., and along with this increase the nuisance arising from dust has become almost intolerable.

In selecting the stone for repair work the greatest care must be taken to obtain a thoroughly hard and tough material, and it has been the practice of the author for some years to test mechanically the stone from various quarries in a form of "rattles" machine. The stone submitted for testing, after being broken to a standard size, is carefully weighed and placed inside the machine. The number of revolutions per minute is uniformly regulated, and an automatic recorder indicates the number of revolutions during the period of the test. The stone is afterwards removed from the cylinder and again weighed, and the percentage of loss due to wear and tear ascertained. This machine has been found to be of the greatest value in determining the wearing qualities of various stones.

After every care has been taken to determine the wearing quality of the stone to be used in the maintenance of roads, there is yet one condition which must be carefully observed, especially in the case of road surfacing, in order to obtain entirely satisfactory results—it is, ensuring that the material used over a given surface is of a uniform quality. The indiscriminate use of two or more stones of different qualities, even when relatively good, both in paved streets and macadam roads, will be found to produce very disastrous results. On macadam roads in particular the traffic will very soon find out the spots where the softer material is situated. Where the surface begins to wear down below the harder material surface water will gather, slightly at first and gradually increasing, with the result that the crust of the road is softened, and the less hard material is subjected to the disintegrating effects of the weather to a far greater degree than the other parts of the road, thereby causing further damage, and, in combination with the traffic, the wear goes on daily in an increasing ratio, and the general surface of the road rapidly becomes a series of hills and hollows.

Before recoating a macadam road the custom is to scarify the surface of the old road crust. After gathering all loose material to the side, a coat of about 3 in. of new metal is carefully spread, and before being rolled the old material from the side of the road is uniformly scattered over the new stone. This coat is rolled dry until all the stones are firmly bedded in position, and is then lightly sprinkled with water. A coating of ½-in. screenings or chippings is then spread, the screenings having been first damped. This coat is then watered sufficiently to allow the roller to work over the same without picking up the material, and from time to time additional water is sprinkled until the binding material has gradually worked its way into the interstices. Two men are employed in front of each roller lightly brushing the ½-in. chippings so that the surface is uniformly fed with the fine stone. It is found that the screenings being damped before use find their way more uniformly between the stones, and that the fine material is not washed through the new stone, but helps to close the road crust along with the coarser chippings.

The author is of opinion that in many cases the quantity of water used in consolidating a macadam road is considerably overdone. In wet weather on flat roads little or no water is necessary. In Ireland in the dryest of summer weather not more than 3½ gallons of water per square yard of road surface is required. The average quantity of water used last year on upwards of 220,000 sq. yds. was somewhat over 400,000 gallons, and works out at 1.84 gallons per square yard. A final coat of gravel, about ⅛ in. in depth, greatly assists in finishing the road surface, and protects a new road from the effects of traffic.

In the North of Ireland, on account of the variable climate, tar-spraying has not met with any considerable success. The greatest difficulty has been found in carrying out the work during suitable weather, and in many cases the mud arising in the winter from roads which have been thus tarred has given a great amount of trouble.

Except where very heavy traffic exists, on a properly maintained ordinary macadam road a general patching of the surface should never be necessary, and where, owing to exceptional circumstances, such repairs have to be undertaken, the work should only be done during wet weather. The method found most satisfactory has been to slightly rough the surface of the road requiring such repair, and to make use of stone of 1½-in. gauge, blinding the new surface with a sufficient coating of ½-in. chippings from which the stone dust has not been extracted. These are carefully packed by the surfaceman, and

*Extracted from a paper presented to the "Surveyor," of London.

all such patches are tightened up twice or three times daily with a brush. In ordinary wet weather, with proper attention, such patches will consolidate under the traffic and become an integral part of the road surface in about three days.

Tar-Macadam Roads, Etc.—A very large number of methods are in operation in the preparation of a tar-macadam or pitch-grouted surface, and the author, in submitting his remarks under this heading, wishes it to be understood that he in no way dogmatizes as to the best form of construction, but rather desires to convey the principles which have guided him in arriving at his present method.

In the manufacture of tar-macadam it is essential that all moisture should be expelled from the stone, and that after it has become absolutely dry the heated stone should be thoroughly mixed with the boiling tar preparation. The heat used for the drying of the stone should be duly regulated, and the proper proportion of boiling tar applied to thoroughly coat all the particles of stone.

In Belfast an entirely novel tar-macadam plant has been devised by the author by which the resources of a refuse destructor have been availed of for drying and heating the stone and boiling the tar mixture, which, if required, can deal with an output of 10,000 tons per annum, and has been working with entire satisfaction from June, 1910.

The general features are as follows: The stone supplied from the quarries is delivered at a high level to the drying towers. In its passage, by gravity, through the towers the stone is thoroughly dried and heated, and passes out at the lower end into a revolving mixer. Boiling tar, of sufficient quantity to thoroughly coat the stone, is also fed into the mixer, and the whole discharged at the outlet, thoroughly mixed, in the form of tar-macadam.

To obtain the heat from the furnace gases before passing up the destructor chimney a by-pass or loop has been built alongside the main flue, and two dampers or doors (one on the main flue and the other on the by-pass) have been built in at either end to regulate the passage of these gases. Into the by-pass a tubular air heater has been built through which, by means of a fan, fresh air is drawn and driven forward at a high temperature into the drying towers, where, after passing through the stone, it finds its way out at the top of the towers. The temperature of the hot air delivered to the drying towers is recorded by a pyrometer, and the heat required is regulated by the opening and closing of the dampers in the flues, and a cold-air inlet valve situated between the heater and the fan.

A cylindrical revolving mixer receives the stone from the outlets of the drying towers, and as the stone passes into the mixer it is treated with boiling tar delivered from one of a pair of tar-boilers on either side.

The power to drive the shafting and belting is derived from the destructor engine.

Twin towers are provided to secure a continuous supply of stone, the stone from one tower being drawn while the other is drying and heating. This arrangement also applies in the case of tar-boiling, and should it be required, there would be no difficulty in working continuously night and day.

Tar-macadam may be laid upon an existing roadway provided the levels of footpaths or abutting buildings will allow. If this is not the case, the surface of the existing roadway must be cut away to provide a sufficient depth for the new coating of tar-macadam, the formation being left to correspond with the finished camber of the tar-macadam. The camber generally adopted on a level tar-macadam road is 1 in 30, while on an incline this may be reduced to 1 in 40, or even 1 in 45. In the case of a tar-macadam road the foundation must be sufficient to support the road traffic independent of the road crust for at least twelve months after the tar-macadam has been laid; there is, in warm weather, a certain amount of "give" in the crust, which, if the road is not to disintegrate as a consequence of the traffic, must be entirely supported by the foundation.

Difficulty has been found in securing uniformity in the distribution of the various sizes of stone in the mass where the aggregate is prepared with mixed sizes, with the result that the road surface wears unequally. It has therefore been found desirable to lay the material in three separate layers, the utmost care being taken that all material shall be uniformly spread and rolled. The bottom layer, being of 1½-in. material, is first spread to a depth of 4 in. and compacted by light rolling, the intermediate coat of 1-in. material being then laid 2 in. in depth, and the two coats thoroughly combined by careful rolling. A top coat of ½-in. material is finally added and the surface rolled until the whole crust is thoroughly compacted. No advantage is obtained by an excessive amount of rolling. Only sufficient material is used in the top coat to thoroughly key the surface, and when finally consolidated the whole forms a tar-macadam crust 4 in. in thickness. After the road has been laid from six to nine months the surface is thoroughly cleansed, dressed with boiling tar, the surplus tar being absorbed and retained by covering off with a coating of fine stone dust. This tar painting may be repeated every two years, and greatly adds to the life of the surface crust.

In regard to repairs, it is of the utmost importance that any patching should be carried out as soon as the surface shows undue indications of wear, always providing that the work is done in dry weather. In executing such repairs the openings are carefully trimmed down plumb from the surface to an even depth, the whole is then thoroughly cleaned and given a light coating of a mixture of hot pitch and creosote oil and filled with 1-in. material, sufficient ½-in. being used to key the surface. The patch is then either rolled or well punned solid. In renewing surfaces it is well to deal with as long lengths as possible, the method adopted being the same as used in patching. In no case should the wear be allowed to extend below the finishing coats.

The life of a tar-macadam road varies in ratio to the intensity of the traffic, and has given best results in suburban roads. In the centre of the city, where subjected to heavy traffic, the results have not proved satisfactory. The author is, however, doubtful whether this is not due to defects in foundation rather than to failure in the wear of the tar-macadam surface crust.

Sett Paving on Existing Foundations.—The author has a considerable mileage of what may be termed second-class streets, through which a large amount of heavy traffic passes, paved with setts upon existing foundations. These setts are usually 6 in. deep, 3 in. broad, and from 5 in. to 7 in. in length, either of granite or whinstone. In most cases these streets were originally either ordinary macadam or boulder paving, and in consequence of the development of the district have been converted as indicated. In the case of a macadam road, sufficient depth is obtained for the new paving, and the old roadway trimmed off to the required contour. The setts are paved on a ¾-

in. bed of compo. formed of 4 parts of sea gravel to 1 of cement, and joined with a grout of 3 parts of sharp sand to 1 of cement. In the case of replacing boulder paving with setts the same method is adopted, with the exception that the setts are frequently bedded in the sand from which the boulders are taken, and grouted in cement. This class of carriageway forms a very serviceable and economical roadway, and although not having the appearance of better-class paving, provided the foundations are suitable, will withstand very considerable traffic. This paving, however, suffers considerably under traction engine traffic.

Sett Paving on Concrete Foundations.—In main thoroughfares and important streets traversed by heavy traffic of all descriptions, sett paving on concrete foundations is found the most serviceable. The concrete bed should be from 6 in. to 9 in. in depth, varying according to the subsoil; and having regard to the development of heavy self-propelled traffic, the author is inclined to advise that in no case should the concrete be less than 9 in. in depth. As mentioned before, the stone for sett paving is specially tested and selected, the requirements being a tough stone which at the same time will not become unduly slippery under horse traffic.

The standard size of setts used in Belfast is 4 in. square on head and 6 in. in depth, truly dressed on all surfaces, so that the setts can be paved on either end; the setts must be squared and dressed to the exact measurement (4 in. by 4 in.), and the variations in depth must not exceed ¼ in. The 4-in. sett on the surface affords greater foothold for horses, while, as compared with cubes, the extra 2 in. depth in the sett secures greater power of resistance to the rolling action of the traffic and breaking of the bond. The setts are paved upon a 1-in. bed of compo. formed of 4 parts of gravel and 1 part of cement, and again grouted with compo. of the same strength. Seven days are allowed for the jointing to set before the traffic is permitted to pass over the new paving.

The camber of a sett-paved roadway should not be greater than 1 in 50. In some cases the sett paving is grouted with a mixture of pitch and tar. This has the advantage of allowing the traffic to pass over the roadway as soon as the jointing has become thoroughly hardened. With properly selected stone this form of pavement will last under the heaviest traffic for fifty years, the setts during that period being once repaved with the lower ends upwards. At the present time there are in Belfast several heavy-trafficked streets near the quays which have been laid between forty and fifty years. Beyond this repaving, such repairs as are necessary cost on an average slightly less than one cent per square yard per annum.

Natural Asphalt, Hardwood and Softwood Paving.—Where sett paving is found undesirable owing to the noise caused by the traffic, natural asphalt, hardwood or softwood paving may be found suitable.

For heavy traffic a coating of 2-in. asphalt should be laid, and care taken in spreading where jointing up to asphalt already hardened to thoroughly make good the jointing in order to prevent fractures appearing in the road after the work has been finished. This form of roadway is usually laid and maintained by various companies who specialize in this material. The camber of an asphalt road should not exceed 1 in 50.

Wood paving, like sett paving, is laid upon a bed of concrete, and, like asphalt, the surface of the concrete is truly floated in cement to correspond with the finished contour of the roadway and the wood blocks directly laid on the cement surface.

The sizes of wood blocks as laid in Belfast are 9 in. by 4½ in. by 3 in. All blocks must be of thoroughly well-

Table No. 1.

Table Showing the Comparative Cost of Various Classes of Road Surfacing, Having Regard to First Cost, Capital Charges, Where Such May be Included, and Cost of Maintenance, Cleansing, and Renewals per Square Yard per Annum for a Period of 20 Years.

Surface Material	Average Life Years	First Cost per sq. yd.	Capital Charges per annum	Maintenance per sq. yd. per annum	Cleansing per sq. yd. per annum	Renewals		Total Cost per sq. yd.		Remarks
						Average cost per sq. yd per annum	Total Cost per sq. yd. for 20 years	Per Annum	For 20 years	
Water-consolidated Macadam (on existing foundations)	Variable	See Maintenance	Nil	4c. to 24c.	2c. to 18c.	See Maintenance		6c. to 42c.	$1.25 to $8.75	All charges paid for out of revenue
Tar Macadam (on existing foundations)	6	$ .50 to $1.12	Nil	2c. to 6c.	2c. to 7c.	2·8c. to 6·3c.	$ .58 to $1.30	9·2c. to 29⅔c.	$1.90 to $5.15	
Sett Paving (on existing foundations)	15	$1.87	Nil	4c.	6c.	3·2c.	$ .62	22c.	$4.58	
Sett Paving (exclusive of concrete foundations)†	*40	$2.25	15c.	1	7c.	—	—	23.2c.	$4.83	*The first cost is entirely paid out of capital in 20 years' period, remaining 20 years free of all capital charges
Natural Asphalte (exclusive of concrete foundations)†	10	$2.25	26c.	12c.	4c.	—	—	42c.	$8.73	First cost and renewals paid out of capital
Hardwood (exclusive of concrete foundations)†	15	$3.00	25c.	6c.	8c.	—	—	39c.	$8.12	Do.
Softwood (exclusive of concrete foundations)†	12	$2.25	22⅓c.	8c.	9c.	—	—	39⅓c.	$8.20	Do.

†9in. concrete foundation, including excavation, &c., costs $1.50 per square yard.
To repay capital charges in 20 years means an additional 11⅗c. per square yard per annum.

seasoned wood, free from shakes or other defects, and cut to exact sizes by machinery. In the case of softwood blocks creosote oil is forced into the blocks under pressure. Not less than 10 lb. of creosote oil per cubic foot of timber must be absorbed during the process. All blocks are examined and passed by the corporation inspector before being creosoted, and the inspector must also satisfy himself that the specified amount of creosote oil has been absorbed by the timber. Hardwood blocks, before being laid, are dipped to a depth of ½ in. in a mixture of pitch and tar or creosote oil, and an expansion joint left on either side alongside the curb to allow for the expansion of the wood when the roadway becomes moist. The width of expansion joint allowed is approximately one-ninetieth the width of the paving. To prevent the space being filled with dirt the joint is loosely closed in with puddled clay.

The author's experience in the case of hardwood paving block has been that the expansion and contraction is greater and more difficult to deal with than in the case of softwood.

Both cement and pitch have been used for grouting wood pavement, and in spite of the great advantage that pitch has over cement in allowing the immediate use of the road as soon as the surface has been thoroughly grouted, the author believes, especially in regard to hardwood, that cement grouting gives a very much more satisfactory result as regards the smooth wearing of the surface, particularly after some years' wear, than does wood pavement grouted with pitch. In some instances the pitch mixture, probably owing to its not having been sufficiently hard, with the vibration of the traffic in hot weather, has worked downwards and found its way under the lower surfaces of the blocks, thereby raising individual blocks above the normal surface level.

To finally determine the relative merits, a roadway in which the traffic is uniform from one end to the other was selected and paved with Jarrah wood blocks in May, 1907, one half with pitch grout, the second half with cement grout, and careful observations have been made since. For the first three years no difference was noticeable. At the end of the fourth the difference was so extremely slight that a person would not have noticed the change without having his attention called to the difference. At the end of the fifth year the change was more apparent. At the present time, although the section of the roadway grouted with pitch is in very good order, it is distinctly more uneven than the cement-grouted section on which the youngsters of the neighborhood disport themselves on roller skates when they are able to avoid the attention of the police.

As regards repairs, hollows appearing in the surface are mainly due to defective or soft blocks; these are cut out and sound blocks inserted with as little delay as possible. A stock of old blocks is kept for this purpose gauged to various depths, so as to fit in with the actual depth of the wood paving at the time that the repairs are required. No very serious difficulty has been experienced in Belfast in summer weather in regard to open joints, but on hot days a special water service is given to all wood-paved roadways. The gravel used for gritting the surface is specified to pass a ½-in. screen, the stones being rounded and about the size of peas.

Statistics.—A large amount of care is taken in the compilation of records as to the qualities of materials used in the construction and maintenance of roads, and also as to the maintenance cost of each road individually.

Every water-consolidated macadam road in the city is scheduled in a macadam road journal, and all charges, both in regard to materials and workmanship, are returned weekly from each district and posted in this journal against the respective roads on which the work has been done. By this means an accurate record is maintained which proves of the greatest importance and use in determining, not only the merits of any special materials or methods that may be employed, but also if the cost of the maintenance of the existing surfaces is the most suitable and economical having regard to the traffic each road is called upon to bear.

With regard to the construction of tar-macadam roads, for some years a register has been kept in which is recorded:—

(1) The date when the tar-macadam road was first laid.

(2) Particulars of the original roadway.

(3) Superficial area dealt with.

(4) Thickness of tar-macadam surface.

(5) Tonnage of materials delivered.

(6) Number of square yards per ton of each size of tar-macadam used.

(7) Cost of scarifying and preparing foundations, including removal of materials.

(8) Value of old materials.

(9) Total net cost of preparing foundations, with cost per square yard.

(10) Cost of laying tar-macadam under the following heads: (*a*) Labor, (*b*) cartage, (*c*) materials, (*d*) miscellaneous charges.

(11) Total net cost of the work.

These items are again worked out to cost per square yard. The condition of the weather during the progress of the work is also recorded, and any special remarks entered that may be of future value. Reference to this register from time to time has been found of the greatest value in investigating and analyzing the behavior of the various road surfaces. A careful record is also made of all repairs done to each road, so that the actual maintenance charge in each case may readily be ascertained.

Cleansing.—In connection with road maintenance, it must be emphasized that it is of the utmost importance that every care and attention should be given to the cleansing of road surfaces, as, if cleansing is not done with due regard to the proper requirements of the road, a very large amount of waste and damage will accrue. This especially applies to water-consolidated macadam roads. All surplus mud should be removed without delay. An undue amount of sweeping, especially in dry or frosty weather, or on a newly made road, causes serious damage by the removal of the binding material in the road surface.

The greatest care should also be exercised in the cleansing of a newly paved street so that the jointing material is not disturbed by the operation; also in the case of wood pavement it is of great importance that a thorough and systematic cleansing should be maintained, the refuse being removed either to orderly bins or in barrows. It will be found necessary at times to wash the surface of the roadway, this being usually done at night, and, as has already been mentioned, the wood pavement should be thoroughly watered during hot or windy weather to protect it from the effects of shrinkage.

In order to indicate the most suitable form of road surface from an economic standpoint, Table No. 1 gives the comparative cost of various classes of road surfacing, having regard to first cost, capital charges, where such

may be included, and cost of maintenance, cleansing and renewals per square yard per annum for a period of twenty years.

Owing to fluctuations in the price of materials and wages due to local conditions, maximum and minimum figures are given for water-consolidated macadam and tar-macadam roads. Should, in exceptional cases, the range provided not be found sufficient, other figures may be supplemented and conditions ascertained.

In comparing these figures, which represent present-day costs, with those of road surfaces of a more permanent nature, allowance should also be made for the advance in price of materials and wages which must take place during the period under consideration. Table No. 2 gives the cost per mile per annum of a road 18 ft. wide, surfaced with the materials scheduled in Table No. 1, and more clearly indicates the comparative maintenance expenditure involved.

Having carefully considered the question of road maintenance in respect to various surfacing materials from a purely economic standpoint, it becomes necessary to consider the probable future developments, not only in respect to a particular road, but also to the district through which it passes, and the requirements in regard to same. One factor which the author feels at times hardly receives the attention it deserves is the direct saving of wear and tear on all classes of vehicular traffic due to the substitution of a suitable road surface in the place of one that has become effete, and also to the saving on adjoining road surfaces by the diversion of traffic on to the new road. Again, the hygienic qualities and noiselessness of the materials selected, in relation to the traffic and needs of the locality, must be carefully weighed. The values of these factors cannot be expressed by any mathematical formulæ, but nevertheless on the accuracy of the conclusions arrived at largely depends the success or failure of a general system of road maintenance.

Table No. 2.

Table Showing Cost of Maintenance per Square Yard and Cost per Mile per Annum of a Roadway 18 Feet in Width.

Surface material.	Cost per sq. yd. per annum.	Cost per mile per annum of roadway 18 ft. in width.
Water-consolidated macadam on existing foundations	6 to 42c.	$642 to $4,497.00
Tar macadam on existing foundations .....9.2 to 24.7c.		$985 to $2,642.60
Sett paving on existing foundations	22c.	$2,355.00
Sett paving exclusive of concrete foundations..	23.2c.	$2,484.00
Natural Asphalte, exclusive of concrete foundations	41.8c.	$4,493.50
Hardwood, exclusive of concrete foundations..	39c.	$4,173.50
Softwood, exclusive of concrete foundations..	39⅓c.	$4,212.00

9 in. concrete foundation, including excavation, etc., at 12 cents per square yard (first cost), repayable in 20 years = $1,080.40 per mile.

Table Showing Relative Merits of Various Road Surfacing Materials in Respect to Ease of Haulage, Noiselessness and Hygienic Qualities.

Ease of haulage.	Surface material.	Noiselessness.	Hygienic qualities.
6	Water-consolidated macadam	1	5
3	Tar macadam	3	2
5	Sett paving on existing foundation	5	4
2	Sett paving on concrete foundation	6	3
1	Natural Asphalte	4	1
4	Hardwood and softwood	2	6

FUNCTIONS OF THE NON-BACTERIAL POPULATION OF THE BACTERIA BED.*

By James Crabtree, B.Sc., A.I.C.

EXPERIMENTS on the part played by protozoa in soils, have been extended to sewage disposal beds, and have shown the decided effect which removal of the fauna of the bacteria bed has upon its capacity, a bed with no (or very little) animal population "making up" much quicker than a bed with a normal fauna.

This absence of fauna can be the only cause of this observed difference in capacity, as any effect caused by bacteria would be in the opposite direction; for, since the number of putrefying bacteria (those growing on nutrient gelatine) was generally greater in the partially sterilized bed than in the control, the tendency would be for a greater resolution of solid matter in the toluened bed than in the control, with a corresponding increase in the capacity compared with the control. This is quite contrary to the observed results, which showed a decrease in the toluened bed compared with the control. The difference can, therefore, only be assigned to the animal population, which in some way keeps the bed "open."

Exactly how this is caused can not yet be said—whether the organisms actually digest the particles of solid matter, or whether the material is taken up to form the tests or shells of rhizopods, etc., thus modifying the nature of the deposit and allowing the water to run off more freely. There is probably a good deal of actual digestion taking place—at any rate, of the more easily resolvable precipitated colloidal matter. To the eye, however, the most striking difference in the deposits on the bed media is in the physical character rather than the amount, the deposit in the toluened bed being, as before stated, much more spongy and less granular than in the normal bed. That there is a difference in amount is shown by the following estimation made at the end of the experiment, on a control bed, A, and two beds B and C, partially sterilized by toluene.

Amount of deposit per 1,000 c.c. bed medium (obtained by brushing off into water the deposit from 50 c.c. medium, taking an aliquot portion and evaporating dry): A bed, 19.2 gs.; B bed, 20.2 gs.

According to these figures there is more deposit per unit capacity of bed in the bed deprived of its animal population.

How much of the difference in capacity is caused by difference in character and difference in amount of de-

*From a paper read at the Exeter Congress of the Royal Sanitary Institute.

posit must be left to the future to decide. The fact remains, however, that the animal population does a good work in keeping the bed medium "open," and, from this standpoint, are very desirable inhabitants of the bacteria bed.

Outside the effect caused by difference in capacity, what is their connection with the actual purification processes taking place in the soluble constituents of the sewage? A consideration of the results obtained leads us to say that it is probably very little.

The improvement in the effluent on a toluened piece of soil, and a similar improvement in a toluened bed outlined in the above experiments may, in our opinion, be explained away by the difference in capacities produced in the beds. The fact that in a toluened bed we get a greater number of bacteria capable of growing on gelatine seems to indicate that we should get a greater purification in that bed. The experiments with beds A and C (which did not differ in amount and nature of surface deposit, but where C contained a greater number of bacteria than A) do not support this idea, for C gave a worse effluent than A. For, after all, a comparison of the counts on nutrient gelatine does not of necessity indicate the relative proportions of those bacteria bringing about the purification in the respective beds. Bacteria growing on gelatine are largely putrefactive, while the processes going on in the bacteria bed are largely processes of oxidation.

Müller, investigating the reduction of bacteria in water samples due to protozoa, finds that although a reduction takes place among the bacteria capable of growing on gelatine, those growing on Heyden agar are practically unaffected. His conclusions are that the protozoa prey only on bacteria foreign to the water (e.g., B. coli, B. Typhosus, and many putrefying bacteria), while the normal population goes untouched.

STEEL VS. WOODEN SIDEWALK FORMS.

BEFORE the advent of steel forms, concrete for sidewalks, curb, and curb and gutter was molded by means of wooden forms. The contact of wet concrete, however, tends to warp the wood out of shape, besides the nailing and staking necessary in setting them up makes moving difficult without danger of breaking or splitting, which shortened the life of the forms. The skilled labor necessary, time required in setting, and cost of lumber for this work, make these items enter largely into the cost of the job. Metal forms of various types have been designed to overcome this difficulty by securing greater durability of forms, more uniform work, besides saving labor, cost and time required to complete the work.

In Municipal Engineering, Mr. Chas. H. Allison, describes their successful use and gives a number of pointers gained from his own experience with them.

No type of concrete construction is better adapted for the use of steel forms than concrete sidewalk, curb and combined curb and gutter. Although steel forms are more expensive than wood in first cost, their advantages are so many that they are now being used to a large extent in the work of this sort.

Sidewalk side rails are used in constructing crosswalks by having 6 or 8 division plates shaped to suit the cross sectional crown of the walk. By the use of two adjustable rigid side-rails, these forms can be set to build a crosswalk for any width of street. The all-steel curb forms are built for a curb 20 inches deep, 6 inches wide on top and 8 inches on the base, in 12-foot sections, with provision for templates at intervals of 6 feet. The side rails are similar to those used for sidewalks. Templates can be made to conform to any desired specifications.

The all-steel curb and gutter forms are made similar to the combination sidewalk and curb forms, with 3-inch flanges. One wide side rail is used to form the back and a narrow one on the front. With these forms a steel side rail is used to mold the face of the curb and is held in position by a metal arm or brace attachment. These forms are also made for curved sections. Division plates are made to be used with plank side rails for curb and combination curb and gutter.

The division plates used in the forms which the writer has been using are entirely different from those found in other systems as they can be removed by one man without disturbing the side rails and without the use of a hammer. They are connected by merely dropping them in their proper places and no wedges, keys, bolts or moving pivots are required. These division plates are to be had in all lengths up to and including 6 feet and in the construction of a 12-foot walk it is only necessary to double the 6-foot plates and in the building a 10-foot walk it is only necessary to double the 5-foot plates.

These division plates do not project or extend above the top or beyond the outside of the side rails. They are perfectly smooth between the side rails and have tapering slots which will not bind when the plate is drawn from the concrete. One of the particular advantages of this system of forms is that there are no intermediate slots in the division plates to corrode and tear up the concrete when the plates are withdrawn.

The side rails, which are connected together without the use of keys, wedges or bolts, are 12 feet in length and are made of a special shape, comprising three right-angle bends, thus making the construction most rigid and durable. These rails are so made that the top surface is free of any obstruction which would interfere with the free passage of rodding-off tools. They are easily adjustable, thus enabling the workmen to place the forms in any odd space without using wood to fill in. These side rails are so made that it is a simple matter to make a block of any desired size.

It is a very simple matter to so adjust 100 feet of these sidewalk forms to be used as 100 feet of curb and gutter forms; all that is necessary is an additional use of 16 curb and gutter templates.

It is a very easy matter to construct 350 feet of sidewalk per day with the use of but 100 feet of these forms. They are simple to place and there is no toggle arrangement to oil and the division plates can be removed before or after finish is applied.

September 15th and 16th are the days of the sixth general Annual Assembly in Calgary of the Royal Architectural Institute of Canada. According to the programme, the two days are well filled, and several of the papers to be presented deserve special mention. A lecture on Ferro-Concrete will be given by Mr. F. Goldie Engholm, A.M.I.C.E., of Vancouver. Prof. E. Brydone-Jack, Department of Civil Engineering, Manitoba University, will also present a paper. The headquarters of the Institute during the assembly will be at the Public Library, Calgary.

STEEL PRODUCTION IN THE UNITED STATES.

THE Bureau of Statistics of the American Iron & Steel Institute has received from the manufacturers statistics of the production of all kinds of steel ingots and castings in the United States in 1912. The production of ingots and castings by all processes reached the remarkable total of 31,251,303 gross tons, against 23,676,106 tons in 1911, an increase of 7,575,197 tons, or almost 32%. The remarkable point is that while the production of steel in 1911 exceeded that of pig iron by a small amount—26,559 tons—in 1912, the excess was no less than 1,524,166 tons. As there were no large stocks of pig iron on hand at the beginning of 1912, it is evident that the openhearth furnaces must have used a large proportion of scrap in making steel last year.

The total production of steel of all kinds in 1912 is given below:

	1911,	1912,			
	Total.	Ingots.	Castings.	Total.	%
Bessemer	7,947,854	10,259,151	68,750	10,327,901	33.0
Acid openhearth .	912,718	712,371	426,850	1,139,221	3.6
Basic openhearth.	14,685,932	19,197,504	443,998	19,641,502	62.9
Crucible	97,653	100,967	20,550	121,517	0.4
Electric	29,105	14,147	4,162	18,309	0.1
Miscellaneous ..	2,844	542	2,311	2,853	...
Total	23,676,106	30,284,682	966,621	31,251,303	100.0

The total increase in 1912, as compared with 1911, was 7,575,197 tons, or 32%. The increase in basic openhearth steel in 1912 was 4,955,570 tons, or 33.7%; in acid openhearth, 226,503 tons, or 24.8%. The gain in bessemer steel was 2,380,047 tons, or 29.9%. The production of bessemer-steel ingots was practically all in standard converters; that of castings was from tropenas and other modified forms of converters. No basic converters are in use in the United States. The make of openhearth steel in 1912 was over twice that of converter.

Included in the 19,641,502 tons of basic openhearth-steel ingots and castings produced in 1912 are 1,438,654 tons of duplex steel ingots and castings which were made from metal partly purified in bessemer converters and finally purified in basic openhearth steel furnaces. This steel was produced by seven works, four being in Pennsylvania, one each in Maryland, Alabama and Illinois.

The production of crucible steel showed a gain of 24% over 1911; that of electric steel, however, was considerably less than in 1911 and 1910. The make of crucible steel was exceeded in two previous years.

Steel Production for Ten Years.—The total make of steel of all kinds in the United States for 10 years past is given in the following table:

	Bessemer,		Openhearth,		Crucible, etc.,		Total,
	Tons.	%	Tons.	%	Tons.	%	Tons.
1903 ...	8,592,829	59.1	5,829,511	40.1	112,238	0.8	14,534,078
1904 ...	7,859,140	56.7	5,908,166	42.6	92,581	0.7	13,859,887
1905 ...	10,941,375	54.6	8,971,376	44.3	111,196	1.1	20,023,542
1906 ...	12,275,830	52.5	10,980,413	46.9	141,893	0.6	23,398,136
1907 ...	11,667,549	49.9	11,549,736	49.5	145,309	0.6	23,362,594
1908 ...	6,116,755	43.6	7,836,729	55.9	69,463	0.5	14,023,247
1909 ...	9,330,783	38.9	14,493,936	60.5	130,302	0.6	23,955,021
1910 ...	9,412,772	36.1	16,504,509	63.3	177,638	0.6	26,094,919
1911 ...	7,047,854	33.5	15,508,650	65.9	120,602	0.6	23,676,106
1912 ..	10,327,901	33.0	20,780,723	66.5	142,679	0.5	31,251,303

The growth of production in the 10 years has been almost wholly in openhearth steel. Bessemer or converter steel reached its maximum in 1906 and has declined since then, its proportion of the total falling from 59.1 to 33%. Openhearth steel ran bessemer closely in 1907; exceeded it in every year since that, and in 1912 its output was more than twice that of bessemer steel.

Alloy Steel.—The following table gives the approximate production by processes of steel treated with ferro-vanadium, ferro-titanium, ferro-chrome, nickel and other alloys:

	Ingots.	Castings.	Total.
Bessemer	159,427	18,814	178,241
Acid openhearth	85,188	75,590	160,778
Basic openhearth	408,007	5,095	413,102
Crucible	27,553	3,208	30,761
Electric, etc.	9,217	402	9,619
Total	689,392	103,109	792,501

In 1912 there were 143 works which made some form of alloy steel. This alloy steel constituted 2.5% of the total make. A large part of this steel was used in the manufacture of rails.

Number of Steel Plants.—At the close of 1912, there were 30 plants equipped to make steel by the standard bessemer process, 35 plants by the tropenas process, and 37 plants by other modifications of the standard bessemer process, while at the close of 1911, 29 plants were equipped to make steel by the standard bessemer process, 29 by the tropenas process, and 31 by other modifications of the standard bessemer process. There were no bessemer plants building at the close of 1912, but 13 plants were projected.

At the close of 1912, there were 182 complete openhearth-steel plants, of which 157 were active during the year and 25 were idle. Of the total 113 were equipped to make basic steel, of which 101 were active during the year and 12 were idle, and 96 were equipped to make acid steel, of which 77 were active and 19 were idle. Some of the plants were equipped to make both basic and acid steel. Six plants were being build on December 31, 1912. On the same date work had been suspended upon three partly erected plants. In addition, five plants were projected. In 1912 four plants made steel by the cementation and other minor processes; in 1911 five plants were active. On December 31, 1912, one plant for the manufacture of steel by a special process was being built in the State of Washington.

The total number of steel plants of all kinds in existence at the close of 1912 was 306, which includes one openhearth plant in the Panama Canal Zone. This total is an increase of 24 during the year.

In connection with the 1912 production, Engineering News published an interesting table a few weeks ago comparing the acid and basic outputs of Germany and the United States, which is given below:

	—United States—		—Germany—	
	Acid.	Basic.	Acid.	Basic.
Converter ...	10,327,901	.....	28,511	10,015,631
Openhearth ..	1,139,221	19,641,502	194,924	6,650,565
Crucible	121,517	.....	79,190	.....
Electric, etc. .	21,162	.....	74,177	.....
Totals	11,609,801	19,641,502	535,802	16,666,196
T'l all kinds.	31,251,303	.....		17,301,998
Proportion of steel to pig iron		105.1	.....	96.8

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

The Long Sault Rapids Power Scheme 405
Hamilton's Railway Problem 406
Canadian National Exhibition 406

Leading Articles:

Spiral or Screw Conveyers 389
Waterproofing of Concrete 393
The Determination of the Magnetic Meridian.. 395
Road Maintenance and Cost 398
Functions of the Non-Bacterial Population of the Bacteria Bed 402
Steel vs. Wooden Sidewalk Forms 403
Steel Production in the United States 404
Street and Pavement Construction 407
Railway Situation in Hamilton 411
Programme American Road Congress 415
The Wire and Nail Mills of the Dominion Iron and Steel Company, Limited 416

Coast to Coast 418
Personals 420
Coming Meetings 420
Railway Orders 75
Construction News 76
Market Conditions 92-94
Technical and Municipal Societies 94

THE LONG SAULT RAPIDS POWER SCHEME.

One would imagine that the history of the project of the Long Sault Development Company, in so far as it pertains to Canada, has reached its closing chapter. The company's proposal involves the erection of a 3,800-foot dam between Barnhart Island and the north-easterly end of Long Sault Island in the St. Lawrence River, and another, 1,450 feet in length, adjacent to lock 20 of the Cornwall Canal, on the Canadian side, thus requiring the construction of a new channel with a new canal at that point. Its proposal includes the generation of 500,000 h.p. of electrical energy on the American side and of 100,000 h.p. on the Canadian side. The company's many and varied assurances that the development was just what Eastern Ontario needs, were commented upon in *The Canadian Engineer* of October 24, 1912, and were accompanied by a note of caution, toward the safeguarding of Canada's interests.

It is now six years since the company obtained a charter in New York State authorizing it to construct dams and other works at Long Sault Island for the development of electrical energy and the improvement of navigation, but not across the international boundary "unless consented to by the Dominion of Canada." In the meantime a Canadian charter has been diligently and persistently sought, for the widening of the whole project. The granting of it has been pending a report, after most thorough investigation, from the Commission of Conservation. Meanwhile the New York charter was repealed a few months ago, and a special application was presented to the United States Congress, also pending.

The Commission of Conservation has just issued its report, expressing strong disapproval of the scheme. The report is a complete review of the question, and presents no vague impressions. The outcome of it should be a discountenancing of the power scheme by the Dominion Government. It is not for the reason that the company resorted to improper tactics in endeavoring to create an impression in Ontario favorable to the granting of a Canadian charter; or that the company is a small part of a strong financial and commercial organization included in which is the St. Lawrence Securities Company, and back of it the Aluminum Trust. Nor it is because the United States franchise has been discontinued. The commission's report places its finger on the vital point when it emphasizes the likelihood of the proposed development placing enormous difficulties in the way of the imminent enlargement of Canadian navigation facilities. Deeper navigation upon the St. Lawrence will forthwith command the attention of the Dominion Government, and a free hand in the undertaking of such an enterprise must be maintained.

The proposed diversion of water by the dam between the Long Sault Island and Barnhart Island would take from the main navigable channel over one-third of its water. The effect of such a diversion of water from the navigable channel is impossible to estimate. It can, however, be stated with centainty that the navigability of the channel would not be improved by such diversion. The construction of the dams in question would result in compelling navigation (other than by the Cornwall Canal) to follow a new route known as the South Sault Channel. Experienced navigators are of the opinion that this route would be much inferior to that now followed.

From the point of view of benefits accruing to Canada from the proposed power development, the report

dispenses with the alleged advantages in the following way:—

"Looking at the whole scheme, it does not appear that any serious attempt can be made to show that Canadian requirements or Canadian interests are an appreciable factor in the plans of the company. The plans contemplate the absolute monopolization of the whole power available from the rapids with a minimum consideration of Canadian interests.

"No market exists at the present time on the Canadian side for the power proposed to be developed, or for any appreciable portion thereof. When any large quantity of power is required in the territory tributary to the proposed works it can be otherwise provided. Should the time come when further power is required by Canadian interests, and the placing of a dam across the St. Lawrence River is determined upon, one-half of the power to be generated thereby will belong by right to Canada and should be permanently retained for Canadian use without exception or qualification."

HAMILTON'S RAILWAY PROBLEM.

Readers will remember our recent reference to the plan which the city of Hamilton is working out in an endeavor to have the railways adopt a common route through the city, and to the dissenting stand which the Toronto, Hamilton and Buffalo Railway is taking. An article beginning on page 411 of this issue goes into interesting detail concerning the whole situation.

It is quite clear that the solution of this problem is going to play an important part in the future expansion of Hamilton. The city is destined to increase in size by reason of its peculiar geographical situation and in spite of the same. Its present population may double in the next 25 years. At any rate, the expansion is well under way, and no more appropriate time than now is likely to present itself for the complete straightening out of the question of railway right-of-way.

Conditions have changed since the T. H. & B. was first granted its right-of-way over the streets of the city. Public opinion against level crossings has developed generally, and the local trend of residential growth toward that section of the city would render it impossible if the railway were seeking to-day the right-of-way it secured twenty years ago. To what extent should further development of its present system, in the matter of a station and trackage extensions, be permitted, is a live factor with which the civic authorities, bent as they are upon an entire revision, must contend.

The refusal of the T. H. & B. to consider the city's plan to unite the railways on a common right-of-way, and in a union station, is largely based upon the adaptability of the location of its present station for passenger traffic. Granting this, alternative plans have been forwarded, dealing with elevation or depression of tracks. Of the two plans, as outlined in the article, while cost and questions of operation are in favor of the elevation project, the depression plan is more consistent with the present condition of entrance from the west, as the tracks are already depressed from the city limits to Park Street. The advantages which the city will thereby derive are beyond question, and the plan should be vigorously pushed forward.

CANADIAN NATIONAL EXHIBITION

Since its inception in 1879, the Canadian National Exhibition has grown—wonderfully. It has kept well in step with the Dominion's march of progress, and the inter-relation between the two has been close. Through its park of 264 acres, its buildings of stone, brick, concrete and steel, costing $2,225,000, its half a million feet of exhibit floor space, and its "million mark," the value of the Exhibition to Canada may be estimated.

President Kent has announced a proposed expenditure of $50,000 in improving the agricultural department of the Fair. This will incite a keener interest in the live stock exhibits, and will be money well spent.

An inspection of the marked indications of the rapid development of Canadian industries, particularly of machinery and processes, creates the impression that the above extension should shortly be followed by added accommodation in this department as well. The great Fair is built up by the co-operation of innumerable units, many of which are each the result of large annual expenditure. Many concerns have cheerfully spent thousands of dollars annually on exhibits that have not seen the inside of these great buildings, but are tented in some necessarily obscure location. This should be remedied. Machinery Hall should be duplicated, in order that these exhibits receive the housing they deserve. Otherwise, firms cannot be expected to retain their co-operative spirit in making the Exhibition what is is.

The Canadian National Exhibition is very deserving of attaining the million mark in attendance. The achievement, considering weather conditions at this time of year, and also the pre-occupation of farmers in harvesting, shows that it is receiving world-wide recognition and that Canada is unknown nowhere on the globe. But to fulfil its function, as an Exhibition, it should have more accommodation for the machinery men.

EDITORIAL COMMENT.

It is anticipated that about 1,100 miles of colonization roads will represent Ontario's progress in this respect this season. The north country is being webbed with good roads at a rapid rate and by another season the work of construction will have so far advanced that a settlement campaign on a large scale may be carried on. Mr. G. W. Bennett, Provincial Superintendent of Colonization Roads, states that the number of men employed ranges between 4,500 and 6,000. Satisfaction is being derived from doing the work by day labor, and no part of it is under contract this year.

* * * *

The navigability of the Saskatchewan River is being investigated by the Dominion Government, and the engineer in charge of operations, Mr. L. A. Voligny, reports that the river will greatly enhance the shipping facilities in conjunction with the Hudson Bay Railway from Le Pas. In many parts of the river the channel is sufficiently deep and for miles little extra work will be necessary to put it into shape. Eventually the waterway may extend from Edmonton to Winnipeg, which, if accomplished, will go a long way to reduce shipping rates.

STREET AND PAVEMENT CONSTRUCTION

ESSENTIAL TO PREMISE NATURE OF FUTURE WEAR—VARIOUS PAVEMENTS IN USE FOR URBAN TRAFFIC, AND THEIR CHARACTERISTICS —THE STREET RAILWAY SYSTEM AND THE RAIL IT SHOULD USE

By A. F. MACALLUM, C.E., A.M. Can. Soc. C.E.,
City Engineer, Hamilton, Ont.

THE first necessary function of a paved roadway is to supply a hard, smooth, and durable surface upon which the vehicular traffic of the town may be conducted with the least expenditure of energy; other considerations being cheapness, and low maintenance. It should also be sanitary, and not slippery in any kind of weather. This would give an ideal pavement that at present does not exist, for a pavement ideal in one location would not be in another, although it has been suggested that the general requirements in all cases would be the same. This does not naturally follow, for in one case low first cost and low maintenance cost may be the first consideration, while in another case ease of hauling and lack of slipperiness may govern, and a third case noiselessness and sanitariness may overbalance all other considerations.

In the following table different authorities give relative values of the various qualities of an ideal pavement:—

	U. S. Bulletin.	Tilson.	Baker.
First cost—Cheapness ..... Maintenance cost—Cheapness.	14	14	15
Durability	20	21	..
Ease of Maintenance	10	10	20
Ease of Cleaning	14	15	10
Low Tractive Resistance	14	15	10
Non-slipperiness	7	7	5
Sanitariness	13	13	25
Noiselessness Acceptability	4	..	15
Favorableness to travel	4	5	..
	100	100	100

It will be noted that while the United States Bulletin and Tilson agree closely, a considerable variation exists between them and Baker. Apparently they had in view pavements subject to heavy travel, while Baker considered a residential type of pavement.

Using values for this from the present costs of different pavements under conditions where the pavement proposed will exist, it is possible for the engineer to select the proper pavement for any particular case without bringing in the personal equation.

The first question that arises when a street is to be paved is what will be the probable quantity and character of the traffic to which it will be subjected. Although it is an obvious fact that a street in a business section should be treated differently from one in a residential section, yet, it is not done so in many cases. In the first case the paved portion of the roadway should be made as wide as the boundaries of the street will permit, while in the second a width of twenty-four feet (24′) is quite sufficient. Any additional width is more than wasted because this additional width of paved roadway will increase in the ratio of its width the cost of maintenance, cleaning, sprinkling, and cuts for house services. It may be objected that carriages and other vehicles could not turn around in a street twenty-four feet (24′) wide. While many could not, yet with blocks of the usual length such vehicles could go around the block. It is a very moderate statement to say that many thousands of dollars have been wasted in this country by making the pavements and roadways in residential districts unnecessarily wide.

Where street railway tracks exist through paved streets they are a serious menace to the durability of the pavement. Unless the paved area outside the tracks is of considerable width (say 18 feet) the traffic is so concentrated in narrow strips on each side of the tracks as to many times increase the traffic per foot of width on these strips with the consequent wear and tear to the pavement. It is also impossible to maintain any kind of a pavement alongside a poorly constructed railway track.

When a street is about to be paved it is not always possible to keep to the existing grade of the roadway to obtain the best grade for the desired pavement. It is doubtful if there is any other municipal improvement that will raise a louder howl of indignation from property-holders than the grading of a street for a pavement. The average property-holder considers only the street directly in front of his property, and believes firmly that the rest of the street should be made to conform with that regardless of drainage, ease of traction, and appearance. The stranger visiting a city for the first time may not remember the handsome buildings, but if the streets are bad he will never forget it.

Preliminary Works.—As water is the enemy of all pavements provision should be made in clay soils for proper drainage.

Every writer on pavements from Macadam to the present has referred to sub-drainage as the first essential to successful pavement construction. Where the sub-drainage is insufficient the underside of the pavement is always damp with the inevitable result of deterioration, and a tendency of the pavement to settle from its normal shape and grade. It may be assumed that any of the modern and practically waterproof forms of pavement now in use will have the sub-soil beneath it dry providing no water percolates from back of the curb which can be prevented by means of small tile drains beneath the curb. If the sub-soil be gravel, or sand, giving natural drainage no artificial drainage is required.

Macadam.—This is not a pavement, but as it is low in first cost, quiet and satisfactory if properly constructed, and used only upon residential streets where the traffic is not heavy. It is a good first pavement in a district not fully built up where there will be considerable tearing up of the roadway for house services.

*Read at the fifteenth annual meeting of the Ontario Municipal Association, Toronto, August 28th and 29th.

The usual method adopted for constructing macadam roads is to dump the broken stone on the road and roll to the form of the road, putting a certain amount of binder on top and wetting. The result is generally an uneven surface and rapid erosion after traffic has been upon it for a short time. Very seldom are large stones placed on edge on a proper camber of foundation, as brought out by Telford, although by so doing it will stand heavier traffic. As in all pavements the roadway should be rolled before the stone is placed upon it to the proper camber, and not more than ten inches (10″) of stone placed before rolling with a fifteen (15) ton roller. This stone should be hard and not all of one size, although such a clause will be found in many specifications. Sufficient small limestone binder should be added and flushed and rolled until the voids are filled and the surface in the proper form. After two or three days the street may be opened for traffic. If it be desired to provide a practically waterproof and dustless macadam then after about ten days' time the roadway should be swept to remove loose material, and a distilled coal tar heated to a temperature of about 250 degrees Fahrenheit should be sprayed using about ¾ of gallon per yard, and immediately covering with about ¼-inch of sand, or stone screenings. After rolling once upon the following day a second coating of about ½-gallon per yard should be applied cold and again sanded. In about ten days' time the roadway will have the general appearance of an asphalt pavement, the penetration of the tar being from one to two inches.

The advent of the automobile has made necessary the protection of the macadam surface from unravelling, and removing of the binding material in the form of dust. Oils of various kinds have been in use for several years—more or less successfully. Crude petroleums which contain the largest proportion of pure asphaltum give the best results. The petroleums having a paraffin or naphtha base are useless as they will not bind besides making a greasy slime and having an ill odor. It has been a common thing for an official to whom all oils look alike to purchase carloads of oil of unknown quality, sprinkle it from watering cars instead of spraying in unrestricted quantity regardless of the road condition, or weather. As a consequence slimy mud has been caused by sudden rainfalls which forms an emulsion with the oil, and the oil has pooled in depression in the roadway. It is necessary for the roadway to be first swept clean, be thoroughly dry, and have the oil heated and applied upon warm days.

From plain macadam roads to oil and tar painted, and on to tar macadam is but a step. Some years ago in Hamilton tar macadam pavements were extensively laid and these were successful in some cases, but not in others. The failures were partly due to using a limestone which was not tough or hard enough, and partly through the variable nature of the coal tar supplied. If tar used be not sufficiently refined the light oils and ammoniacal liquors will disintegrate. If it be heated too much it becomes brittle and forms black dust. There are now tar preparations on the market which give a reliable uniform product. In every city having a gas works using various grades of coal the quality of crude tar from a given tank will vary. Even with the coal constant the tar drawn from the bottom of a full tank will often differ materially from that taken from the same tank when nearly empty. Most failures in using crude tar may thus be traced to the variable nature of the tar which would not have occurred by using tar refined to the proper uniformity.

The tar macadam pavements which failed as such in Hamilton were not, however, total failures. The pavements were levelled up with concrete and asphalt binder, and a sheet asphalt top placed on it at very small comparative cost and with excellent results. These tar macadam pavements cost from 97 cents to $1.06 per square yard.

By the use of asphalt instead of tar a suitable pavement may be secured. The asphalt is applied in either of two ways, by penetration or pouring, or by mixing, as in the case of the tar macadam just mentioned. Using the penetration method, and after the foundation course has been rolled, there is placed a wearing surface of two inches thick (after compression with a road roller) of stone passing a two-inch ring. If there is already a foundation of concrete, old brick, block or macadam of sufficient strength no other foundation course will be necessary. On this wearing surface of compressed stone no water should be used but with suitable distributors from one and a half to two gallons per square yard of an approved asphalt binder should be poured depending upon the character of the broken stone. This binder should have a temperature ranging from 300 to 350 degrees Fahrenheit, and applied when stone is dry. Stone screenings are placed then on top sufficient to fill all surface voids, and the surface again rolled until smooth and true to cross section. Approximately one cubic yard of this material will cover 50 yards of roadway surface. A squeegee coat of approved asphalt from ½ to ¾ gallons per yard is then applied, and again sufficient screenings and rolling when the roadway is open for traffic.

In the mixing method the 1½-inch stone is dried and mixed with asphalt at the plant at a temperature not less than 300 degrees Fahrenheit, and spread on the prepared foundation to a depth of three inches after compression with a roller while the mixture is still hot, however, and before rolling stone chips, or sharp coarse sand free from dust should be spread over the surface. It is important that the rolling be thorough, especially about manholes, etc. As for the penetration a squeegee coat is spread and re-rolled as in the previous method. By this latter method an asphalt plant either portable or stationary is necessary. The crown of these bituminous pavements should be flatter then for macadam; in fact should be about ½-inch per foot of width where the grade will allow as in cold weather, it is apt to be somewhat slippery. The average cost of macadam in Hamilton was 60 cents, and for bituminous pavements as described, the cost would be from 25 to 40 cents more.

From bituminous macadam we naturally drift into bituminous concrete, where the stone is varied in size from sand to stone one inch in size graded to have as few voids as possible. Under this head come proprietary pavements, as Westrumite Bitulithic, and Warrenite The ingredients are combined and mixed at the plant and spread about two inches thick upon the foundation which is usually of concrete roughened on the surface. The following mortar has been used successfully in Chicago:—

Bitumen	18.8%
Passing 200 mesh	11.0%
" 80 "	10.6%
" 40 "	36.6%
" 10 "	23.0%
	100.0%

In proper grading of the smaller constituents about as above a close firm pavement is secured, less care being necessary for the larger sizes, provided also, of course, that a good asphaltic cement is used.

These bituminous pavements will cost from 95 to 90 cents per square yard, not including the concrete base, and are not intended for streets upon which the traffic is heavy. It may be intense that in having a large amount of light or rapidly moving vehicles with occasional teaming of coal or building material, and still be an excellent pavement, but it will not stand the traffic on business streets in cities.

Street asphalt pavements are laid only in the larger cities in Ontario on account of the skill required in properly mixing at the plant. Another reason is that such a plant is necessary. The refined asphalt is softened with a heavy mineral oil in the proportions of about eighty-one to eighty-six parts by weight to nineteen to fourteen parts of flux, and this forms the asphaltic cement. This cement forms from 9½ to 11½ parts by weight of the asphaltic mixture which forms the wearing surface. Between the wearing surface and the concrete base is placed a binder of ½ to 1″ stone which holds the surface to the base.

A few years ago several cities in the United States, and one or two cities here, including Hamilton, laid pavements without the binder course, roughening the concrete base instead. While it was successful on some streets with very little traffic it failed on well-travelled streets by rolling on the base. It was found almost impossible to get a roughened base without projecting stones too deeply into the surface mixture, and as a consequence much of the base was made too smooth with the resultant rolling under traffic. In earlier pavements an open binder was used, but recently a binder much closer is used.

The asphalt surface is principally graded sand; in fact about 90 per cent. of the surface mixture with a small percentage of stone dust and mixed with the asphalt somewhat less than will fill the voids to prevent rolling. The surface must be hard enough to prevent caulking by horses, and soft enough to prevent cracking in winter which is between comparatively small limits in this climate. For about two years the asphalt surface becomes about 5 per cent. harder each year so that in repairing a penetration much less should be used for the new material.

In grading the sand we have followed the following standard as closely as possible usually by mixing sand from two or more different places:—

Passing	200	mesh	0%
"	100	"	12%
"	80	"	12%
"	50	"	26%
"	40	"	11%
"	30	"	16%
"	20	"	12%
"	10	"	8%
"	8	"	3%
			100%

200 mesh sand does not pack well, and is therefore, not so desirable as 200 mesh limestone dust, as it tends to make the pavement mush in hot weather.

The grading given above is somewhat coarser than usual, but it has been found that this mixture gives a richer mixture with the same amount of bitumen, and will also lessen the drying out of the pavement.

The mixture should reach the work at a temperature not less than 28 per cent., and spread with hot rakes for a depth of 3″ to give a compressed surface of 2″. This requires also some skill and care to obtain good results.

The asphalt pavements will cost, including binder, but not the base from 65 to 80 cents per square yard. It will stand up under heavy traffic better than any of the asphalt concrete mixtures (including the proprietary ones). It requires a certain amount of traffic to keep in condition, and for business streets it is better than the asphalt concrete mixtures that depend on the stone in them for their strength, which on account of the size is apt to move about losing the inherent stability of the pavement.

Asphalt block is composed generally of 77 per cent. crushed gneiss, 10 per cent. limestone dust, and 13 per cent. asphaltic cement put in moulds, subjected to a pressure of from two to three tons per square inch, after which it is slowly cooled in water, all of which is done at the factory. Their only advantage over sheet asphalt is that the blocks can be laid by unskilled labor, but there are few cases where sheet or concrete asphalt is not preferable, especially on account of its high cost of about 2.70 per square yard without the base.

Vitrified brick pavements have been used extensively in some of the larger cities in Ontario, but in the case of Hamilton it is no longer used for pavements, except alleyways, where it replaced concrete. A vitrified brick pavement is not so slippery as asphalt, is durable under moderate traffic, and requires no special plant for laying. The reason for the re-action against the brick pavements in some of the cities is that the people prefer wooden block as being much quieter and lacking the peculiar roaring noise produced by the passage of light wagons. Much credit has also been thrown upon the use of brick by the careless and ill-judged manner in which some manufacturers have sent out irregular or imperfectly burned brick, along with the laying by inexperienced city foremen; a brick that is too hard being just as bad as one too soft upon the bricks surrounding. One drawback is that a street paved with brick and grouted cannot be travelled upon for a week or two after being laid without injuring the joints, and this is almost impossible to prevent upon some streets with the consequence that the flushers afterwards take it out and leave the edges of the brick unprotected, which under traffic causes the edges to chip off. The pavement is laid on a concrete foundation usually with a two-inch cushion of sand to take up an unevenness of the brick and to spread the pressure on the base.

The brick pavement is well laid under good specifications will give as good satisfaction under moderate traffic as asphalt block, while the cost is much less, being about $1.55 without the base.

Stone block pavements are only desirable for steep grades on streets of large cities where the heaviest traffic exists. There is no such traffic in any city of moderate size, so that in Ontario there are very few places where it would be necessary. It is a difficult pavement to keep clean, is extremely noisy, and about the most expensive pavement that can be laid.

Treated wooden blocks have come into use in the past few years, and each year shows a large increase in the amount being laid. It is practically noiseless, free from dust, and will withstand the heaviest traffic. The writer examined pavements in New York wholesale district where the traffic was of the heaviest, and after eight years' use these pavements were in excellent condition. In Hamilton at the intersection of James and King Streets, where there is the heaviest traffic in the city, the wooden blocks show no indications of wear after four years.

Although some engineers call for less the consensus of opinion is that the blocks should be treated with twenty pounds of creosote oil per cubic foot, and even then there will be a certain amount of swelling of the pavement, as a small percentage of water can still be absorbed. There will be a little bleeding of the oil from the blocks during the first summer after being laid, but it generally disappears by the second season. Longleaf Georgia pine has been the wood usually specified, but good results have also been obtained from Norway pine, tamarac and birch when properly treated. The joints may be filled either with grout, or pitch, the latter being the better, increasing the cost of the pavement. The blocks are laid with the grain vertical, and laid in a one-inch bed of cement and sand upon a concrete foundation, blocks being driven together, but having expansion joints at each curb of 2″ and every 10′ across the pavement.

In Hamilton this pavement has become so popular that some residential streets have petitioned for it on account of its quietness, although it is a costly pavement running from $2.25 to $2.65 per square yard, according to the kind of block, whether plain or grooved for heavy grades. All of these pavements have assumed a concrete base 6″ thick at least on business streets, with a mixture not less than 1-3-6, which will cost from 50 cents to 60 cents per square yard.

Pavements of concrete and reinforced concrete are now being built, but it should be remembered that the hardest concrete is less durable and softer than the average brick pavement, hence the hardest obtainable surface should be constructed. Two-course and one-course pavements have been built, and successful pavements have been built under either specification on residential streets. It is now entering into competition with brick and asphalt on business streets, and its use under such conditions is doomed to failure, as streets where such pavements ought to be laid cannot be successfully paved with concrete. While there is a wide field for its use on highways, and many streets in cities, yet it is the duty of the engineer to recognize that concrete has its limitations like other paving materials. Its proper use, however, under proper specifications, will prove a profitable investment for property owners on many streets where low first cost is a consideration, as it can be laid at a cost of from $1 to $1.20 per square yard, including the base. Unfortunately commercial interests have sent forth a lot of literature booming this pavement under all conditions which will work to the injury of such pavements if carried out under such advice. The success of this pavement depends greatly upon the way it is laid and some of its failures may be traced directly to the poor workmanship even with good specifications. Other causes will be improper materials, lack of screening, improper mixing, careless placing of materials, faulty joints, neglect of protection and curing. These pavements are sometimes reinforced with wire mesh two inches beneath the surface to eliminate cracks and have successfully done so where otherwise under the existing conditions cracks would have appeared from settlement, freezing, or contraction.

Grades.—Much misleading information is given out as to the grades upon which pavements can be laid. It is misleading because the conditions are not named and while the grade may be satisfactory under conditions of light traffic, yet be far from it where heavy teaming exists. The writer has found that in the condition existing in Hamilton that macadam, or asphalt-macadam can be used safely to 8 per cent. bitulithic to 4 per cent. brick, 3½ per cent. asphalt to 3 per cent. wood 2½ per cent., or where grooved or spaced with both 4 per cent. for heavy teaming. For general traffic 1 per cent. may be added.

Street Railway Tracks.—While the street or suburban railways always want tee rails because of cheapness and deeper flanges, it is the policy of the city to insist upon girder rails. No pavement will last alongside the inside of the tee rail as long as the steel protecting lip of the girder rail and sooner or later there is a groove worn out alongside the inner face of the rail where loaded vehicles will pull off wheels and which will become dangerous to general traffic.

The rails should be at least 80 pounds per yard, preferably fastened to steel ties with clips spaced ten-foot centres, with one tie at each rail end. A poorer construction is with wooden ties fastened to the rails with spikes which are apt to work loose allowing the rail to move. Even with the heaviest construction there is a certain amount of vibration which has a tendency to loosen the blocks of the pavement adjacent to the rail, especially at the joints.

In conclusion I would say that where a small city or town is about to spend large sums on paving, that it is money well spent to retain a consulting paving engineer to work out the proper pavement for each street. Infinitely better results would be obtained than at present where the councils are pulled about by representatives of different paving interests, or where deputations from such councils are steered to other cities to look over carefully selected pavements by these same commercial interests.

THE MINER'S INCH.

On the Pacific coast, the unit for measuring water in mining is known as the miner's inch. This varies greatly in different localities, and is now generally defined by legislative enactment. The statute inch of Colorado, for example, is defined as "an inch square orifice, which shall be under a five-inch pressure measured from the top of the orifice to the surface of the water, in a box set in the banks of the ditch. This orifice shall in all cases be six inches perpendicular inside measurement, and all slides closing the same shall move horizontally, while from the water in the ditch the box shall have a descent greater than one-eighth of an inch to the foot."

In British Columbia, under the Water Clauses Consolidation Act, 1897, Section 143, a miner's inch is declared to be a flow of water equal to 1.68 cubic feet per minute. Therefore, a miner's inch is equal to .028 cubic feet per second, and 1 cubic foot per second is equal to 35.71 miner's inches, approximately. One cubic foot per second would be equal to 38.4 Colorado miner's inches.

THE RAILWAY SITUATION IN HAMILTON

PECULIAR LOCATION OF CITY CREATES PROBLEM—SOLUTION IS SPEEDILY NEEDED—CO-OPERATION OF LINES NECESSARY—FUTURE DEVELOPMENT WILL NECESSITATE CHANGES NOW CONTEMPLATED

By E. H. DARLING, M.E., A.M. Can. Soc. C.E.

SEVERAL very important questions are involved in Hamilton's railway problem, some of which are of recent origin, while others date back many years. First of all there is the growing need for better station accommodation for the existing steam roads. This is a chronic trouble in a rapidly growing city. There is the question of grade separation,—the elimination of grade crossings with their dangers and delays. There is the smoke and noise nuisance which gradually grows as the railway traffic increases. All this, but principally the fact that another steam railway is seeking right-of-way through the city, has impressed upon the minds of the city officials, and many citizens in general, that now is the time to consider the railway problem as a whole, and, if possible, to find some solution which will not only answer present needs, but will provide for the future growth of the city.

The location of Hamilton is such that it is extremely difficult to bring a railroad into it, quite apart from the thousand and one obstacles which are always encountered in locating a right-of-way through a thickly populated district. To the north lies Burlington Bay. On the south abruptly rises the Niagara escarpment or "mountain" to a height of over 320 feet above the centre of the city, and 400 feet above the bay. On the west lies the "marsh" and the broken irregular Dundas valley. Between the marsh and the bay is a narrow ridge of land or "Hog's Back," a hundred feet in height, extending diagonally across the city. On the east, the level flats of the Niagara fruit district, permit an easy access, but this only for a line from Niagara Falls.

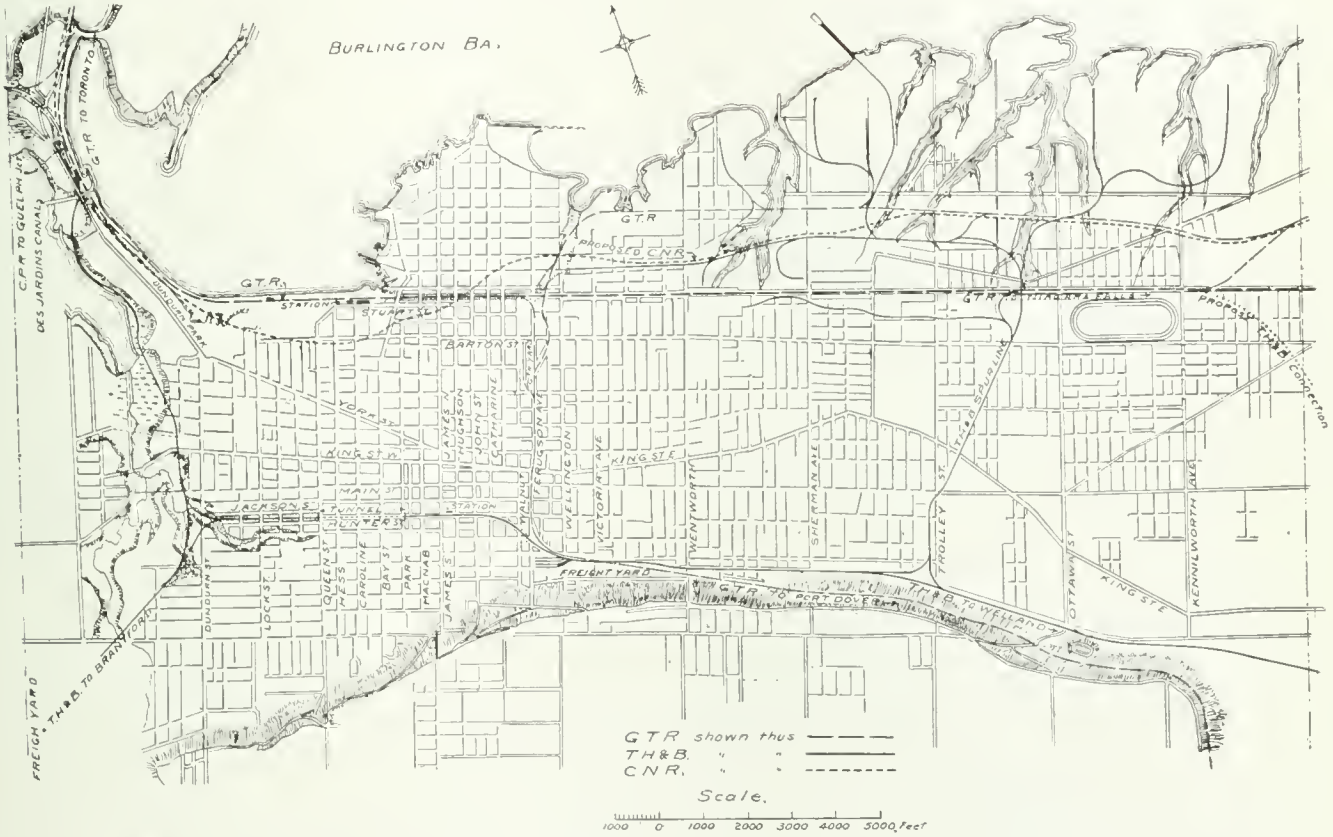


Fig 1.—Diagram of the city of Hamilton Showing existing railroads and proposed route of the Canadian Northern Railway.

Over fifty years ago the Great Western Railway, (now the Grand Trunk), occupied the bay shore. Its Port Dover branch (the old Northwestern Railway) cuts across the city and climbs the mountain to the eastward. In 1894-5 the Toronto, Hamilton and Buffalo Railway tunnelled the "Hog's Back" and entered between the centre of the city and the mountain. Last year the Canadian Pacific Railway, Guelph Junction branch, connected with the Toronto, Hamilton and Buffalo outside the city at the Des. Jardine Canal, (See Fig. 1). Besides these steam roads there are five suburban electric roads each with its independent entrance. These, with the street railway system, occupy most of the main streets.

About two years ago the Canadian Northern Railway began buying land for a right-of-way through the city, and filed their plans with the Railway Commission. Their plan is to follow the Grand Trunk Railway around the end of the bay, keeping at a higher level, cutting through Dundurn Park and striking the grade of the city streets about Bay Street. (See Fig. 1). From here there are three alternative routes to Ferguson Avenue. (Only the southerly one is shown). The remainder of the right-of-way follows the spur line of the Toronto, Hamilton and Buffalo and the Grand Trunk Railway, Burlington Beach Branch, to the city limits.

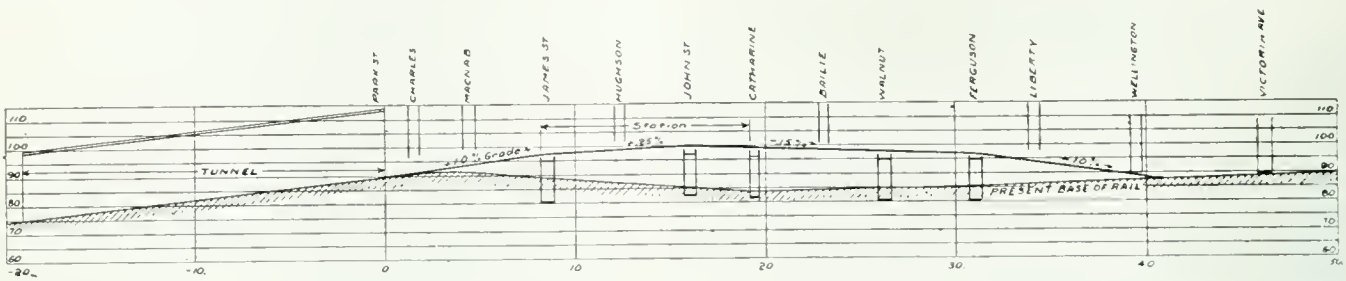


Fig. 2.—Profile of track elevation plan for the Toronto, Hamilton and Buffalo Railway, by Westinghouse, Church, Kerr and Company.

This route has called forth strenuous opposition from many quarters, principally on account of the many grade crossings and the injury to Dundurn Park and other property. The fact that the proposed line follows the Grand Trunk Railway so closely, naturally suggested the idea of a common right-of-way and a union station. In this case the Canadian Northern Railway would come along the north shore of the bay, bridging the end at the long peninsula, (shown on Fig. 1), keeping outside of the Grand Trunk Railway and following the same grade.

While this question was before the public an agitation had been developing, in the south end of the city, against the Toronto, Hamilton and Buffalo Ry. The conditions under which this road operates to-day are far different to what they were when it was built in 1894-5. Since that time the city has doubled in population and the number of residents south of the tracks has increased more than this in proportion, not counting the rapidly growing section on the mountain. The Railway Company has grown even more rapidly than the city. Its connections with the Vanderbilt lines through the Michigan Central and the Canadian Pacific Railway to Guelph and Toronto, make it the entrance of these two great systems.

The number of trains per day has greatly increased. Also, they have become heavier, longer, and operate day and night. As the station platform is only a short city block in length,—(about three hundred feet)—it is impossible to handle this heavy traffic without more or less blocking of streets. This, with the noise and smoke, is what the residents in the neighborhood are complaining about.

For some time it is believed that the Toronto, Hamilton & Buffalo Ry. has been buying lands on either side of its right-of-way for the purpose of adding tracks and increasing the station accommodation. There is also a probability that the Canadian Pacific Railway will build a line to Niagara Falls, using the Toronto, Hamilton and Buffalo Ry. right-of-way through the city and station. The fear of some such step has done more to arouse those interested to action than the other things they complain of. Their hope is to forestall the Railway Company, so that when the time comes to extend their station they (the company) will be committed to a plan that will not only be unobjectionable but will relieve present troubles.

At the last municipal election the residents on Hunter Street, and in the neighborhood, organized to work for

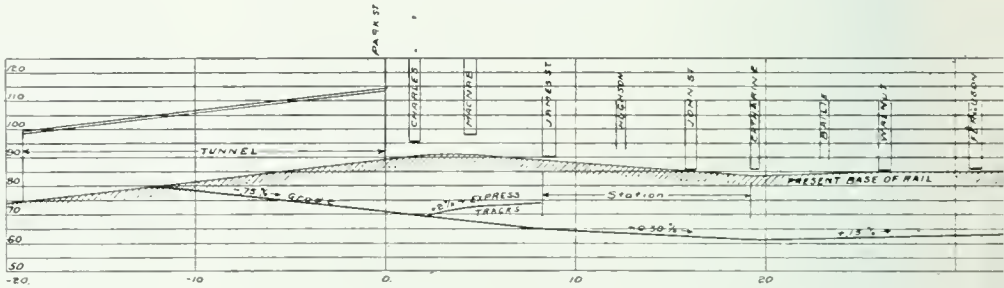


Fig. 3.—Profile of track depression pl

candidates who would agree to support their efforts in the city council. Since then the matter has been brought to a head by the sending of a largely-signed petition to the Railway Commission, asking that the Toronto, Hamilton and Buffalo Ry. be ordered to remove its tracks from Hunter Street.

It was while this matter was pending that the city authorities, acting on the suggestion of the City Engineer, approached the officials of the Grand Trunk Railway, the Canadian Northern Railway, and Toronto, Hamilton and Buffalo Ry. to ascertain if they would consider a plan of uniting to use a common right-of-way through the city, and of building a union station.

There are many reasons why this scheme is desirable from the city's point of view. In the first place, Hamilton is so confined between the mountain and the bay that an independent right-of-way through it effects as much as 10 per cent. of the city. The granting of another right-of-way is therefore a serious proposition.

(2) It would be a decided convenience to have all the steam roads use a union station just as do the electric lines, and thus do away with awkward transferring from station to station. If the union station were placed somewhere near the corner of James and Barton Streets it would be more convenient for a large majority of the citizens than at any other point for it would be within easy walking distance from the centre of the city and every street car line, with one exception, passes through that point without transfer.

(3) The land along and adjacent to Hunter Street, on account of the rapid growth of the city is becoming

very valuable (or would be if the railway were not there) and will be needed for the future growth of the business section. The land in the north end, as pointed out by the City Engineer, has reached its limit in value for residential purposes, and is more suitable for manufacturers and railroads.

(4) The proposed improvement to Hamilton harbor by the Dominion Government will make it all the more desirable to concentrate the transportation companies in the north end.

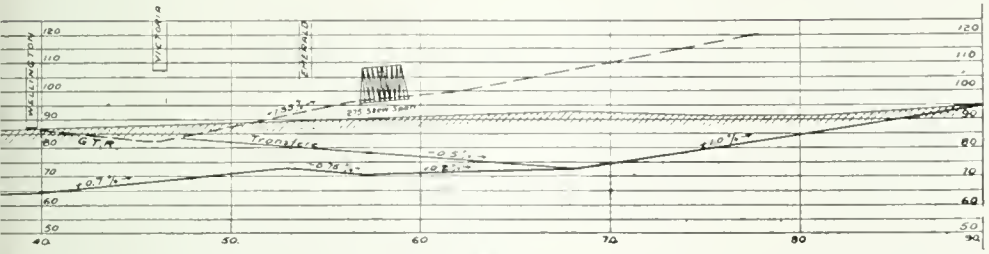
(5) The street traffic in the centre of the city has already become so congested that it requires special regulation, and as the city grows it will become more and more important to clear the streets now more or less obstructed by the Toronto, Hamilton and Buffalo Ry.

(6) At present the Toronto, Hamilton and Buffalo Ry. has a spur line across the city into the manufacturing district. A glance at (Fig. 1) shows a regular network of switches, and only the main ones are indicated. From these are collected every day several train-loads of freight, which are now transferred across the city, up heavy grades, the most of it travelling along Hunter Street to the west end freight yards. If all this traffic, along with the through freight, could be diverted to the Grand Trunk Railway right-of-way and taken to the yards by way of the Des Jardines Canal, practically every objection of the Hunter Street residents would be done away with. Besides it would not only bring the Railway Company within reach of new customers, but it would apparently be a convenience in handling freight.

Taking everything into consideration the common right-of-way scheme would seem to be a very satisfactory solution to the railway problem from the city's point of view, and the officials were correspondingly disappointed when, after the Grand Trunk Railway and Canadian Northern Railway had signified their willingness to confer on the question, the Toronto, Hamilton and Buffalo Ry. recently absolutely refused to consider it. However, the city decided to go ahead with the preparation of plans and of an estimate of the cost of connecting the Toronto, Hamilton and Buffalo with the Grand Trunk Railway, and will also ascertain if the Railway Commission has power to order the railway to make the change. The plans are now ready but have not yet been made public.

The attitude of the Toronto, Hamilton & Buffalo Ry. on this question is hardly to be wondered at. The company has very little to gain directly, even if it has nothing to lose. Its franchise through the city is of great value, quite apart from the actual value of the property it holds. This value increases every year as the city grows. The present location of its station affords an advantage in passenger traffic that is estimated at four to one. This, however, would be very materially effected should the Grand Trunk Railway build a proper station near James and Stuart Streets. There is one thing, however, that might make it worth while for the Toronto, Hamilton and Buffalo Ry. to consider the union station scheme and that is the outcome of the petition to the Railway Commission mentioned above, which might be an order to depress or elevate its tracks through the city.

Coming back to this petition. In replying to it the Toronto, Hamilton & Buffalo Ry. submitted a report, prepared by Westinghouse, Church, Kerr and Company, of New York, in which plans for both elevating and depressing the tracks through the city were worked out, with an estimate of the cost. These plans are both on the basis that the present alignment is to be



Westinghouse, Church, Kerr and Company.

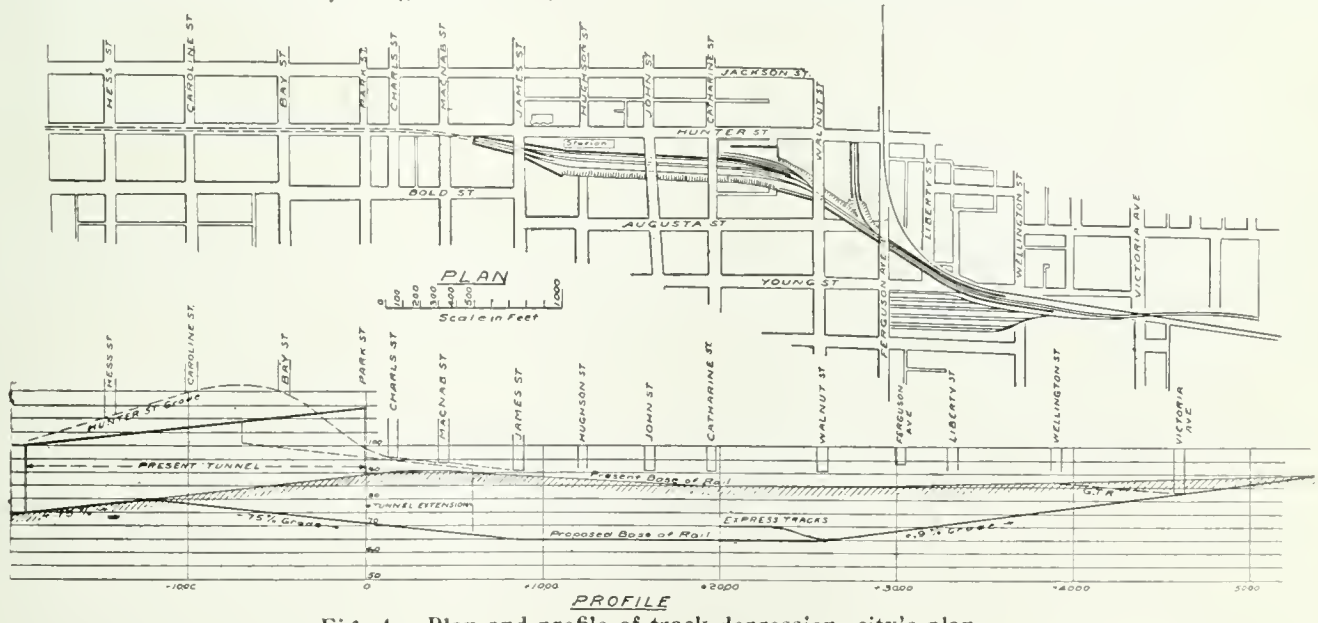


Fig. 4.—Plan and profile of track depression, city's plan.

maintained. At the session of the Railway Commission held in Hamilton, on April 28th, 1913, at which the case came up, the city submitted a third plan showing the tracks depressed and swung entirely off Hunter Street,

or covered in a tunnel.

A rough estimate of the cost of the three plans is as follows:—

Plan No. 1.—For elevating the tracks.....	$760,000
Plan No. 2.—For depressing tracks	2,940,000
Plan No. 3.—For depressing tracks, city's plan	1,200,000

These figures do not include land damages. For plan 3 in which this item is larger than for the other plans, it is estimated that these would amount to $310,000, allowing for salvage on property owned by the Toronto, Hamilton and Buffalo Ry.

All these plans include extensive additions to the station platforms, tracks, etc., which are much needed at present, and the cost of which should not be included in the actual cost of grade separation.

Fig. 2 shows the profile of the track elevation plan as worked out by Westinghouse, Church, Kerr and Company. Beginning at the mouth of the present tunnel the track rises on a 1 per cent. grade to James Street, where the station platform begins. James Street is depressed about nine feet and John, Catharine, Walnut and Ferguson Avenues, are depressed from three to six feet. The maximum street grade is 5 per cent. The following streets are closed entirely; Charles Macnab, Hughson, Bailie and Liberty Streets, while Hunter Street would be diverted and only one side-walk left on the present street. This plan is probably the least expensive and most satisfactory way of eliminating grade crossings from a construction and operating point of view, but to the city it would mean the loss of Hunter Street, the closing of five other streets and the introduction of long heavy grades in some of the main business streets. A glance at Fig. 1 will show that every north and south street from James to Bay Streets,—a distance of a quarter of a mile, would be practically closed as the grade on Park Street, over the portal of the present tunnel, makes it useless except for very light traffic. The embankment through the city would do more to depreciate property than the present tracks, while the trouble from noise and smoke would be increased rather than diminished, on account of the heavy grades.

A profile of the alternative plan is shown in Fig. 3. This is a comprehensive plan from depressing the tracks not only under the main streets of the city but also under the Grand Trunk Railway tracks of the Port Dover Branch. The change in grade begins about 1,200 feet west of the east portal of the present tunnel, and would necessitate the rebuilding of part of the tunnel. Other expensive items would be the 275-foot skew-bridge for the Grand Trunk Railway and the bridge at Victoria Avenue. The presence of the transfer tracks east of this point makes a double cut necessary.

Plan number three of which a profile is shown in Fig. 4 was developed by the Hunter Street residents and adopted by the city. It is a much simpler proposition. It would require the rebuilding of 700 feet of the present tunnel and the extension of it eastward for a distance of 600 feet. But the main feature is the complete deviation of the line off Hunter Street. This would restore Hunter, Park, Charles and Macnab Streets to their original grade and free them from obstruction. On the east the present grade is reached at Victoria Avenue. East of this street the railroad is practically out of the city as there is no land of much value between it and the mountain.

There will probably be a joint meeting of the engineers of the parties interested early this fall to go over the plans and reduce the estimates to a common basis. The Railway Commission will then be in a position to consider the question.

REINFORCED CEMENT DRAIN TILE.

MR. CHARLES E. SIMS, writing in "The Iowa Engineer," refers to a contract which he secured in the spring of 1912, for the 30 to 42-inch cement drain tile for Rock County, Minn. The contract called for 3,700 feet of 42-inch tile, 1,500 feet of 34-inch, 1,300 feet of 32-inch and 2,200 feet of 30-inch. The 42's were to be laid at an average depth of 17 feet 9 inches and a maximum of 22 feet and 6 inches; the 34's at a maximum depth of 13 feet 6 inches, the 32's at a maximum of 11 feet 4 inches and the 30's at 9 feet 7 inches.

The earth pressure at the greatest depth of the 42's, figuring the trench 62 inches wide, was estimated at 5 tons per foot, or 15 tons on a tile 3 feet long. The engineer, in charge, specified a wall thickness of 4 inches and a system of reinforcing consisting of 6 wire hoops placed in pairs 8 inches apart in the length of the tile, and the hoops of two sizes, such that one set was to be 1 inch smaller than the outside diameter of the tile.

It might have been a saving of metal to have used a deformed steel bar in place of a pair of hoops, since the earth pressures may be assumed to be vertical, and theoretically, therefore, the need for reinforcement exists only at the inside of the tile wall at top and bottom of the tile and at the outside of the tile wall at the sides. To make this clear let us imagine a tile failing from the load upon it. As the tile fails, cracks open on the inside at top and bottom and on the outside at the sides, hence reinforcing is needed where the cracks can first be seen. It was a question, however, whether the earth pressures would always be vertical; for the banks of a trench of such depth may be expected to cave, in which event the single bar reinforcement might not come at the right place to be effective and the tile be no stronger than it would have been without reinforcement. The wire hoops were, therefore, considered the better type of reinforcement.

To avoid all risks the reinforcing was placed in the tile 6 inches centre to centre instead of 8 inches, and all tile for the deepest positions were made of alternately No. 6 and No. 3 wire hoops. Further, the wall thickness was increased from 4 inch as specified to 4½ inch and the wires purchased of such diameter as to cover them ¾ inch from the surface of the concrete.

To make sure that the hoops when dropped into the tile mold would come to the desired position in the concrete, the hoops were wired together in four or five places with No. 16 wire ties, each end wound around the hoop wires and made to project outward ⅝ to ¾ inch. This process is not expensive, one man being able to tie 250 pairs of hoops in ten hours.

The tile were made in 3 foot lengths. One part Portland cement to 3 parts of sand and gravel was used for the concrete, and as much water as possible, with the result that the tile made have watertight walls, and it is believed that the bond between the reinforcing and the concrete is all that is necessary for strength and preservation of the metal.

The smaller sizes of tile were made of wall thickness equal to one-tenth the inside diameter of the tile and reinforced 8 inch centre to centre with No. 7 wire hoop placed 5/8 inch from the surface of the concrete, except the 30 inch, which were made with the walls one-twelfth the diameter of the tile, as they would not be used for six months after manufacture and the thinner wall was deemed sufficient, with good materials, mixed wet and tamped densely.

The 42's have been shipped 45 miles without breakage, and hauled seven miles frequently when but ten days old, thus demonstrating the quality of material and the effectiveness of the reinforcing in reducing breakage. A thousand feet of the tile are now in place, some under a fill of two-thirds the maximum due to tamping the fill at the sides of the tile.

PROGRAMME OF THE AMERICAN ROAD CONGRESS.

The American Road Congress, which is held under the auspices of the American Highway Association, the American Automobile Association, and the Michigan State Good Roads Association, and in which some twenty-five Road Associations will participate, is being held in Detroit, September 29th to October 4th.

The following is a list of papers to be presented. They will be read by title only, advance proofs being previously circulated and the sessions of the Congress given over to prepared discussion.

"The Labor Problem in Road Construction," by Captain P. St. J. Wilson, State Highway Commissioner of Virginia. Discussion to be opened by Mr. W. E. Atkinson, State Highway Engineer of Louisiana.

"Systematizing the Purchase of Road Materials and Equipment," by Mr. Henry G. Shirley, Chief Engineer, State Roads Commission of Maryland. Discussion to be opened by ——.

"Unsurfaced Roads," by Mr. W. S. Keller, State Highway Engineer of Alabama. Discussion to be opened by Mr. George W. Cooley, State Highway Engineer of Minnesota.

"Gravel Roads: Their Construction, Maintenance, Cost and Special Treatment," by Hon. S. Percy Hooker, State Superintendent of Highways of New Hampshire. Discussion to be opened by Mr. H. L. Bowlby, State Highway Engineer of Oregon.

"Treatment of Worn-out and Ravelled Macadam Surfaces," by Colonel E. A. Stevens, State Highway Commissioner of New Jersey. Discussion to be opened by Hon. Robert C. Terrell, State Commission of Public Roads of Kentucky.

"Bituminous Macadam Construction and Maintenance," by Mr. S. D. Foster, Chief Engineer, State Highway Department of Pennsylvania. Discussion to be opened by Mr. W. A. McLean, Provincial Engineer of Ontario, Canada.

"Brick Roads," by Mr. James M. McCleary, County Engineer of Cuyahoga County, Cleveland, Ohio. Discussion to be opened by Mr. R. Keith Compton, chairman Paving Commission, Baltimore, Md.

"Concrete Roads," by Hon. Frank F. Rogers, State Highway Commissioner of Michigan. Discussion to be opened by Mr. Paul D. Sargent, State Highway Engineer of Maine.

"Selection of Road Materials," by Hon. Logan Waller Page, Director, United States Office of Public Roads. Discussion to be opened by ——.

"Dust Prevention," by ——

"Drainage Structures," by Mr. A. R. Hirst, State Highway Engineer of Wisconsin. Discussion to be opened by Professor T. H. MacDonald, State Highway Engineer of Iowa.

"California's $18,000,000 State Highway System," by Mr. A. B. Fletcher, State Highway Engineer of California.

"Highway Accounting, with Special Reference to Maintenance," by Mr. Halbert P. Gillette, Editor-in-Chief, Engineering and Contracting.

"The Organization and Management of Working Forces," by Mr. A. N. Johnson, State Highway Engineer of Illinois.

"Contract Law," by Mr. William Bowman, of New York.

"The Protection and Upkeep of Road Equipment," by Mr. Daniel J. Hauer, of New York.

"The Merit System in Road Management," by Hon. J. A. McIlhenny, President United States Civil Service Commission.

"Financing Road Improvements," by Mr. Wm. G. Edens, President Illinois Highway Improvement Association.

"Bond Issues for Road Improvement," by Mr. S. E. Bradt, Vice-President First National Bank, DeKalb, Ill.

"The International Congress and the Roads of England, France and Germany," by Col. Wm. D. Sohier, chairman, Massachusetts State Highway Commission.

"Economics of Road Improvement," by Mr. J. E. Pennybacker, Secretary, American Highway Association.

"Dirt Roads and Politics," by Mr. Charles P. Light, former State Highway Commissioner of West Virginia.

Addresses by Hon. James H. MacDonald, Dr. Jos. Hyde Pratt, Mr. Clarence A. Kenyon and others.

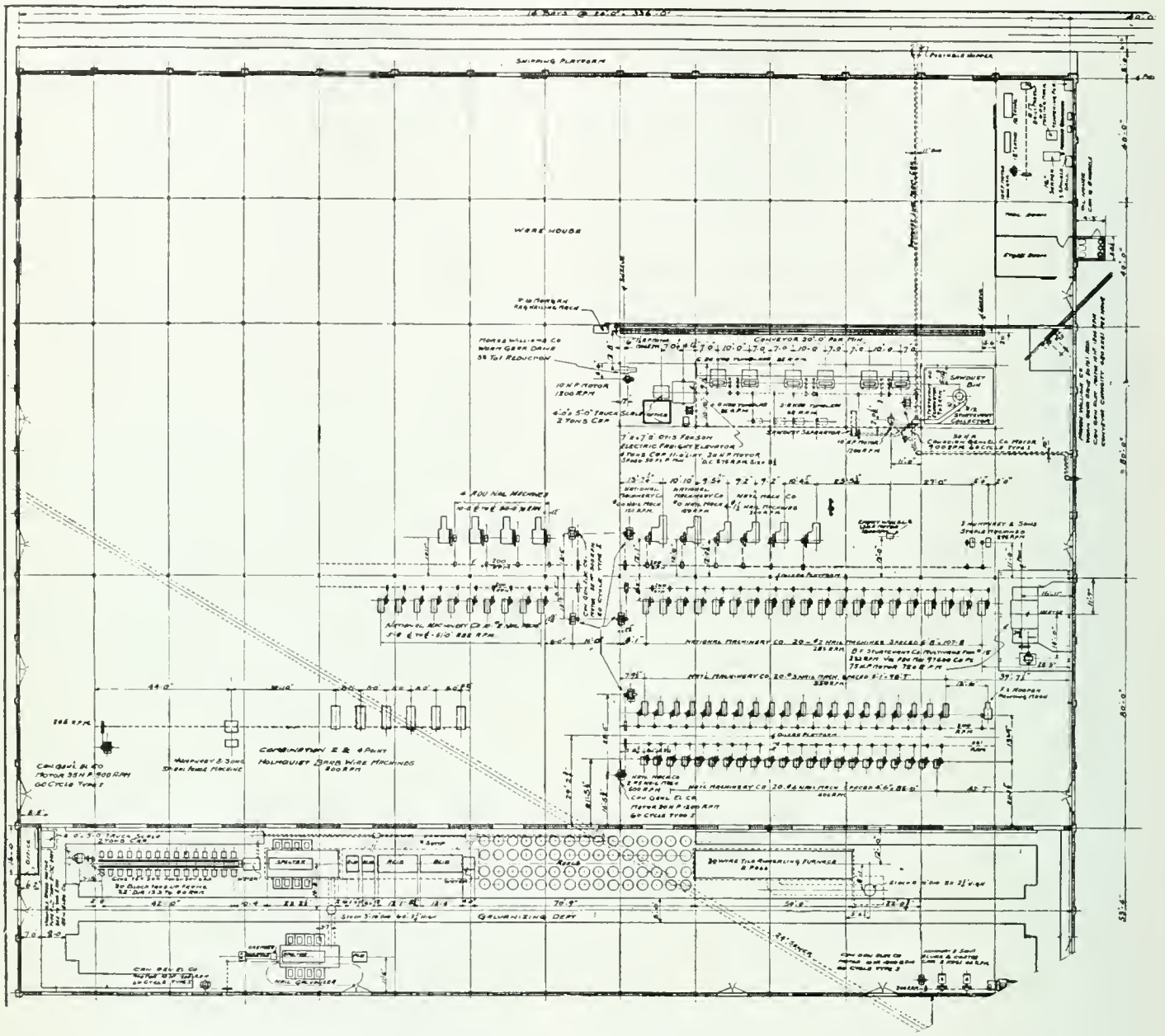
THE STRENGTH OF WALL AND COLUMN FOOTINGS.

In a bulletin recently issued by the University of Illinois, Professor A. N. Talbot gives the results of 114 tests made on the strength of wall footings, and of 83 tests on the strength of column footings. The wall specimens were in the shape of ⊥, the table being generally 5 ft. long by 12 in. deep, and the stem, representing the wall, was 12 in. square. During the tests the specimen rested on a nest of helical car-springs, of which as many as 225 were used in some tests. The load was applied to the top of the stem, and failure occurred generally by bending about a section parallel to one face of the "wall." The tests included footings of brick and of plain concrete, as well as of reinforced concrete, but the latter only gave fairly consistent results. The unreinforced specimens showed great irregularities. With the reinforced footings, on the other hand, the results were in fair accord with the ordinary theory of the reinforced concrete beam. The reinforced column footings were 5 ft. square and 12 in. deep, and the column was represented by a stem 12 in. square. As in the experiments with the wall footings, the specimen was supported during the test on car-springs. The general question of the distribution of stresses in slabs is discussed by Professor Talbot on a qualitative rather than a quantitative basis, the problem being, of course, of a very complicated character. This fact makes it difficult to give any really useful summary of the results, of which, however, full particulars, with illustrations of characteristic cases of failure, will be found in the bulletin.

THE WIRE AND NAIL MILLS OF THE DOMINION IRON AND STEEL COMPANY, LIMITED.

Like almost all the large and successful enterprises, the works of the Steel Company at Sydney, N.S., have grown by a process of evolution. In the earliest days the output was confined to pig iron and steel in its primary forms, the manufacture of which is not always profitable, but without which there can be no permanent or satisfactory development of the secondary industries producing more highly finished materials. Later, when the expanding trade of the country seemed to warrant a forward movement, mills were erected to produce rails, billets and wire rods. During the past year a third stage of development was reached by the completion of the Merchant Mill, described in *The Canadian Engineer* of July 31st, and the establishment of a department for the manufacture of a large scale of all kinds of wire and wire products, including not only various sorts of wire nails required for the home market, but others specially adapted for export.

An indication of the importance of this latest development of the works is given by the fact that the buildings in which the various processes are carried on for the conversion of rods into wire and nails cover no less than four acres of ground and that the tracks serving these buildings and connecting them with the company's general railroad system take up nearly as much more.



General Arrangement of Nail and Wire Mill, Dominion Iron and Steel Company, Sydney, Cape Breton.

Briefly stated, the course of operations is as follows: Rods, coming direct by hook conveyer from the rod mill, are prepared for drawing by cleaning and coating, they are then drawn into wire which may be finished for sale plain as it comes from the drawing blocks, or as annealed or galvanized wire. Part of the galvanized wire is put through machines which convert it into fencing of one sort or another. A large part of the plain wire is sent to the nail mill where it is made into nails of all patterns and sizes from a quarter of an inch to twelve inches in length, bright, coated, blued or galvanized.

For convenience, the departments in which these various processes are carried on may be described separately.

Cleaning and Coating Department.—The cleaning house occupies a space 94 ft. by 160 ft. with a lean-to on the west side for storage of acid and lime. It contains acid and water rinsing tubs, lime coating tank, measuring tank, two jib cranes and a baker with ten tracks and capacity for ninety trucks.

Rods in bundles are delivered to cleaning house by hook conveyer direct from the mill. They are first placed in the acid tubs to remove scale and rinsed in the water tub. They are then thoroughly coated in the lime tank and heated in the baker until the lime coating is firmly set and the rods are ready for drawing.

Wire Drawing Department.—This immediately adjoins the cleaning house, covers a space of 94 ft. by 192 ft., and contains seven wire-drawing benches equipped with 83 twenty-six-inch blocks of the most modern types. The benches are separately driven by six 100 h.p. and one 150 h.p. motors, through Morse silent chain drivers. Provision is made for making and annealing and tempering the steel plates through which the wire is drawn.

Annealing is done either in a muffle furnace set near the baker in the cleaning house, or in four coal-fired annealing pots housed in a building 33 ft. by 80 ft., served by a five-ton overhead electric crane.

Nail Department.—This occupies a space 240 ft. by 336 ft., and is equipped with eighty-two nail machines designed to make a great variety of sizes and patterns of nails, including some that have not been previously made in Canada. There is a full equipment of tumblers and other accessories, including a package printing press and automatic nailing machines, and a tool-room fitted up for making the dies required for the nail machines.

A space 80 ft. wide and running the whole length of the building is reserved for storage and has capacity for 80,000 kegs.

Galvanizing Department.—This is under the same roof as the nail mill on the west side, but is separated from it by a brick wall. The whole floor space, 53 ft. by 330 ft., is occupied by apparatus required for galvanizing wire and wire nails.

In the wire galvanizing process the wire is given two passes through a tile annealing furnace and afterwards goes in succession through water and acid baths, a pan of molten spelter and a water tank. It is then wound on electrically driven take-up blocks or reels, of which there are thirty in all, forming coils 22 inches in diameter inside.

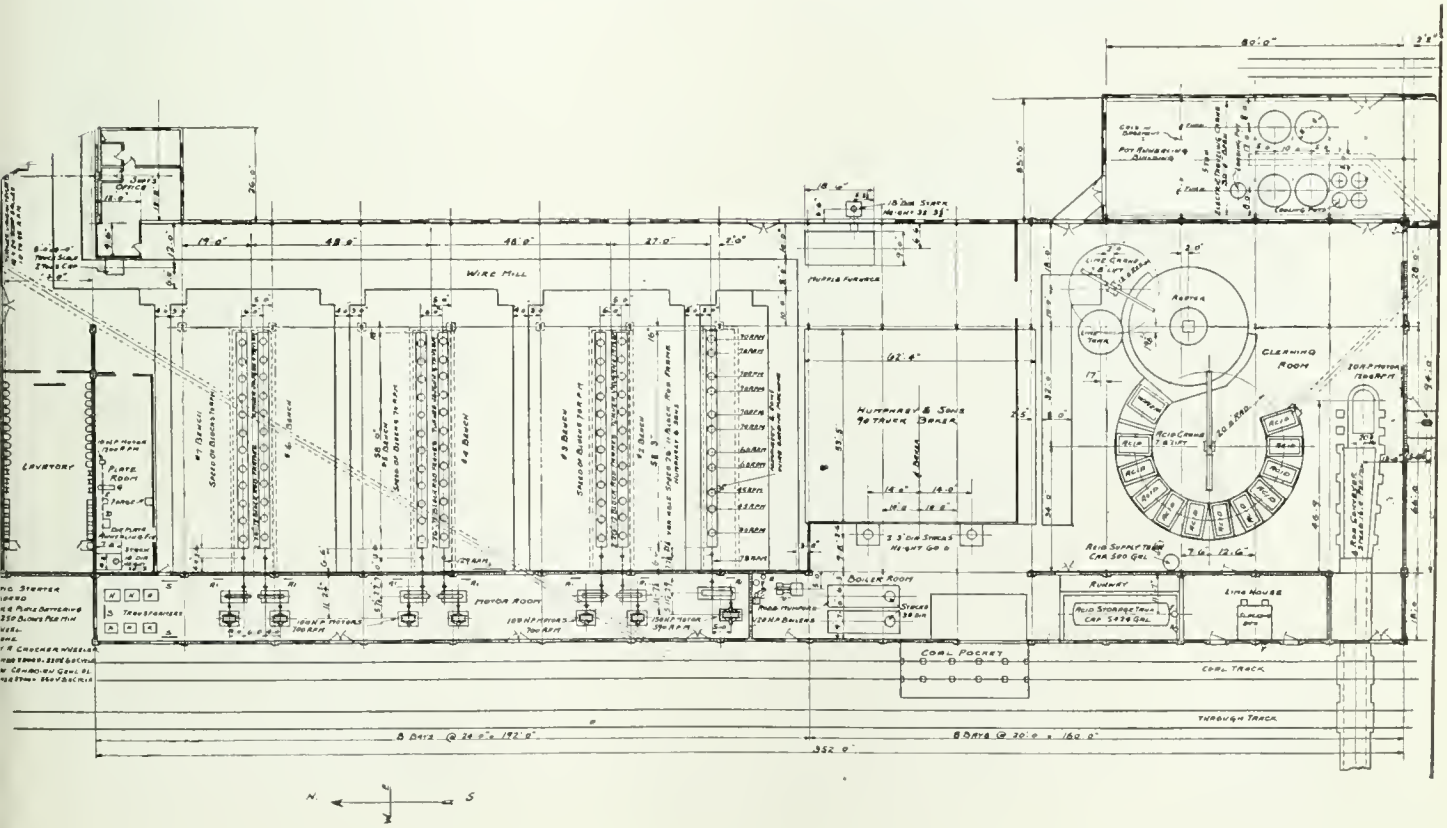
Coming from these reels the wire is ready to be bundled for shipment or to be put through the fence machines, of which there are six in the main building. This branch of the business might be largely increased, but at the present time conditions are such that there is little inducement for expansion.

The nail galvanizing unit consists practically of a tank for holding melted spelter into which the nails, previously cleaned, are dipped in steel baskets and a shaker and conveyer upon which they are kept in motion until the coating of spelter has cooled and set and there is no longer any danger that they will stick together.

Cooperage.—The cooper shops are housed in a two-story brick building, 40 ft. by 80 ft., with a single-story frame and corrugated iron extension the same size for storage of shooks.

They are fitted with dry kilns and suitable machinery for turning out an adequate supply of steel-bound nail kegs. The staves and heading are provided by the Sydney Lumber Company, Limited, one of the subsidiaries of the Steel Corporation, having its base of operations in the Restigouche county in New Brunswick.

Construction and Equipment.—Except where otherwise stated, the whole of the buildings are of steel and concrete construction with roofs of the high and low bay type, giving ample supply and even distribution of light.



Motive power throughout is electric. Steam for dry kilns, cleaning house and heating is furnished by 500 h.p., W.T. boilers. The buildings throughout are served by a Sturtevant heating and ventilating system. Lavatories and toilet rooms equipped with all modern conveniences are provided for the use of the employees.

Self-Dependence.—In this latest development of its varied activities there is a striking illustration of the ability of the Steel Corporation to carry on its business independently of aid or opposition. It wins the ore, coal and flux from its own mines and quarries, smelts the ore in its own furnaces, carries the resulting pig iron in its own works through the various processes that are necessary to convert it into the finished article that is required by the consumer, puts it in a package made in its own shops from lumber cut in its own mill from timber taken from its own lands, and delivers it to the user in the heart of the Dominion by means of its own ships.

What this really means is, that practically every cent of the value of a cargo of rails, or nails, or wire laid down at Port Arthur or Winnipeg, manufactured and transported under conditions such as are described above has been paid to our own people—and that not one cent has gone abroad.

The same statement could not be made if the pig iron were imported and made into steel, if steel billets were imported and made into rails or rods, or if rods were imported and made into wire and nails. The fewer the operations done at home the smaller the earnings of the home people; and the more complete the chain from the earth to the article ready for use, the more independent the nation and the greater its earnings and wealth.

The ground plan shown herewith needs no particular explanation beyond what has already been given.

ELECTRIC RESISTANCE OF MAGNETIZED GRAPHITE.

Magnetization affects the electric resistance of elements in different ways, generally increasing it, but decreasing it in the case of ferro-magnetic metals. This influence is several hundred times stronger in cadmium than in tantalum and bismuth. When investigating the magnetic properties of the elements, Morris Owen, Amsterdam, found that graphite possessed exceptionally high magnetic susceptibility. It, therefore, occurred to D. E. Roberts that the electric resistance of graphite would also be very greatly altered by magnetization, and his experiments entirely confirm this assumption. They also showed, however, that different specimens of graphite behave very differently, just as Owen had found that the magnetic properties of the elements were very much affected by their purity. Roberts experimented first with ordinary lead pencils, and afterwards with prismatic bars of various graphites, the specimens being about 10 mm. long, 1 mm. or 2 mm. in width, up to 0.5 mm. in thickness, at temperatures ranging from —200 deg. Cent. to + 200 deg. Cent. Some of his graphites conducted nearly half as well as mercury under ordinary conditions. When the graphite was magnetized, the direction of the lines of force being at right angles to the plane of cleavage, the electric resistance for continuous currents increased by several hundred per cent. in many cases, but the values fluctuated very much. As the temperature rose, the increase in resistance was generally less marked, but on the other hand it was sometimes also more clearly defined.

COAST TO COAST.

Vancouver, B.C.—The city has under consideration the expansion of the water system by the purchase of the watershed of Seymour Creek and the construction of a large reservoir or storage basin therein, a project which will involve much engineering.

St. Boniface, Man.—About two weeks ago the formal opening took place of the new stock yards at St. Boniface, Man. The function brought together a representative gathering of public men, and after Premier Roblin had declared the yards open, the party inspected the yards, which possess considerable interest for the engineer and the contractor. The contract for the laying of the sewers, water mains, together with all the concrete work, constitutes a problem that is quite interesting in itself when it is remembered that the pavements alone cover an area of 65,000 square yards. The paving consists of a concrete base 5½ inches thick, the mixture being 1:3:5. On top of this there is a one-inch thickness of finish, one part cement to 1½ parts coarse sand. The base and topping took 12,000 cubic yards of mixture. The runways for the cattle from the landing platforms to the level of the pens are all built of concrete. Altogether, it is an interesting piece of concrete construction. The contract for laying the sewers, water mains, laterals and concrete paving was carried out by the Hurst Engineering and Construction Company, of Winnipeg.

Brantford, Ont.—Ratepayers living on Brant Avenue became incensed over the deplorable condition of the street pavement, and have stated their intentions to the city council of refusal to pay charges upon the work when the tax bills are due in October. They state that they are prepared to go to the courts if necessary in defiance of any attempt on the part of the city to exact payment. Meanwhile, the paving company has received several ultimatums to repair the street, but nothing has been done, although the nuisance has prevailed for several months. Latest report has it that the city council has instructed that proceedings be commenced against the Westrumite Company to enforce the company's contract with the city for keeping the Brant Avenue in good repair.

Toronto, Ont.—The new Ontario Highway Commission has constructed a programme for the balance of the year that involves the collection of an immense quantity of statistics covering provincial road conditions, expenditure, and traffic, for each municipality. This will include data gathered from the United States, and concerning the experimental road work which many of them are doing. From the course adopted it is evident that the new system will primarily serve the interests of the farmer, and will endeavor to achieve a proper proportioning in the interests of the agriculturist and the automobilist. Laws and regulations, economic features, finance, construction and maintenance, and educational facilities is a summary of the work which the commission has undertaken for the next few months.

Calgary, Alta.—Analyses of the sample of Calgary drinking water sent to Edmonton recently by Dr. Stanley Mahood, medical health officer, show that the water from the Bow River, now being pumped into the city mains, is free from colon bacilli, which is a practical indication that there are no typhoid germs present. Dr. Mahood expressed himself as pleased with the result of the analyses, but pointed out that the city will soon be in a position to protect itself absolutely against possible contamination through daily analyses of the drinking water. "The new municipal laboratory, with City Chemist Field in charge, will be ready to make analyses of our water, beginning next week," said Dr. Mahood, "and the tests of the water will be made daily. This will enable

us to keep a constant check on our water supply, and will be of the greatest assistance to the health department." At the present time the water that is being pumped into the mains from the Bow River is chlorinated to destroy harmful germicidal life. The chlorine, however, to a certain extent favors the propagation of harmless bacilli, as shown by the Edmonton test. The water taken direct from the Bow showed 7,400 bacilli to the cubic centimeter, while that treated with chlorine showed 8,800 of the harmless bacilli to the cubic centimeter. The fact that the water samples have to be sent to Edmonton by train also permits the water to stand for a time, with the result that the propagation of bacilli is favored. The complete result of the analyses of water taken direct from the Bow River and the chlorinated water is as follows:—

	Direct from Bow River.	Chlorinated.
Hardness	120	114.2
Total solids	215	243
Loss on ignition	82	120
Alkalinity	132	120
Ammonia, free	.008	.026
Ammonia, albuminized	.032	.006
Nitrites	None	None
Nitrates	.04	.04
Chlorine	1.8	2.7
Sulphate	None	None
Colon bacillus	Negative	Negative

Edmonton, Alta.—City Engineer Latornell has submitted to the Commissioners blue prints showing the proposed sewage purification works to be erected on Ross Flats. As he pointed out, for some time past it has been proposed to erect a disposal plant there to purify the sewage from that portion of the city, which, roughly speaking, lies south of Jasper Avenue, between First and Twelfth Streets. In 1912 an appropriation of $30,000 was set apart for the construction of such a plant. But further study of the question has led Mr. Latornell to the conclusion that it would be an advantage if the city could bring across to this side of the river the sewage from that part of the South Side, which is already provided with drainage, and treat this South Side sewage in the plant located on Ross Flats. The new drawings are for that plant. A larger plant is in consequence required than was originally intended, but the ultimate economy in having one plant instead of two will be considerable, in the opinion of the city engineer, even though the new arrangement will necessitate one very expensive item, namely, a syphon under the river.

Ottawa, Ont.—On the suggestion of City Engineer Currie, a recommendation will be made to the city council by the board of control with a view to improving the manner of laying pavements. The main point aimed at is to prevent pavements sinking over where water or sewer pipes have been laid, and also to avoid having public services companies cut up a pavement the next day or so after it is laid. The proposition is that no permanent pavement be laid on any street till six months after the work has been passed by the city council. This will give the city time to do its underground work on the street and allow the earth used for filling in to settle. The public service companies will also be notified to do their work under the same conditions. The board discussed the matter, and all were agreed that the suggestion of the city engineer is a good one. So far, the Ottawa Gas Company has been cutting up pavements whenever it wished, claiming that under its charter it has a right to do so without asking the permission of the city. The board is of the opinion that recent legislation by the Dominion Parliament gives the municipality more control over the streets and prevents future work without the sanction of the city. At any rate, if the board's report is approved, the companies will be so notified.

Montreal, Que.—Chairman Drayton, of the Canadian Board of Railway Commissioners, and a small party recently witnessed a demonstration in London by the South Western Railway at Hamilton Court Station of the Prentice system of automatic wireless traffic control. It was invented by a young Canadian telegraphist, and is claimed to be an ideal scheme. The essential factor is that if any obstructive vehicle is on the track it interrupts wireless operations. A highly insulated wire is laid in the casing of the middle track. Normally, electric waves are constantly discharged, but the green and red signal lights are automatically shown when there is any danger on the track. The demonstration was entirely successful. A special train automatically was brought to a stop when a light engine was on the track some distance ahead. The cost of installation has not yet been indicated.

Vancouver, B.C.—An instrument that is expected to save the city of Spokane, Wash., $1,000 every day in the year by preventing a daily loss of 15,000,000 gallons of water from the system of mains, is being set up under direction of Water Superintendent Alexander Lindsay. It is a new leak detector, purchased by the department after a thorough investigation by Mr. Lindsay showed that 15,000,000 gallons of water was being lost each day by defects hard to locate in the complex system of underground mains. "We have just received the instructions for setting up the rather complicated piece of apparatus," Mr. Lindsay said. "The meter is attached to a single lead running into a given district, and all other inlets are cut off. It records every gallon of water sent into the pipes at the hour pumped. Then we trace the flow, and if it is found that much water is going into the district between the hours of 1 a.m. and 3 a.m., when the use of water is at the minimum stage, we can tell that there is a leakage. Then the district is made smaller, parts of it being cut off, until by a process of elimination we find just where the section is that is causing the waste. It will take some time to test out all of the mains in a city of 120,000 population, but our regular force will start the work immediately, and we hope to be able to reduce a great amount of waste in the very near future."

Quebec, Que.—Interesting forecasts of the business to be brought up at the next session of the Provincial Legislature, when a further loan for the good roads work, aid for the Canadian Northern Railway, in the Province of Quebec, and the question of a new court house for Montreal will be dealt with, were made by the Hon. Mr. L. P. Berard, Legislative Councillor, of Quebec, in an interview recently. The Highways Bill, passed in the early part of the year, authorized a loan of $10,000,000 for the improvement and building of roads in the province. About $3,000,000 of this has already been secured. So much work is in progress, however, says Mr. Berard, that more funds will be needed before long, and an additional loan floated towards the end of this year. Another important measure for consideration at the next session will be financial aid for the Canadian Northern Quebec lines. Mr. Berard does not anticipate any serious opposition in this matter, as he believes it to be generally recognized that the railway is entitled to the same benefits received by other great systems in the Dominion. Such assistance on the part of the Provincial Government will, of course, only provide for lines in the province. A proposition for the erection of Montreal's new court house, so long the subject of discussion, Mr. Berard states, will be introduced at the next session. The bench and bar of the city are practically unanimous on the question, and Sir Lomer Gouin is in favor of a new building also. Consequently, there is a good prospect of definite action being taken before the spring of 1914.

PERSONAL.

Geo. A. JANIN, city engineer of Montreal, is at present in Europe on a short vacation.

P. J. MITCHELL, of London, England, who organized The Canadian P. J. Mitchell Company about two years ago, is spending a few weeks at Banff, Alta.

C. A. MEADOWS, B.A.Sc., has acquired the management of the newly-opened Toronto branch of the Dominion Engineering and Inspection Company, of Montreal.

R. C. HARRIS, commissioner of works for Toronto recently received an offer from Vancouver, B.C., to a similar position there at a salary of $10,000 a year. Mr. Harris will likely remain with Toronto, however.

R. G. FINCH, of the State engineer and surveyor's staff, New York Barge Canal, has been spending a few days in Ontario acquainting himself with Canadian canal developments.

W. F. TELTZEL, provincial government agent a Nelson, B.C., has resigned his present position to accept the position of selecting and recommending sites for all public buildings throughout Western Canada. He will make his headquarters at Victoria.

OAKLEY T. BROWN, M. E., formerly combustion engineer on the Camden, N.J., engineering staff of R. D. Wood and Company, of Philadelphia, has been appointed chief engineer of The Mechanical Engineering Company, Limited, Montreal.

J. L. CHAMBERS, of Chambers, Limited, Toronto, has just returned from a business trip to Great Britain, while abroad Mr. Chambers visited the works of John Fowler and Company, Leeds, Manlove, Alliott and Company, Nottingham, Bertrams, Limited, Edinburgh and others of his principals over there.

HON. W. F. ALYMER, Dominion public works engineer at present in Vancouver, will go north shortly for the purpose of examining the Fraser River between Soda Creek and Lillooet with regard to the feasibility of navigation along this part of the river, and also to report regarding the channel in the south fork of the Fraser near Tete Jaune Cache.

FRANCIS A. JACOBS, the Montreal mechanical engineer who invented the Jacobs shop furnaces and oil burning equipment, has sold his patents and business to the Mechanical Engineering Company Limited, of Montreal. Mr. Jacobs becomes president of the new company. Mr. Graham being secretary-treasurer. The company has a well-equipped shop on Mill Street, Montreal. They are building furnaces and burners under the trade name of "Mecol," and are also agents for Canada for R. D. Wood and Company, of Philadelphia, and Mesta Machine Company, of Pittsburgh.

OBITUARY.

E. M. STOREY, a prominent architect residing in Regina, Sask., died on August 24th. Mr. Storey was formerly a resident of Kingston, Ont.

ALEXANDER MACFARLANE, D.Sc., LL.D., whose prominence as an educationalist in mathematical and physical research grew to be universal, died at his home in Chatham, Ont., on August 28th.

Dr. Macfarlane was born at Blairgowrie, Scotland, April 21st, 1851. He was a pupil-teacher at the age of thirteen, and in 1869 entered the University of Edinburgh, where he won many scholarships. In 1875 he finished an unusually extensive course in undergraduate study by taking the degree of M.A., with honors in mathematics and physics.

After graduation he won the MacLaren fellowship, and in 1878 he obtained the doctorate, after one year spent on botany, chemistry and natural history. His thesis was a remarkable experimental research into the conditions governing the electric spark. This brought him to the attention of the celebrated electrician and philosopher, Clerk Maxwell. In 1879 he was elected to the Royal Society of Edinburgh.

In 1885 he was called to the chair of physics in the University of Texas, and in 1887 received the honorary title of LL.D., from the University of Michigan. In 1891 he was actively engaged in organizing the Texas Academy of Science, and for two years acted as honorary secretary.

About fifteen years ago Dr. Macfarlane moved to this country, and since that time he has been actively engaged in mathematical research. A few months ago Dr. Macfarlane read a paper before the Royal Society of Britain that elicited much praise from its members. At a special invitation from President Falconer he gave, last spring, a series of five lectures on Vector Algebra at the University of Toronto. A brief of these lectures, written by Dr. Macfarlane, appeared in "Applied Science" for July.

Dr. Macfarlane lived in Chatham for the past nine years, during which time he took great interest in educational matters.

COMING MEETINGS.

THE NEW ENGLAND WATERWORKS ASSOCIATION.—Annual Convention to be held in Philadelphia, Pa., September 10th, 11th and 12th, 1913. Secretary, William Kent, Narragansett Pier, R.I.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Tenth Annual Meeting will be held at Cleveland, Ohio, September 17th and 18th. Secretary, W. P. Blair, 824 Engineers' Building, Cleveland, Ohio.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Third Annual Meeting in Regina, September 18th, 19th and 20th. General Secretary, Major Lorne Drum, Ottawa; Local Secretary, R. H. Murray, C.E., Regina.

ILLUMINATING ENGINEERING SOCIETY.—Annual Convention to be held at Pittsburg, Pa., September 22nd to the 26th. Secretary, I. D. Israel, 29 West 39th Street, New York City.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, Lo21 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS
OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20043—August 12—Refusing application of board of trade of Lethbridge against cancellation of G.N.R. tariff, C.R.C. No. 720, applying between stations on various lines in Eastern Canada, and stations on the Alberta Railway and Irrigation Company's Railway.

20044—August 13—Authorizing C.P.R. to revise a portion of the present main line of its Farnham Subdivision and to construct additional track across Central Vermont Railway.

20045—August 14—Amending Order 19803, July 17th, 1913, in re C.P.R. crossing at mileage 9.7 from Aylmer, by striking out the word "Aylmer" and substituting the word "Hull."

20046—August 5—Authorizing C.N.R. to construct spur to premises of Mackenzie Ellis Company, Prince Albert, Sask.

20047—August 8—Directing C.P.R. to reduce its rate on coal from Port Burwell to Lambton and Islington from 75 cents to 70 cents per ton; effective not later than September 1st, 1913.

20048—August 13—Amending Order No. 19946, dated July 31st, 1913, re C.P.R. crossing G.T.R. at Tecumseh Street, Toronto, by striking out the words "or construction purposes only."

20049—August 13—Amending Order 4669, dated April 15th, 1908, in re Toronto and Niagara Power Company carrying its wires across C.P.R., in Lot 6, Con. 3, Twp. of York, by providing that crossing be made in accordance with plan on file with the Board under File No. 22682; subject to supervision of the Board's Electric Engineer.

20050—August 1—Approving proposed alteration by C.L.O. and W. of its line in the Twp. of Camden, at mileage 45.5, so as to include extra lands required for station grounds.

20051—August 12—Amending Order No. 19239, dated May 9th, 1913, re protection at King Street, by providing that the whole cost of the flagman maintained at said crossing be paid by G.T.R.

20052—August 12—Authorizing G.T.R. to construct two branch lines to premises of Riordon Pulp and Paper Company, Hawkesbury.

20053—August 14—Authorizing G.T.R. to renew bridge No. 5, on the 15th District, Middle Division, King Street, Toronto.

20054—July 29—Authorizing G.T.R. B.L. Co. to cross Harry and Francis Streets, in the city of Calgary.

20055—August 9—Approving plans and specifications of proposed repairs to Little Creek Drain, filed by G.T.R., in the Tp. of Tilbury North.

20056—August 12—Rescinding Order No. 5390, dated August 13th, 1908, in re application of Alex. Pilon, of Casselman, Ont., declaring a charge of $3 per car to be made by G.T.R. for switching at Casselman.

20057—August 13—Directing C.N.R. to fence its right-of-way on its Rossburn Branch from mileage 35 to mileage 40, Manitoba; work to be completed by September 1st, 1913.

20058—August 11—Authorizing Wm. Alexander, of Silverwood, Sask., to construct spur across C.N.R. to N.E. ¼ of Sec. 15, Tp. 37, Rge. 5, and N.W. ¼ of Sec. 14, Tp. 37, Rge. 5, W. 3 M., Mun. of Cory, Sask.

20059—August 7—Amending Order No. 18616 in re public road between Cons. 12 and 13, Tp. of Chisholm, by approving of proposed diversion shown on plan, filed by the Railway Company.

20060—August 13—Authorizing C.N.O.R. to cross and divert public road in Lot 38, Con. 18, Tp. of Ferris.

20061—August 13—Authorizing C.N. B.L. Co. to cross thirty highways on its Grosse Isle Branch.

20062—August 13—Approving location of station grounds of Inter-provincial and James Bay Railway Company, at mileage 9.56, Parish of Mercier, Que.

20063—August 11—Approving terms and conditions of Bell Telephone contract forms 1 and 2, in so far as they restrict or limit telephone company's liability.

20064—August 13—Authorizing the St. Lawrence Pulp and Lumber Corporation to cross Atlantic, Quebec and Western Railway in the County of Gaspe.

20065—August 12—Authorizing G.N.R. to remove frog and switch at crossing at Crescent, B.C., and to construct a new switch thereat.

20066—August 15—Authorizing C.P.R. to construct spur for J. Gunn and Sons, Winnipeg, Man.

20067—August 15—Authorizing C.P.R. to reconstruct bridge No. 5.7 over Mill Street, Norwood, Ont.

20068—August 15—Authorizing C.N.R. to construct spur for Manitoba Gypsum Company, near Moosehorn.

20069—August 12—Authorizing C.N.R. to construct branch line through Block 6, Hudson Bay Reserve.

20070—August 15—Authorizing G.T.P. B.L. Co. to cross 14 highways in the town of Battleford, Sask.

20071—August 15—Approving clearance of coal conveyer on C.P.R. at sidings of Ontario National Brick Company, Limited, Twp. of Toronto.

20072—August 14—Authorizing Bell Telephone Company to construct wires and poles upon twenty-one streets in the city of Montreal, for the purpose of operating its telephone service.

20073—August 15—Approving proposed Scale "P" to the Express Classification for Canada.

20074—August 12—Amending Order No. 17384 to provide charges for cream up to 400 miles, as follows:—

Miles.	Five-gallon cans, each.	Eight-gallon cans, each.	Ten-gallon cans, each.
350	71 cents	91 cents	96 cents
400	79 cents	101 cents	106 cents

to become effective not later than September 18, 1913.

20075—August 15—Authorizing the C.N.O.R. to construct a temporary level crossing over public road between Cons. B. and 2, Twp. Westmeath.

20076—August 14—Authorizing the C.P.R. to construct siding tracks across St. Roch St., Quebec, St. Peter's Ward, P.Q., to storage yard, at mileage 159.8 from St. Martin Jct., on the C.P.R. line, Eastern Div., Dsitrict No. 3, Quebec Sub-division.

20077—August 15—Approving location of the C.N.O.R. station grounds at Westmeath, Twp. Westmeath, mileage 79.64 from Ottawa.

20078—August 19—Authorizing C.P.R. to construct three extra tracks across Jamieson St., in the town of Lacombe, Alta, by means of grade crossings.

20079—August 15—Authorizing the C.P.R. to revise the grade of the present grade crossings, necessitated by an additional track (double track); and to construct additional track across certain highways between mileage 10.00 and mileage 39.1, London Sub-division.

20080—August 18—Approving proposed location of C.P.R. station on Lot 2, 7th Con. of the Twp. of Cavan, Co. Durham, Ont., at mileage 38.66 on its Toronto Sub-division at Bethany Jct.

20081—August 18—Amending Order No. 19939 by striking out paragraph 2 of the Order and substituting therefor the following:—

(Continued on Page 84).

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
✚—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

PLANS AND SPECIFICATIONS ON FILE.

The Canadian Engineer, 820 Union Bank Building, Winnipeg:—

ISSUE — CLOSE

28-8—Supplying power house machinery, Neepawa, Man. 12-9

The Canadian Engineer, 62 Church Street, Toronto:—

28-8—Supplying power house machinery, Neepawa, Man. 12-9

The Canadian Engineer, 628 Transportation Building, Montreal:—

28-8—Supplying power house machinery, Neepawa, Man. 12-9

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Canoe, B.C., public wharf	Sept. 11.	Aug. 28.	80
Cayuga, Ont., macadam road	Sept. 16.	Aug. 7.	88
Chilliwack, B.C., school building	Sept. 8.	Aug. 28.	82
Fraser River, B.C., jetty and dredging	Sept. 30.	Aug. 21.	80
Gillies Bay, B.C., wharf	Sept. 15.	Aug. 28.	80
Kingston, Ont., pavements	Sept. 5.	Aug. 28.	84
Laprairie, Que., protection dyke.	Sept. 23.	Aug. 28.	80
Listowel, Ont., drill hall	Sept. 16.	Aug. 21.	80
London, Ont., bridge	Sept. 11.	Aug. 21.	76
Main Duck Island, Ont., construction of buildings	Sept. 16.	Aug. 28.	80
Merritt, B.C., drill hall	Sept. 11.	Aug. 28.	82
Montreal, Que., postal station	Sept. 8.	Aug. 28.	80
Moose Jaw, Sask., elevator	Sept. 8.	Aug. 21.	80
Ottawa Ont., double tracking	Sept. 8.	Aug. 21.	76
Ottawa, Ont., substructure of bridge at Smith Falls	Sept. 6.	Aug. 14.	76
Ottawa, Ont., Int. Ry. works	Sept. 8.	Aug. 28.	76
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Regina, Sask., power house equipment	Oct. 1.	Aug. 28.	86
Saskatoon, Sask., elevator	Sept. 8.	Aug. 21.	80
Steelton, Ont., public building	Sept. 9.	Aug. 14.	82
Victoria Harbor, Ont., wharf	Sept. 8.	Aug. 14.	80
Victoria, B.C.,	Sept. 9.	Aug. 28.	84
Winnipeg, Man., transmission system	Sept. 20.	Aug. 28.	78

RAILWAYS—STEAM AND ELECTRIC.

Derby Junction, N.B.—Tenders will be received up till the 19th of September, 1913, for the diversion of line Nelson to the Junction. Plans and specifications may be obtained from the Chief Engineer, Moncton, N.B., and Department of Railways and Canals, Ottawa. J. K. Jones, secretary.

Edmonton, Alta.—The work of ballasting the main line of the Canadian Northern Railway between Edmonton and Tollerton, the first division point west of the city, is progressing rapidly and it is expected the line will be ready to turn over for operation by the middle of September. It is the intention of the company to operate a tri-weekly service between Edmonton and Tollerton as soon as the road is completed.

Fort William, Ont.—At the last meeting of the city council it was decided that all efforts possible would be made to have the street railway extensions across the Kaministiquia River to island No. 2, completed and in operation before the end of the present year, which will assuredly be a great accommodation for the many workmen employed on the various industries in this locality.

St. Malo, Que.—Tenders will be received up till the 9th of September, 1913, for the construction of locomotive and car shops. Plans and specifications may be obtained from Board of Commissioners of the Transcontinental Railway, Ottawa. P. E. Ryan, Secretary.

Toronto, Ont.—Mayor Hocken expects that the experts who are appraising the value of the Toronto Street Railway and Toronto Electric Light Companies' assets will be ready about the end of the week.

Victoria, B.C.—Mr. Hall, general manager of the western lines of the Canadian Pacific Railway, stated that the locomotives on the Cascade subdivision of the line would be transformed into oil burners and would be ready for service under the new system by the end of October, or even earlier. The railway is establishing oil tanks at different divisional points to supply the engines with fuel. Freight, passenger and yard locomotives will use oil as fuel. Commenting on the double track operations, Mr. Hall said that gratifying progress was being made and that trains would be running on the new track at an early date between Mission and Ruby Creek. The general manager observed also that the company had completed its preparations for handling the grain crop, which he believed from the estimates would be very good. He added that the reported damage in some of the prairie sections was only slight.

✚—**Vancouver, B.C.**—The Kettle Valley Railway Company has awarded MacARTHUR BROTHERS COMPANY, New York, the contract for the construction of the 38-mile section of the railway between the summit of the Hope Mountains and the town of Hope. The contract price is $3,000,000.

Welland, Ont.—The Dunnville, Wellandport and Beamsville Electric Railway, which has been under construction for some years, but which lately has not been progressing on account of financial difficulties, is now about to be started again, arrangements being completed for the sale of extra bonds. Thirteen miles are already graded and ties laid on this part of the road, the bridges and structural work being also completed on this division. The line has a charter from Port Dover to St. Catharines, with branches to Dunnville, Welland, Jordan Harbor and other points, making train connections with the G.T.R., Wabash, Michigan Central, and Toronto, Hamilton and Buffalo. It runs through a good section of the country, and when in operation will no doubt be a great success.

BRIDGES, ROADS AND PAVEMENTS.

▲—**Cayuga, Ont.**—Tenders will be received up till the 16th of September, 1913, for the construction of 26½ miles of stone macadam road. Plans and specifications may be obtained from T. A. Snyder, County Clerk.

Barrett Specification Roofs

Economy *and* Protection

THE fire standards for theatre buildings are especially rigid. It is significant, therefore, that a large number of theatres throughout the country carry Barrett Specification Roofs. These roofs take the base rate of insurance and are acceptable to fire underwriters everywhere

Their cost is less than that of any other permanent roof covering; they require no expenditure whatever for maintenance and usually last about twenty years.

A Barrett Specification Roof consists of five plies of tarred felt and pitch with a top covering of slag, gravel or tile. Being one continuous sheet with no laps or seams it blankets the flames in case of fire and will last until the supports beneath are entirely destroyed. From the standpoint of both economy and protection such roofs should be used on all permanent buildings.

A copy of the Barrett Specification with tracing, ready for incorporation into your building plans sent free on request. Address nearest office.

THE PATERSON MFG. CO., LIMITED

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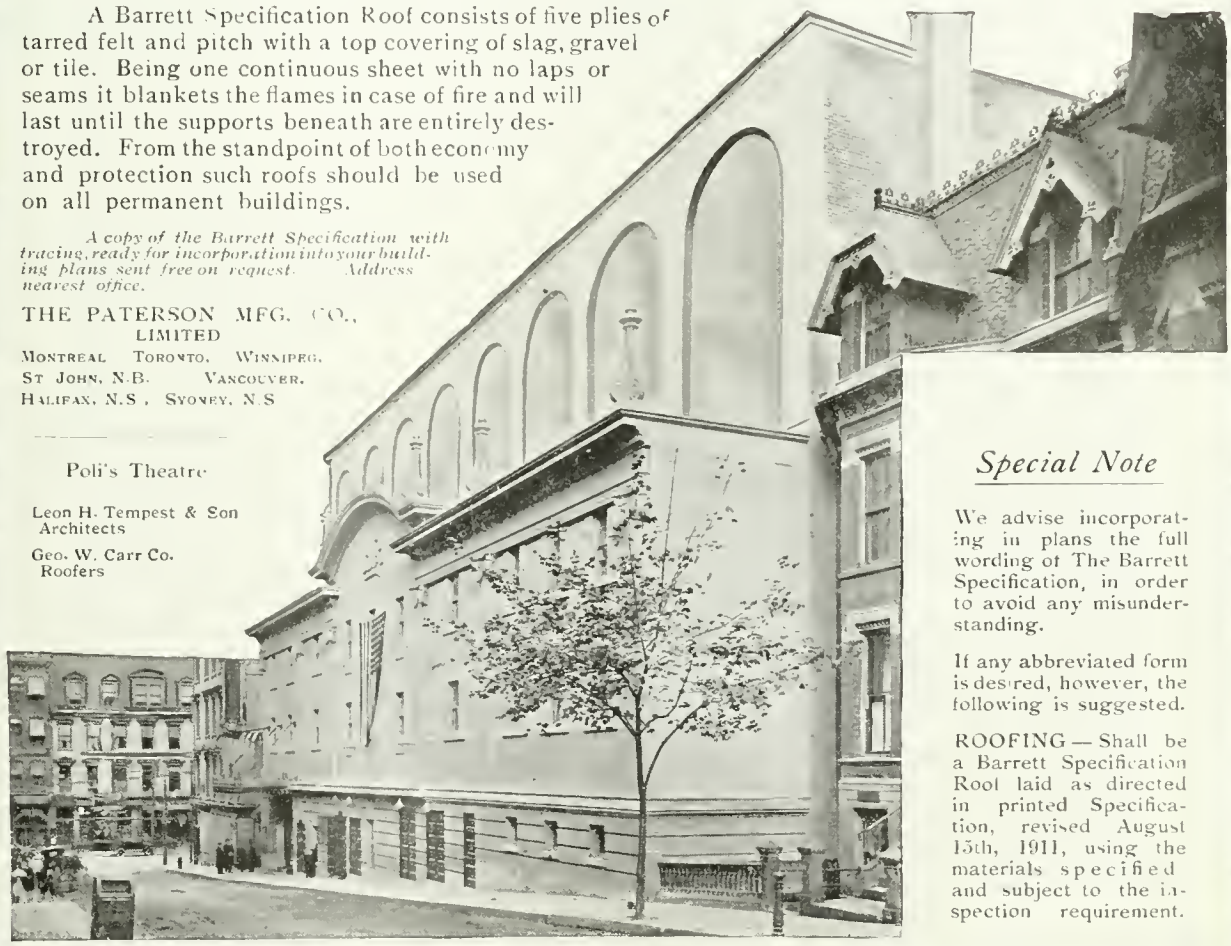

Poli's Theatre

Leon H. Tempest & Son
Architects

Geo. W. Carr Co.
Roofers

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested.

ROOFING — Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified and subject to the inspection requirement.

Danville, Ont.—Tenders will be received up till the 6th of September, 1913, for the erection of a single-span bridge at Nicolet Falls. Plans and specifications may be obtained from C. C. Brown, secretary-treasurer.

Fredericton, N.B.—Tenders will be received up till the 8th of September, 1913, for the construction of a public highway from McAdam Junction to Havery settlement a distance of about nine miles. Plans and specifications may be obtained from the Department of Public Works, Fredericton, N.B.

Guelph, Ont.—Mr. C. H. Mitchell, consulting engineer, Toronto, has examined and approved of the plans prepared by City Engineer Holland for the alterations to the Neve Street bridge and the Sewerage and Public Works Commission will commence work for an additional span and a 200-foot retaining wall as soon as possible. It is expected that when completed it will put an end to the spring floods have done thousands of dollars' damage in the city the last two years.

Halifax, N.S.—Tenders will be received up till the 11th of September, 1913, for the construction of bridges and culverts in the County of Lunenburg. Plans and specifications may be obtained from the Department of Public Works, Halifax, N.S. E. H. Armstrong, Commissioner.

Hamilton, Ont.—The McKittrick Syndicate is planning the erection of a $100,000 bridge in the southwestern portion of the city to connect with the McKittrick Syndicate survey.

+—Kansas City, Mo.—The DOLARWAY PAVEMENT COMPANY has been awarded the contract for the construction of 16,000 square yards of pavement. The contract price is not given.

▲—London, Ont.—Tenders will be received up till the 11th of September, 1913, for the supply and erection of three 130 feet spans riveted truss steel highway bridges over the Thames River. Plans and specifications may be obtained from Wm. N. Ashplant, City Engineer.

Montreal, Que.—Headed by alderman Houle, a delegation of residents of St. Denis ward called on the controllers recently and asked that the work of levelling and paving the eastern side of St. Denis street be carried out as soon as possible. The commissioners promised to recommend to the council that the work which will cost $27,000, be immediately got under way.

+—Montreal, Que.—The Board of Control has awarded the following paving contracts amounting to $330,067: To the BITHULITHIC PAVING COMPANY, Sherbrooke St., from Champlain to St. Denis Street, at $2.75 a square yard for $72,117.50; Sherbrooke Street from St. Denis to McGill College at $2.78 a square yard, $74,870; Durocher Street from Prince Arthur to Pine Avenue at $2.75 a square yard, $4,812.50; St. Hubert Street from Ontario to Sherbrooke street, at $2.84 for $6,665.48; and Union Avenue, from Sherbrooke to Burnside Street, at $2.88, for $7,056, making a total to this company of $165,521.49. To the WARNER QUINLAN ASPHALT COMPANY, Sherbrooke Street from McGill College to Guy Street, at $2.95, $67,810; St. Andrew Street from Dorchester Street to Laugauchetiere Street, at $2.82 for $3,553.20; Ontario Street from Sherbrook Street to Burnside at $2.87 for $6,084, and MacGregor Street in all its length at $2.91 for $11,640, making a total of $89,087.20. To the SICILY ASPHALTUM PAVING COMPANY, partly in asphalt: Aylmer Street, Sherbrooke to St. Catherine Street, asphalt, at $2.53 and special paving at $2.83, for $9,213.33; McGill College Avenue, from Sherbrooke to St. Catherine Street, asphalt at $2.53, and paving at $2.80, for $11,355.60; Beaudry Street, from Ontario to Sherbrooke Street, asphalt at $2.54; special paving at $2.80, for $9,345.51; Champlain Street, from Ontario to Sherbrooke Streets, asphalt at $2.35 and special paving at $2.85, for $14,019.15; City Councillors Street, from St. Catherine to Sherbrooke Street, asphalt at $2.54 and special paving at $2.78, for $8,593.68; St. Charles Borromee from St. Catherine Street to Sherbrooke Street, asphalt at $2.53 and special paving at $2.80, for $11,434.18; and St. Urbain Street, from Demontigny to Sherbrooke, asphalt at $2.54 and paving at $2.83, for $11,497.46; making a total of $75,458.91.

+—Ottawa, Ont.—The Electrical Commission has awarded the IMPERIAL WIRE AND CABLE COMPANY, Montreal, the contract for supplying wire cable required for the conduit work.

Saskatoon, Sask.—President Walter C. Murray, M.A., LL.D., recently turned the first sod in connection with work on the new traffic bridge which will connect the University with the city. It will be the largest reinforced concrete bridge in Canada, and will cost $450,000.

Wynyard, Sask.—Three new bridges are to be constructed by the Highway Commission this season. Two will be steel of forty feet span with concrete abutments. With the construction of these bridges and the completion of road work in progress considerable improvements will be effected.

LIGHT, HEAT AND POWER.

+—Carlyle, Sask.—The town has awarded the following contracts in connection with the waterworks and electrical lighting plants:—Brick power-house building, and reinforced concrete reservoir, BENNETT, DEBNAM CO., Calgary; return tubular boilers, stack, steam piping, WATEROUS ENGINE WORKS CO., high speed vertical engine, GOLDIE & McCULLOCH CO.; air-lift pumping system and compressor, CANADIAN INGERSOLL-RAND COMPANY; compound duplex service pump, J. McDOUGALL CALEDONIAN IRON WORKS COMPANY; alternator and switchboard, (for Swedish generator), GENERAL SUPPLIES, LIMITED, Calgary; copper wire, E. F. PHILLIPS ELECTRIC CO., Montreal; transformers, CANADIAN MALONEY ELECTRIC CO.; line erection, E. SMITH ELECTRIC CO., Melville, Sask. John Galt Engineering Company, Winnipeg, are the consulting engineers.

+—Hamilton, Ont.—The Board of Control has awarded Mr. G. M. Guest, Montreal, the contract for the laying of the underground conduit system. The contract price is $177,822. Other firms tendered as follows: F. F. Ley and Company, Springfield Mass., $180,371; H. E. Fox, New York, $292,806, and J. W. Turner, Des Moines, Iowa, $197,366.

+—Montreal, Que.—The Board of Control has awarded Mr. G. M. GUEST the contract for the construction of conduits along Bleury Street from Craig to Pine Avenue, and for the second section of St. Catherine Street from Guy Street to Atwater Avenue, the contract price in the first case being $58,000, and in the second $35,000.

▲—Neepawa, Man.—Tenders will be received up till the 12th of September, 1913, for supplying machinery for additions to the power plant. Plans and specifications may be obtained from *The Canadian Engineer's* offices at Winnipeg, Toronto, and Montreal; W. E. Skinner, Limited, Consulting Engineers, Winnipeg, and J. W. Bradley, Secretary-Treasurer.

Ottawa, Ont.—Tenders will be received up till the 10th of September, 1913, for supplying 95 ornamental iron posts and fittings. Specifications may be obtained from J. E. Brown, electrical superintendent.

Port Arthur, Ont.—The Canadian Northern Railway is about to install electric apparatus for the operation of the big elevator plant in this city, according to information received. Commissioner Hackney has been on a campaign of late endeavoring to get manufacturers in the city to use electricity in lieu of steam and eventually he has succeeded. The new government elevator is to use power and now comes the announcement that the largest elevator in the world is to fall in line with the others in this respect. It is estimated that with the additional unit to be constructed to the elevator in the near future, the plant will require from 1,100 to 1,500 horsepower.

▲—Regina, Sask.—Tenders will be received up till the 1st of October, 1913, for supplying equipment for power-house. Plans and specifications may be obtained from E. W. Bull, Superintendent of Light and Power Commission.

Toronto, Ont.—At the meeting of the Hydro-Electric Commission recently it was decided to allow the St. Thomas-Windsor extension of the power line to follow the most southerly of the four routes proposed, and pass through St. Thomas, Ridgetown, Rodney, Dutton and intermediate points. The route selected will allow the cheapest and easiest construction, and will be in proximity to the line of the Michigan Central Railroad. Construction work on the new line will be commenced at once. It is not known just what the scheme will cost, but there is little doubt that it will mount into the millions. There were many influences exerted to cause the commission to choose one of the several

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Manufacturer of

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WOOD STAVE PIPE

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RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

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MANNESMANN STEEL PIPE

IS COVERED WITH A SPECIAL PREPARATION WHICH ACTS AS A NON-CONDUCTOR, THUS PREVENTING ANY DAMAGE TO GAS OR WATER MAINS BY ELECTROLYSIS OR BY EXTREME VARIATIONS OF TEMPERATURE IT IS IMPERVIOUS TO RUST IN ANY KIND OF SOIL. THE OUTSIDE IS COVERED WITH SPECIAL JUTE CLOTH.

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BOOKLETS ON REQUEST **59 Victoria Square, MONTREAL**

other proposed routes, but the one decided on will serve the largest area and most thickly populated district. The entire line is 112 miles in length and the commission will construct it.

+—**Victoria, B.C.**—The Pelton Water Wheel Company has awarded MR. ALBERT KELLEY, Seattle, the contract for supplying two miles of welded steel pressure pipes ranging from 48-in. to 54-in. in diameter, for the hydro-electric plant at the Jordan River.

+—**Winnipeg, Man.**—The Board of Control has awarded the CANADIAN WESTINGHOUSE COMPANY the contract for supplying three generators for the municipal power house at Point du Bois. The contract price is $103,800. There were five other tenders submitted.

GARBAGE, SEWAGE AND WATER.

+—**Ottawa, Ont.**—The city council has awarded Messrs. LOMIS, McBEAN & WILLIAMS the contract for the lifting, repairing and relaying of the old intake pipe. The work will be commenced at once.

Ottawa, Ont.—Tenders will be received up till the 6th of September, 1913, for the material required in connection with the relaying of the 40-inch steel clear pipe. Plans and specifications may be obtained from Arch. Currie, City Engineer.

Winnipeg, Man.—Winnipeg's permanent water supply from Shoal Lake will cost $13,045,000, and it will take at least five years to install, according to the formal report of the consulting experts read recently before the administration board of the Greater Winnipeg water district by Mayor Deacon, of Winnipeg. The report was adopted and the work will proceed at once, although definite action was deferred by the board for one week to enable the members to study details. Part of the plan is for a great uncovered reservoir at Transcona, eight miles east of Winnipeg, to hold 250,000,000 gallons. Gravity will carry the water to this reservoir, from where it will be pumped into Winnipeg with sufficient pressure to deliver it at the householder's tap.

Winnipeg, Man.—Tenders will be received up till the 19th of September, 1913, for supplying cast-iron water pipe and hydrants. Plans and specifications may be obtained from the Board of Control. M. Peterson, secretary.

INDUSTRIAL WORKS.

Amherst, N.S.—Tenders will be received up till the 22nd of September, 1913, for the extension of a wharf. Plans and specifications may be obtained from District Engineers, T. G. Locke, Shelbourne, N.S., and C. E. W. Dodwell, Halifax, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

London.—The first of the mammoth dredgers left Gravesend recently to work on the twelve million dollar contract for the Courtney dock at St. John, N.B. She is self-propelling and with fair weather will take three weeks in crossing. Her capacity is a thousand tons an hour. A second dredger will leave Holland next month and a third will go from the Argentine.

Meaford, Ont.—Tenders will be received up till the 29th of September, 1913, for the construction of an extension and repairs to the revetment wall here. Plans and specifications may be obtained from District Engineers, J. G. Sing, Toronto, and J. H. Armstrong, Midland, and the Department of Public Works, R. C. Desrochers, Secretary.

+—**Prince Rupert, B.C.**—The Edward Townsite Co., Limited, has awarded MESSRS. RITCHIE, AGNEW & CO. the contract for the construction of a crib dam, and supplying and laying 10,400 lineal feet of wood stave pipe.

+—**San Francisco, Cal.**—The MacARTHUR CONCRETE PILE & FOUNDATION CO., New York, has been awarded the contract for covering the concrete pile foundation for the new United States Sub-Treasury Building.

+—**Toronto, Ont.**—The Board of Harbor Commissioners have awarded the CANADIAN STEWART COMPANY, Montreal, the contract for dredging the harbor. The contract price was 19½ cents per cubic yard, or approximately $5,500,000. Other firms tendered as follows:—Tilbury Dock & Dredging Company, London, England, 24½ cents per cubic yard, $7,521,500. Sir John Jackson, London, England, 20½ cents per cubic yard, $6,293,500. Pearson & Company, Incorporated, London and New York, slightly over 20 cents per cubic yard, approximately $6,000,000. Sherman, Stalter Company, New York, tendered on a portion of the work, slightly over 20 cents per cubic yard. The total number of cubic yards to be dredged is slightly less than 30,700,000. The work will be commenced about March, 1914, and will take eight years to complete. The successful tenderers will have to construct two new dredges which will be amongst the largest in the world. In the meantime they will use a number of dredges which have been employed on the New York State barge canal.

Vail's Point, Ont.—Tenders will be received up till the 15th of September, 1913, for the construction of a wharf. Plans and specifications may be obtained from District Engineers, J. G. Sing, Esq., and J. H. Armstrong, Esq., Midland, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—**Victoria, B.C.**—The P & O Steamship Company has awarded Messrs. CAMMELL, LAIRD & COMPANY the contract for two passenger steamers of the new Khiwa class. These ships will be of 9,000 tons gross register, length 480 feet, breadth 58 feet, depth 33 feet, with spacious accommodation for about 150 saloon passengers. They are chiefly intended for the company's Indian trade, and will, for vessels of their type, be powerfully engined.

+—**Victoria, B.C.**—The Peebles Explosives, Limited, has awarded MESSRS. CULLINTON BROS. the contract for the erection of a wharf in connection with the company's buildings on James Island.

Winnipeg, Man.—Tenders will be received up till the 8th of September, 1913, for the interior decorations for the King Edward Hospital. Plans and specifications may be obtained from Board of Control, M. Peterson.

MISCELLANEOUS.

Calgary, Alta.—The first unit of Calgary's 20,000,000 bushel internal elevator, which the government proposes to build here, will cost $1,500,000 and have a grain capacity of 3,500,000 bushels. It will be a duplicate of the big internal elevator which the government purposes building at Saskatoon.

Calgary, Alta.—The by-laws upon which the ratepayers of Calgary will be called to vote on September 27th will provide for the expenditure of $2,333,440. There will be 16 money by-laws. All will be submitted on the one day. The money by-laws to be voted on are as follows:—$52,000, fire department; $45,100, parks and cemeteries; $250,000, erecting, equipping, and constructing industrial building; $60,000, Hillhurst athletic grounds; $350,000, union stock yard purposes, etc.; $19,250, paving, curb and gutter, Boulevard, N.E.; $468,900, high level concrete bridge across Bow River at Centre Street; $173,000, concrete bridge across Bow River at Ninth Street West; $319,350, concrete bridge at Fourth Street West; $82,100, steel bridge across Bow River at Fifteenth Street East; $82,500, concrete bridge across Elbow River at Fourth Street West; $173,000, concrete bridge across the Bow River at Fourteenth Street West; $10,000, straightening Elgin Avenue and Second Avenue northwest; $155,000, Lowry Gardens; $63,140, trunk sewer at Ogden; $30,000, hospitals, tubercular

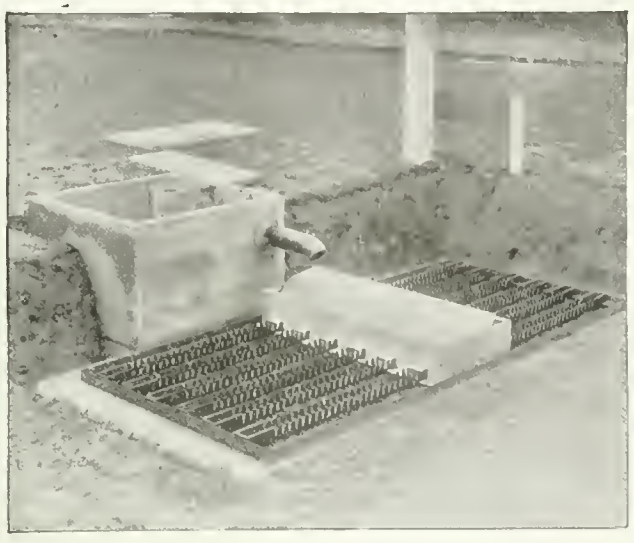
Edmonton, Alta.—The Bank of British North America will erect a three-story bank building. The estimated cost is $150,000.

Grosse Isle, Que.—Tenders will be received up till the 8th of September, 1913, for foundations for the infectious diseases hospital. Plans and specifications may be obtained from District Engineers J. A. Tremblay, Montreal, and Charles Chapais, Quebec, and the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

London, Ont.—A fire occurred on August 29 a week before the opening of the Western Fair, which destroyed five of the exhibition buildings to the extent of $50,000. The work of rebuilding has commenced.

THE "SEMI-SEPTIC" SEWAGE PLANT

THE BEST SYSTEM OF PURIFYING SEWAGE, FOR COUNTRY HOUSES, OR ANY ISOLATED BUILDINGS



Short List of Installations recently carried out,

KNEBWORTH HALL,	for The Rt. Hon. The Earl of Lytton
MARLOW.	" The Rt. Hon. Lord Davenport
HURST GREEN	" Sir Fredrick Fison, Bart.
LOTHERTON HALL	" Colonel Gascoigne, D.S.O.
LLANDINAM	" David Davies, Esq., M.P.
MALVERN	" J. W. Wilson, Esq., M.P.
FROME	" Admiral Arbuthnot
STEVENAGE, HERTS	" Captain Usher
GORDON HILL (WHITE WEBBS)	" H. Orr Lewis, Esq., of Canada
PENZANCE	" W. E. Bolitho, Esq.
HUNSTANTON	" The Bungalow Village
WINCHESTER.....	" Crawley Rectory
TWYFORD	" Twyford Station
BANBURY	" Engine Sheds
INGATESTONE	" Fryerning Rectory

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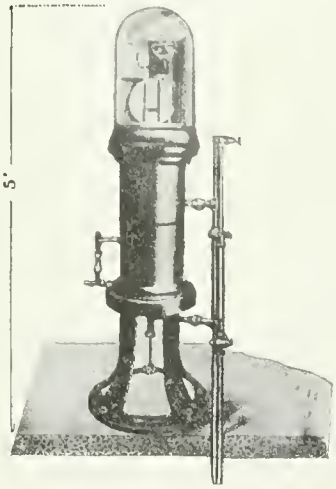
Simplex Water Meter

Type 'G' Register

adaptable and furnished with either Venturi tubes or Pitot tubes, and now fully developed and successfully tested for Triangular Notch or Rectangular Weirs.

Hot or Cold Water



Actuating power, simple shaped float in mercury.
Greatest range of flow with minimum friction through Venturi tube.
No cams—uniform graduations.
One eight-day marine clock.
Rectangular chart—daily or weekly. Total flow five dial register—glass dome or metal dome with glass doors, if desired.
Chart can be averaged with ordinary planimeter.
Indicating dial may be graduated in gallons, cubic feet, pounds or horse power.

Particulars, diagrams, tests and other data upon request

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The Hampton Sedimentation Tank

Used in connection with an electrolytic hypochlorite treatment, the process is ABSOLUTELY ODORLESS and the effluent is free from disease germs.

Nine years of operation in large and important installations in England have demonstrated that an effluent exceptionally low in suspended solids and as free from odor as the entering sewage may be obtained with The Hampton Tank.

The Hampton Tank reduces the cost of any subsequent treatment.

Write for leaflet showing construction of the tank and explaining the special features of its design which make it particularly successful. This tank is not an experiment. It has been used for nine years with most satisfactory results, and has **PROVED** its efficiency and economy.

Leaflet on request.

Sterilization Co.

Union Building, Clinton Street

NEWARK, N.J.

Also engineers for the electrolytic treatment of water.

+—**Medicine Hat, Alta.**—The city council has awarded Messrs SACKRIDER & TURNER the contract for the erection of an electrical sub-station at Ogilvie Mills. The contract price was $9,900. Three other firms tendered, all over $10,000.

+—**Montreal, Que.**—The Canadian Vickers Co., Limited, has awarded the MacARTHUR CONCRETE, PILE & FOUNDATION CO., New York, the contract for the foundations of the new shipbuilding plant. About 750 pedestal concrete piles will compose the foundation.

▲—**Ottawa, Ont.**—Sketch designs in a preliminary competition for the erection of departments and courts buildings, will be received up till the 2nd of January, 1914. Conditions for both competitions may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Prince Rupert, B.C.—Tenders will be received up till the 23rd of September, 1913, for the construction of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy-Minister.

Sault Ste. Marie.—Following the partial destruction by fire of the big power plant of the Lake Superior Corporation after the big building had been struck by lightning, 1,100 men are idle while the repair gangs and electricians are working under pressure to get matters into shape for another start. It is hoped that a big portion of these men will be able to resume in a few days, but several hundreds will be idle for at least two weeks. The damage will run into many thousands of dollars.

+—**Vancouver, B.C.**—Messrs. E. J. RYAN & COMPANY have been awarded the contract for the erection of a new opera house on Pender Street. The contract price is $400,000.

+—**Vancouver, B.C.**—The Irish Fusilier Regiment has awarded Messrs. PERRY & FOWLER the contract for the erection of a new drill hall. The contract price is $200,000.

Vancouver, B.C.—The Dominion Government has prepared plans for the erection of a new immigration building. The estimated cost is $300,000.

Vancouver, B.C.—The following will be expended by the city council during the ensuing year: General hospital, $10,000; sewers, $100,000; rocking, planking and grading streets and lanes, $75,000; waterworks extensions, $300,000; park improvements, $25,000; exhibition committee, $35,000; opening and grading streets in Ward Seven, $15,000; Mountain View cemetery, $5,000; east end police station, $3,000; North Vancouver ferry subway, $17,000; creche, $20,000; schools, $158,000; Georgia-Harris bridge, $200,000; police headquarters, $75,000.

+—**Vernon, B.C.**—MR. T. A. ROBLEY has been awarded the construction of a three-story hotel. The contract price is $25,000.

Victoria, B.C.—Tenders will be received up till the 15th of September, 1913, for the erection of Somenos school. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffiths, Public Works Engineer.

+—**Victoria, B.C.**—The School Board has awarded MESSRS. DINSDALE & MALCOME the contract for the erection of a High School. The contract price is $400,000.

Victoria, B.C.—Tenders will be received up till the 15th of September, 1913, for the erection of Colwood school. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffiths, Public Works, Engineer.

Welland, Ont.—The building permits for the month of August amounted to $38,100. For the same month last year they amounted to $20,550. This is an increase of $17,550. D. T. Black, town engineer.

CURRENT NEWS.

Panama.—The blowing up of the Gamboa dike, which will remove the last obstruction to the navigation of the Panama Canal by light draught vessels, has been set for September 6. A flooding of the 5,000 foot section of the canal between the Miraflores locks and the Gamboa dike by diverting into the newly excavated pit the water from a nearby stream was begun August 23. It is desired to fill the pit nearly to a level with the open water in the channel on the other side of the dike, in order that the steam shovels may remove the material of the barrier after blasting, with facility. On this account it was deemed advisable to delay for a brief period the destruction of the dike. The pit is filling slowly and sea water probably will be admitted to hasten the process. The lower gates of the Miraflores locks have been permanently closed to prevent flooding of the lock chambers.

Toronto, Ont.—The purchase of two steamships for the Atlantic trade and two steamships for the Pacific coast service is announced by Sir Thomas Shaughnessy, president of the Canadian Pacific Railway, in the annual report just issued, which also brings out the additional lines to be constructed by the Canadian Pacific Railway this year. For the Atlantic trade the two vessels are to be of the intermediate type, 500 feet long, 64 feet beam, 11,600 gross tonnage, 15 knots speed, and to cost about a million and a half dollars each. The steamers to be acquired for the Pacific coast service are to be 395 feet long, 54 foot beam, and capable of making 22½ knots per hour at sea, and to cost approximately a million dollars each. It is the intention of the Canadian Pacific Railway to use the two Atlantic steamships for second and third-class passengers and freight traffic between European ports and Canada. The Pacific coast steamers are to be placed in the service between Vancouver, Victoria and other ports on the Pacific coast.

PATENTS.

Below will be found a complete list of patents recently granted to inventors in Canada and United States which is furnished by Messrs. Fetherstonhaugh and Company, patent barristers, solicitors, etc., head office, Royal Bank Building, 10 King Street East, Toronto. Offices in Hamilton, Montreal, Ottawa, Winnipeg, Vancouver and Washington, D.C., from whom all information may be readily obtained.

United States Patents.—C. Bellemare, tire-protectors; E. Danforth, horse blanket fasteners; P. E. Dcolittle, adjustable hangers; S. D. Hansen, insect collecting machines; F. A. Nugent, sod pulverizing machines; C. A. Tuerk, concrete mixer; J. C. Tweedale, pen-holder: T. L. Wilson, manufacturing an ammonium superphosphate fertilizer.

Canadian Patents.—F. C. Peck, outlet boxes; W. M. Shores, stoves; A. W. Anderson, flexible films; H. Ashbee, combined-key-rings and pouches; E. S. Aubry, compositions of matter for water-proofing; H. O. Blayney, joints for concrete structures; F. W. Bull, pneumatically-operated player pianos; F. W. Bull, expression controlling devices for player pianos; N. Champagne, ventilators; A. W. Crane, horse shoes; W. M. Day, tooth-ache easers; H. Hillard, horse shoes; W. J. Holmes, saw setting machines; A. W. Kemp, horse shoes and calks therefor; L. N. Lymburner hose hoisting and hanging devices; D. A. L. McDonald, street cars; E. S. Manny, hot water heaters; F. P. Murphy, display racks; F. W. M. A. Schneider, electric cartridge fuses; C. E. Stewart, warm air registers; A. Stoddard, lacing hooks; A. Wait, needle valves.

THE SUPPLY OF EMERY.

The world's supply of emery comes from Greek islands and from Asia Minor, near Smyrna. Importations to America, which average $250,000 annually, have been hampered within the past year because of disturbed conditions in the Balkans and the withdrawal from industrial life of so many men for the armies. Some American manufacturers have been inconvenienced by the delay in emery shipments.

It is announced that both the Canadian and the United States Governments will be officially represented at the third American Road Congress, in session in Detroit during the week of September 29th.

The Departmental House for Mechanical Goods HAS ARRIVED

What the department store is to the general public our "Mechanical Goods Departmental House" is to the engineering and contracting field.

The public takes the efficient and time-saving merchandising methods of the department store as a matter of course. In the mechanical world we offer the same convenient service.

Why lose time "shopping" around town when you can buy anything you want and of a standard quality all under "one roof"?

Our business is divided into a number of departments in order that it may be handled most expeditiously and to the best interests of our customers.

In addition to the staple articles pertaining to each department we handle a great many specialties, some of which are listed below.

SCALE DEPARTMENT
- Fairbanks World-famous Scales, of all types and sizes

VALVE AND STEAM GOODS DEPARTMENT
- Fairbanks Brass and Iron Valves
- Pratt and Cady Valves
- Foster Reducing Valves
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- Wainwright Joints
- Penberthy Oilers
- Strong Steam Traps
- Wainwright Heaters
- Burt Exhaust Heads
- American Safety Valves
- Trident Water Meters
- Palmetto Packing
- Durabla Packing
- Oster Stocks and Dies
- Tools and Fittings

ENGINE DEPARTMENT
- Fairbanks-Morse Oil Engines
- Fairbanks-Morse Marine Engines
- Fairbanks-Morse Tractors
- Farm Machinery
- Motor Boat Supplies
- Automobile Supplies

PUMP DEPARTMENT
- Fairbanks-Morse Steam Pumps
- Power Pumps
- Goulds Power Pumps
- Hand Pumps
- Combined Engines and Pumps
- Spraying Outfits
- Air Compressors
- Suburban Water Systems

ELECTRICAL DEPARTMENT
- Fairbanks-Morse Generaters and Motors
- Edison Storage Batteries
- Suburban Lighting Outfits

MACHINERY DEPARTMENT
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- Brown and Sharpe Tools
- McDougall Lathes
- Bertram Tools
- Machine shop tools of all kinds
- Wood Working Machinery

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- Universal Giant Shaft Hanger
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- Barrett Jacks
- Arthur Koppel Industrial Ry. Equipment
- Fairbanks-Morse Air Compressors
- Fairbanks-Morse Hoisting Engines
- Fairbanks Trucks
- Milburn Lights
- Smith Concrete Mixers

SMALL TOOL AND SUPPLY DEPARTMENT
- Pratt and Whitney Tools
- Brown and Sharpe Tools
- Yale and Towne Hoists
- Alundum Grinding Wheels
- Crystolon Grinding Wheels
- India Oil Stone
- Parker Vices
- Union Chucks

SAFE AND TYPEWRITER DEPARTMENT
- Dominion Safes and Vaults
- Noiseless Typewriters

TRUCK DEPARTMENT
- Mack Trucks (gasoline)

Send now for catalogue of goods that interest you

The Canadian Fairbanks-Morse Co. Limited

"The Departmental House for Mechanical Goods."

MONTREAL ST. JOHN QUEBEC OTTAWA TORONTO
WINNIPEG CALGARY SASKATOON VANCOUVER

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

(Continued from Page 75.)

"2. That the Applicant Company be, and it is hereby, authorized to slope the side of its cutting back on to the lands of the Grand Trunk Railway Company, shown colored red on the said plan, and then replace the fence on its former location along the property line; and that the slope be carried back on an incline of only 1½ to 1 according to the standard cross sections of cuttings for the Applicant Company's railway and for a depth of cutting shown on the profile on file with the Board under file No. 3701.298."

20082—August 16—Authorizing the C.P.R. to construct Bridges Nos. 86.45 and 50.95 on its line of railway.

20083—August 18—Authorizing the C.P.R. to operate its trains over the Lachine Canal drawbridge, near Highlands, without their first being brought to a stop.

20084—August 18—Authorizing the C.P.R. to construct Bridges Nos. 15.83, 12.65, 120.79, 9.17, 20.42, 39.11, 37.00 and 19.17 on its line of railway.

20085—August 14—Authorizing the C.P.R. to divert Pincher Creek Trail and to close that portion of the said Trail so diverted within the limits of its right of way; and construct a road diversion in Sec. 3, Tp. 7, Rge. 29, W. 4 M., Alta., in lieu of the said portion to be closed.

20086—August 15—Amending Order No. 19900 by striking out the figures and letters "19th" where they occur in the recital and operative parts of said Order, and substituting therefor the figures and letters "10th."

20087—August 15—Authorizing the C.P.R. and G.T.R. to operate their trains over the crossing of their tracks one mile north of St. Johns, Que., at mileage 20.85, without their first being brought to a stop.

20088—August 15—Authorizing the C.P.R. and the St. Lawrence and Adirondack Ry. to operate their trains over the crossing at Adirondack Jct., without their first being brought to a stop.

20089—August 19—Authorizing the C.P.R. to construct, maintain and operate a branch line of railway or spur for the Dominion Brick Co., Montreal, from a point on the southeasterly limit of the right of way of the C.P.R.'s St. Lin. Sub-division, in Lot 523, P.Q., to and into the premises of the Dominion Brick Co., situate in said Lot 523.

20090—August 19—Authorizing the C.P.R. to construct the tracks of extension of meeting siding at Islington Jct., C.P.R.'s main line, Ont., Sub-division, across Mimico Ave., at grade, between Lots 6 and 14, Con. 5, Tp. Etobicoke, Co. York, Ont.

20091—August 19—Authorizing the C.P.R. to construct road diversion in Lot 9002, Twp. 23, Rge. 18, W. 5 M., B.C.

20092——August 19—Authorizing the C.P.R. to reconstruct Bridge No. 113.1, on its Sherbrooke Sub-division, Eastern Div., P.Q.

20093—August 15—Approving revision in the location of a portion of C.P.R.'s main line as constructed of an additional track (double track) on the said revision, from a point in Lot 10, Con. 3, Twp. Balfour, thence in a westerly direction through Twps. Balfour, Dowling and Cascades to a point in Lot 1, Con. 1, Twp. Cartier.

20094—August 19—Authorizing the C.P.R. to construct Bridges Nos. 114.01, 128.79, 5.5 on its line of railway.

20095—August 18—Amending Order No. 19852 by inserting after the figure "13," in both the preamble and the operative part of the said Order, the word and figure "Township 13," so as to make the same read, "Sections 12 and 13, Township 13, Range 15, west of the 4th Meridian."

20096—August 16—Authorizing the the Cambellford, Lake Ontario and Western Ry. to construct an overhead farm crossing on the farm of Mrs. M. J. West at a point opposite the building, about eighteen rods from the east boundary of her farm, where there is a twenty-foot cut on the railway.

20097—August 18—Dismissing complaint of the business men and residents of East Calgary, Alta., complaining against the removal of the C.P.R. Co.'s station known as Maharg Stn., formerly Calgary Junction, at East Calgary.

20098—August 16—Ordering the C.L.O. and W. Ry. Co. to provide and construct a suitable cattle pass under its railway, where the same crosses the property of Fred S. Farrott, on Lot 12, Con. 1, Tp. Thurlow, Ont.

20099—August 16—Authorizing the C.P.R. to construct its tracks across the highway, at grade, in Lot 2566, Kootenay District, B.C., at mileage 41.27 from Golden.

20100—August 18—Authorizing the C.P.R. to construct road diversion in Sec. 19, Tp. 22, Rge. 23, and Sec. 13, Tp. 22, Rge. 24, W. 4 M., from mileage 5.23 to mileage 5.69 on its Gleichen-Shepard Branch.

20101—August 18—Authorizing the C.P.R. to construct the tracks of its Bromhead Ballast Pit Spur, at grade, across the roadway in Sec. 6, Tp. 3, Rge. 13, W. 2 M., Sask., at mileage 2 of said spur.

20102—August 18—Authorizing the C.P.R. to construct a diversion of the road allowance in Sec. 9, Tp. 13, Rge. 15, W. 4 M., Alta.; and to construct its tracks, by means of a grade crossing, across the said diversion, at mileage 45 of its Sheffield-Blackie Branch.

20103—August 14—Ordering the C.P.R. to provide and construct a farm crossing near J. M. Carroll's farm buildings in Beaver, B.C. at Station 3350-76.5.

20104—August 18—Approving location of a portion of C.P.R.'s Bassano Easterly Branch from a point in Sec. 15, Tp. 23, Rge. 1, W. 5 M., at mileage 116.00, thence in an easterly direction to a point in Sec. 13, Tp. 23, Rge. 1, W. 4 M., at mileage 118.39; and also approving revision in location of a portion of said branch line from a point in Sec. 10, Tp. 2, Rge. 1, W. 4 M., at mileage 115.59, thence in an easterly direction to a point in Sec. 15, Tp. 23, Rge. 1, W. 4 M., at mileage 116.00.

20105—August 18—Approving revised location of G.T.P. main line, mileage 321.6 to mileage 330.1, Prince Rupert East, through Tibbets Indian Reserve, Rge. 5, Coast District, B.C.

20106—August 15—Dismissing application of the Empire Flour Mills, Ltd., St. Thomas, Ont., for an order restoring the milling-in-transit arrangement on U.S. corn, the product of which is shipped from St. Thomas to points on or via the G.T. and the C.P. Railways.

20107—August 15—Authorizing the Niagara, St. Catharines and Toronto Ry. to construct, at its own expense, its lines and tracks across the lines and tracks of the Michigan Central Railroad Co.'s siding to the factory of the Dominion Canners, in the town of Niagara-on-the-Lake, Ont.

20108—August 16—Authorizing the C.N.O.R. to construct its line of railway across Wimma St., in O'Connor Park, town of Sudbury, Ont.

20109—August 15—Ordering the C.N.R. to remove Peace Avenue Siding, situate at the corner of Twenty-fifth St., Edmonton, on or before the 1st Sept., 1913.

20110—August 18—Authorizing the C.N.O.R. to take the portion of the east part of Lot 10, Con. 6, Tp. Nepean, the property of David Finlay.

20111—August 13—Authorizing the C.N.O.R. to construct its line of railway across Dell St. in O'Connor Park in the town of Sudbury, Ont.

20112—August 16—Authorizing the C.N.O.R. to construct bridge to carry its line of railway across the Indian River, at mileage 106.4 from Ottawa, Tp. of Fraser, Co. Renfrew, Ont.

20113—August 16—Authorizing the C.N.O.R. to construct bridges at mileage 188.1 from Toronto and mileage 98.06 from Ottawa, on its line of railway.

20114—August 19—Authorizing the C.N.O.R. to construct bridge to carry its line of railway over the Indian River, Tp. of Stafford, District of Nipissing, Ont., at mileage 88.2 from Ottawa.

20115—August 15—Authorizing the C.N.R. to construct highway crossing on its railway in the S.E. ¼ of Sec. 25, Tp. 12, Rge. 25, W. 2nd M., west of the station grounds at Bayard Townsite, Sask.

20116—August 19—Approving location of the C.N.R.'s station grounds at MacRorie, Sask.

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EXTENSION OF TIME.

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J. W. BRADLEY,
Secretary-Treasurer, Neepawa, Man.

CAYUGA, ONT.

Sealed tenders will be received up to noon on the 16th day of September, 1913, by the undersigned at Cayuga, Ontario, for the construction of twenty-six and one-half miles of stone macadam road in the county of Haldimand.

The work will be let in three separate and distinct contracts, not necessarily to the same individual.

Tenderers are required to examine the localities of the work and are requested to be present at the opening of the tenders at 2 p.m., on Wednesday, the 17th day of September, 1913.

Plans and specifications may be seen at the office of the County Engineers, Messrs. Jackson and Kyd, Dunnville, or may be had from them on the payment of $10, which sum will be refunded on return of the documents.

Lowest or any tender not necessarily accepted.

T. A. SNIDER, K.C.,
County Clerk,
County of Haldimand,
Cayuga, Ont.

CITY OF REGINA, SASK.

Sealed tenders, registered and clearly marked on the outside of the envelope "Tender for Power-House Equipment," and addressed to the City Commissioners at Regina, Sask., will be received up till noon of October 1st, 1913, for the supply of:—

Coal bunkers, ash hoppers, coal and ash conveyers and crushers.

Price to be on equipment erected on foundation built by the City of Regina according to contractor's requirements.

A marked cheque for 5 per cent. of the amount of the bid, and made payable to the City Treasurer, City of Regina, must accompany each tender.

Specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

The City Commissioners reserve the right to reject any or all tenders.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade has been received. The names of the firms making these inquiries, with their addresses, can be obtained upon application to "The Inquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary, and Chambre de Commerce du District du Montreal:—830.—A large Rotterdam house, lumber importers, is prepared to receive quotations from Canadian shippers. 836.—A Sicilian firm is open to give its agency to a party already connected with hardware and painters' supplies wholesale. 842.—A Scottish manufacturing firm, who are patentees of lock-joint cast-iron piping for water and gas works, invites inquiries from Canadian engineers responsible for drafting projects for municipal and railway work. 846.—Glasgow metal firm wishes to appoint agent. Only one with connection among engineers and works will be considered. Salary and commission. Full particulars are requested. 857.—A Durban firm with connections in engineering trade throughout South Africa is prepared to consider any offer of machinery specialties. 859.—A Durban firm of merchants is prepared to purchase wire. Quotations requested. 863.—A firm in South Africa, now handling many shovels, is prepared to purchase direct. Quotations and catalogues requested. 870.—A Durban firm will purchase direct, pine shelving and other lumber. Correspondence requested with f.o.b. St. John or Montreal quotations, or if preferred c.i.f. Durban. 880.—A Durban firm of lumber dealers requests correspondence re lumber-pine and poplar shelving, ½ inc and 1 in., must be even widths, 12, 14, 16, 18 and 20 inches, no odd widths. Lengths, 12, 14 and 16 feet. 886.—A Durban firm will purchase Canadian made shovels. Would prefer to see samples. 892.—A London firm, who import railway ties, would be glad to receive offers from Canadian manufacturers of same. 893.—A Manchester firm makes inquiry for names of Canadian exporters of St. John's spruce lumber. 897.—A London correspondent is open to purchase supplies of old scrap galvanized iron wire, and would like to hear from Canadian firms in a position to ship large quantities.

NEW INCORPORATIONS.

Howick Station, Que.—Howick Paving Company, $10,000. J. H. Lefebvre, T. Vass, C. A. Vass, both of Casaville.

Toronto, Ont.—Canadian Mineral Development Company, $40,000. G. B. Balfour, J. Barker, K. C. Balfour. St. Petersburg Graphite Mining Company, $500,000. R. D. Moorhead, L. Macaulay, J. E. Anderson. The Tube and Pipe Bending Company of Ontario, $100,000. J. F. Edgar, J. E. Maybee, L. M. Lewis.

Montreal, Que.—Montreal Advertising Club Company, $10,000. E. M. McDougall, J. J. Creelman, G. S. Stairs. Como Lake Shore, Incorporee, $20,000. J. N. Legault, Vaudreil, H. L. O'Donnoghue, J. Brousseau. Mallinckrodt Chemical Works, $100,000. J. W. Blair, C. A. Hale, R. W. Gibb. Arcade Film Theatre, $25,000. R. Chenevert, F. Callaghan, M. J. McLaughlin.

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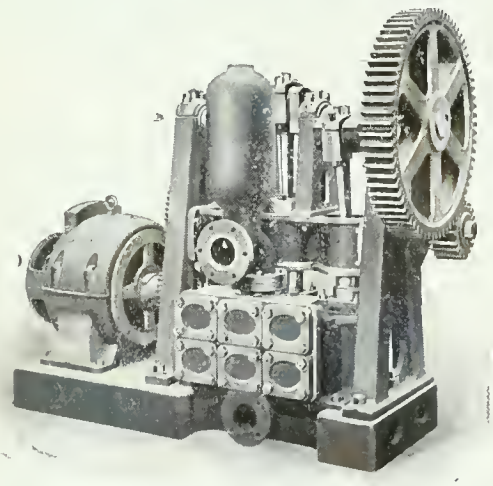

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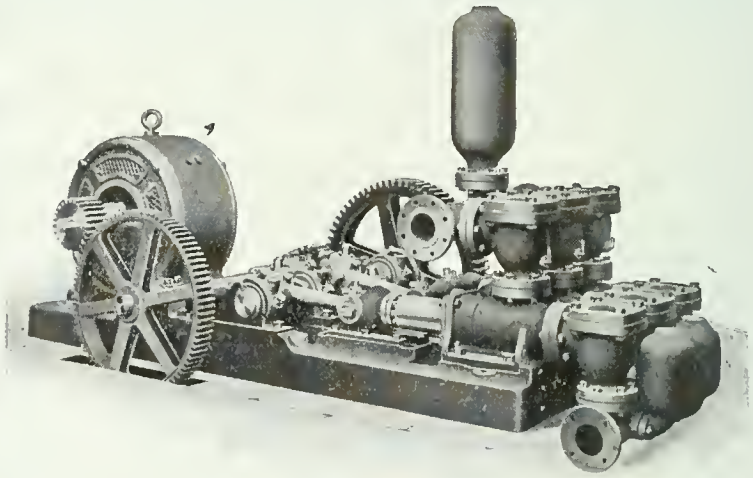

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Regina, Sask.—W. G. F. Scythes and Company, $50,000. Sykes Company, $20,000.

Waldeck, Sask.—Dafoe, Lewis and Prentice, $20,000.

Prince Albert, Sask.—Saskatchewan River Transportation and Fuel Company, $200,000. Zoellner Sons, $40,000.

Kerrobert, Sask.—Western Farmers Elevator Company, $10,000.

Hamilton, Ont.—Cameron Island Syndicate, $200,000. J. Routledge, H. Hennessey, H. J. Kirkpatrick.

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SUPERINTENDING ENGINEER of construction now free to accept appointment. Large experience on public works, with specialty in tunnelling. Unexceptional references. Nine years' U.S.A. experience. Address T. H. D., Bartram & Wadsworth, Bank of Toronto Building, Toronto.

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ENGINEERS' AND CONTRACTORS' Reinforced Concrete Screw Piles—important Canadian and American patents for license or sale, enquiries invited. Helical Reinforced Concrete Screw Syndicate, 40 Commercial Road, Portsmouth, England.

THE ARCH PRINCIPLE OF SHIP CONSTRUCTION.

It is a matter of considerable interest to shipowners to know that, although the arch principle of ship construction is of comparatively recent date, yet during this year alone three vessels of this type have been taken in hand at various shipyards. One was delivered to Canadian owners a few months ago; a second similar ship is under construction by the North of Ireland Shipbuilding Company at Londonderry, and the third for the Donald Steamship Company, of New York, is now receiving her finishing touches. This is striking evidence of the increasing popularity of the arch principle of ship construction, showing that shipowners do really appreciate the economy to be effected by using this type of ship. The principal advantages of building on the arch principle are, briefly, a large reduction in first cost, cargo holds free of pillars and other obstructions, and increased carrying capacity, combined with very low net tonnage. Other special points of a more technical nature might be noted, namely, increased strength, better stability, greater freeboard, an unusually high deck platform, and no so-called "wells," either forward or aft of the bridge amidships, for seas to fill.

SCHOOL FOR HEALTH OFFICERS.

Beginning this fall, Harvard University and the Massachusetts Institute of Technology are to maintain in co-operation a school for public health officers. The object of this school is to prepare men for public health work, especially, to fit them to occupy administrative and executive positions, such as health officers or members of boards of health, as well as secretaries, agents, and inspectors of health organizations.

It is recognized that the requirements for public health service are broad and complicated, and that the country needs leaders in every community, fitted to guide and instruct the people on all questions relating to the public health. To this end, the instruction of the new school will be on the broadest lines. It will be given by lectures, laboratory work, and other forms of instruction offered by both institutions, and also by special instructors from national, state, and local health agencies.

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BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, August 30th, 1913.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ¾ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in., $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath.—See Lumber, etc

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. of for galvanized; 3½-inch, $95; 4-inch, $1 08.

Toronto, Sept. 3rd 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15¾ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¾ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1¼c. per hundred. For 10-case lots and over deduct ¼ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1¼ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.85
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.85	2.00	3.85	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	25.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cnt to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, Sept. 2nd, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; shars, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

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Contents of this issue on page 437

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

THE DEVELOPMENT OF SEWAGE DISPOSAL PRACTICE

HISTORICAL REVIEW OF THE SCIENTIFIC DISPOSAL OF WASTE — VARIOUS AGENCIES IN USE — PAPER READ BEFORE THE ONTARIO MUNICIPAL ASSOCIATION, TORONTO, AUGUST, 29TH

By E. SHERMAN CHASE,

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IT is a fundamental biological law that no living organism can long exist in the midst of its own wastes. This law is as applicable to the municipal organism as to the individual. Methods for the disposal of human wastes are as old as mankind itself, but the problem of sewage disposal which confronts us today originated only sixty or seventy years ago. Before this time the disposal of waste was largely an individual duty and not until the adoption of the water-carriage system did it become a civic responsibility. At the beginning of the water-carriage system, the method of disposal was by discharging the contents of the sewers into the nearest watercourse. This same method is too frequently used to this day. As long as the volume of water receiving the sewage was large compared with the amount of sewage no great attention was paid to the desirability or otherwise of this means of disposal. Before the germ theory of disease, and even much later, the discharge of sewage in bodies of water used for water supply has been tolerated and the use of unpurified water from such sources has caused enormous loss of life from typhoid. With rapid growth of population the waters receiving sewage have become not only unsafe for water supply but have become, in many cases, so grossly polluted as to be unfit for boating, bathing or fishing. Many otherwise attractive streams and lakes have become open sewers, offensive both to sight and smell. In other cases, as with certain sea coast towns, extensive shell-fish industries have been threatened by the pollution of harbor water.

In Europe the problem became acute much earlier than in America, on account of the smallness of the streams and the density of population. Local nuisances, due to fouling of the streams, became so pronounced that means had to be taken very soon after the introduction of the water-carriage system to prevent further fouling of the streams receiving sewage. The condition of the Thames at London became so intolerable that a government commission was appointed in 1868 to investigate methods of sewage disposal with the end in view of restoring the river in England to some degree of its former purity. This commission, called the Rivers Pollution Commission, after investigation, reported that the best means of disposal was land irrigation, and for many years this opinion was of powerful effect in shaping sewage projects in Europe, and in England land irrigation had official sanction almost exclusively until 1908.

In America the problem was first attacked in Massachusetts, and the Massachusetts Board of Health started experiments in 1888 on the purification of water and sewage which are being continued to the present day. In respect to sewage the immediate result of their first experiment was the adoption in Massachusetts of sand or gravel beds for sewage treatment. The most important results, however, were the establishment of the scientific basis upon which sewage purification depends and the stimulation given to other investigations of the sewage question.

The Massachusetts experiments proved that sewage purification is largely a matter of oxidation through bacterial agencies. Bacteria and other micro-organisms in soil, water or artificial devices, if given an abundance of oxygen, oxidize complex, putrescible, organic compounds to simple, non-putrescible, inorganic substances. As long as oxygen is present the organic compounds in sewage give comparatively little offence, but as soon as this oxygen is exhausted the unoxidized organic matters decompose, giving rise to foul, ill-smelling compounds and gases. From this it will be seen that the whole problem in a nutshell is to supply sufficient oxygen to the sewage. In fact, the sewers of a city may be likened to the veins of a human body, the sewage to the impure blood in the veins and the means of purification to the lungs where the impurities are oxidized by the inhaled air.

Sewage Defined and Classified.—Sewage itself has been defined as the water supply of a city after use. It contains the wastes of man and of man's activities. In composition it is mainly water and the proportion of solid matter to water is about 1 to 999. Aside from the solid matter it carries innumerable forms of microscopic life, and often contains bacteria dangerous to health. The solid matter and the harmful bacteria bring about the sewage problem, the solid matter by offensive decomposition and the bacteria by producing disease. The solid matter can be divided into two kinds, organic and inorganic; the organic solids being those subject to purification. For practical purposes, another classification is made of the solids into floating, suspended and dissolved

solids. Floating solids consist of garbage, rags, paper, sticks, etc. The suspended solids are smaller particles carried in suspension by the sewage; and the dissolved solids are those in solution. The suspended solids are divided into settling and non-settling solids, the settling solids being those which will settle out when subjected to quiescent sedimentation, and the non-settling those which will not. The aim of proper sewage disposal is to prevent nuisances from the decomposition of these solids and to also prevent injurious effects to health from the disease bacteria.

Natural Purification of Sewage.—When sewage is discharged into a body of water, the forces of nature immediately begin its purification; bacteria and oxygen oxidise its organic constituents adverse conditions of temperature and food supply destroy large numbers of harmful bacteria and thus, under some conditions, disposal by dilution is both practical and scientific. It is estimated by various authorities that the amount of water in a stream receiving sewage must flow at a rate of 3 to 6 cu. ft. per second for each inhabitant contributing to the sewers. In lakes, the extent to which disposal by dilution can be used, depends entirely upon local circumstances, in respect to location of outlets, currents, location of water supply inlets, etc. Where disposal by dilution can be used it is important to prevent deposits of solids and to keep the oxygen content of the diluting water from becoming exhausted.

Screens to Collect Floating and Suspended Solids.—Under some conditions, where disposal by dilution can be practised, it is necessary to remove the floating solids. In this case screening is usually resorted to. Screening is also used previous to further treatment to protect pumps and prevent scum-forming materials from entering tanks. There are many types of screens, the most common, probably, is the bar screen. This screen consists of iron bars, spaced at regular intervals and inclined vertically to the sewage flow. The spacing of the bars varies from one-half to several inches. Sometimes two or more sets of screens are used, the spacing of the bars in the second set being less than that in the first. The material collecting on the bars is removed and destroyed. Of late years, especially in Europe, mechanical screens of fine mesh have been used and with more or less satisfactory results. Fine mesh screens not only remove the floating matter but also a portion of the more finely divided suspended solids, and in some cases they have been used in place of sedimentation tanks.

In America the best known mechanical screen is a cylindrical framework of steel, about 6 feet in diameter and 12 feet long, upon which wire-cloth of 40 meshes to the linear inch is fastened in removable segments. The wire-cloth is protected by a copper screen of larger mesh and heavier wire. This screen is revolved slowly and the wire-cloth is washed by the jets of water. The sewage enters at one end of the cylinder and, passing through the cloth, leaves behind the floating and some of the suspended solids. The screenings are carried by a worm to the outlet end of the screen where they can be collected and disposed of. For burning, the screenings can be dried in a centrifugal dryer and mixed with coal. This type of screen removes 15 to 20% of the undissolved solids contained in a sewage. It is a somewhat expensive operation and is unnecessary where tanks are used.

Settling Tanks.—Tanks with and without the aid of chemicals have been used for many years for the settling out of sewage solids. Plain settling tanks are those receiving sewage untreated by chemicals and from which the deposited solids or sludge are removed before very much decomposition has taken place. Usually they are built rectangular in plan with sloping floors for sludge drainage. In the design of sewers, it is the aim of the engineer to keep the cross-section small enough to prevent low velocities of flow, thereby preventing deposition; on the other hand, in the design of settling tanks it is essential to obtain as low a velocity as possible in order to increase the amount of sedimentation. The length of time that sewage stays in a tank is much less important than the velocity with which it flows through, provided the period of retention is not so great as to cause undesirable decomposition. A very efficient type of tank is that designed by Mr. Watson for Birmingham, England. This is a cylindrical tank with a conical bottom, the sewage enters above the bottom at the centre of the tank and, flowing upward, slowly passes out through wires arranged around the top of the tank. The solids settle out into the conical part and can be removed by the hydraulic head without interrupting the operation of the tank.

Tanks for chemical precipitation are of various shapes but are most frequently rectangular in plan and the addition of chemicals take place just before the sewage enters the tank. The chemicals commonly used are lime and copperas; these, when mixed, form a flaky precipitate which carries down the particles of suspended solids. In some cities where trade wastes from iron manufacture enter the sewage the amount of iron in the sewage is sufficient to give a good precipitate when lime alone is added. The tanks can be cleaned by draining off the supernatent tanks to the level of the sludge and the sludge removed by sludge pumps. The sludge in chemical precipitation tanks is very heavy and rather difficult to handle. Chemical precipitation has the advantage over plain sedimentation that it removes some of the non-settling solids as well as the settling. It is, however, more expensive.

The Function of the Septic Tank.—The so-called septic tank is an attempt to utilize the decomposing action of bacteria in reducing the amount of organic solids to be dealt with. The septic tank is similar in design to the plain settling tank, but it is operated with very infrequent removal of the sludge. The period of retention of the sewage in the septic tank is usually much longer than in the settling tank. After the sewage has been retained a short time the oxygen originally present is exhausted and the putrefactive bacteria which work best in the absence of oxygen, begin to break down the organic matter. The organic solids are decomposed into liquids and gases thereby becoming somewhat less in quantity. At one time it was thought that this action would prevent the forming of any sludge, but while there is some reduction in the quantity of sludge, it is much less than was formerly thought. Besides, when a tank of sewage is undergoing rapid decomposition bubbles of gas bring quantities of sludge to the surface, often forming a scum on the top of the tank as well as on the bottom. The effluents from septic tanks are often more offensive than those from plain settling tanks, due to products of putrefaction.

Within the past few years a two-story tank has been derived which attempts to combine the advantages of plain sedimentation of the settling solids with the sludge digestion by the septic process. Tanks of this type have been devised by Mr. Imhoff, of Essen, Germany, and are known as Imhoff tanks. These tanks are coming into general use both in America and abroad. The Imhoff

tank is divided into two stories by a false bottom; the upper part serving as the sedimentation chamber and the lower part for the storage and digestion of the sludge. The false bottom is arranged into slits in such a way as to allow the settled solids to pass into the digestion chamber and yet not allow the gases or sludge to pass through into the sedimentation chamber. By this means the liquid passing through the tank remains practically unchanged by any septic action which takes place in the deposited solids. This type of tank is usually twenty to thirty feet deep and the decomposition of solids under head produces a sludge full of gas bubbles under pressure. When the sludge is withdrawn the gas expands and the resulting sludge is very porous and easily drained and dried.

Another development in tank treatment is the tank originated by Dr. Trans at Hampton, England. This tank not only removes settling solids, but a portion of the finely divided non-settling solids. This is accomplished by hanging plates in the sewage flow and on these surfaces aggregate the small particles of solids until a settling mass is formed which sinks into the sludge tanks. Like the Imhoff tank, the Trans tank has a separate compartment for sludge digestion, but unlike it, allows a portion of the flow to pass through this digestion chamber.

The Disposal of Sludge.—Whatever method of tank treatment is used, some means must be found to dispose of the sludge produced. Even the best sludge contains considerable amounts of putrescible organic matter and this organic matter, together with the high per cent. of water, renders the sludge problem somewhat difficult to solve. Part of the sludge treatment really takes place in the tanks due to the action of the bacteria in breaking down the organic compounds, but the removal of the water or drying of the sludge must take place outside. The sludge from deep tanks, where the sludge is drawn off under pressure, contains less water than that from shallow tanks, or that from tanks which have the supernatent water removed before cleaning. The best sludge will run as low as 75% moisture, but even then it is too wet to handle easily. Methods used for sludge drying are filter pressing, draining on sand beds and drying in centrifugal machines. Strictly speaking, these methods do not finally dispose of the sludge, but the dried sludge can be used for filling in low land or for fertilizer. Without drying, sludge can be disposed of by trenching the land and filling the trenches with wet sludge and eventually plowing the sludge underneath the soil. At Columbus, Ohio, the sludge is run into the river during the winter when the flow is sufficient to dilute the sludge without nuisance.

Although there are undoubtedly valuable fertilizer constituents in sewage sludge, the great difficulty in realizing this value is due to the high per cent. of water in even the dried material. To have value as a fertilizer it must not contain over 15% of water, and about the best that sludge-drying methods to date have been able to accomplish is 50% moisture. Probably the next few years will show developments in successful sludge utilization.

For the removal of dissolved organic solids, the earliest method is that of land irrigation. This method simply controls the flow of sewage over an area of land, this land being utilized for farming. Land irrigation given satisfactory effluents requires large areas of land, gives rise to nuisance from odors and flies, and on the whole is more costly than the modern methods. The sewage farms in Berlin cover about 43,000 acres, and those which are being abandoned gradually in Birmingham, England, 28,000. The financial aid realized from the sale of crops is not as great as might be expected and this method is generally going out of use.

A step in advance is the intermittent sand filter, as developed by the Massachusetts Board of Health. This filter consists essentially of a graded bed of sand or gravel, four or five feet in depth, well underdrained by lines of tile laid with open joints. Sewage applied evenly to the surface at regular intervals percolates through the bed and runs off in the drains. Bacteria and other microorganisms form a jelly-like covering on the surfaces of the sand grains and in conjunction with the air present oxidize the impurities. It is necessary to operate this type of filter intermittently in order to admit the air required for oxidation. Although excellent results are obtained with intermittent filtration, the same objection holds as with land irrigation. For large plants this type is very seldom adopted now-a-days, although for small quantities and where high degree of purification is required, it is extremely useful.

The Contact Bed and Sprinkling Filter.—The experiments of the Massachusetts Board of Health with sewage filtration through coarse gravel, led to further investigation on a practical scale in England and two forms of filters of coarse material were developed, the contact bed and the sprinkling filter.

The contact bed consists of a tank filled with broken stone to a depth of 4 or 5 feet, the bottom being underdrained and devices for the control of the sewage flow provided. The method of operation is to fill the bed with sewage, allow it to stand full for a short period, then drain until empty; this process being constantly repeated. While standing full some of the solid matter is deposited upon the surfaces of the stone, and while draining the air admitted, aided by the bacterial films developed on the stone, oxidizes the organic matter. It is necessary to pass the sewage through two or more beds of this type successively to get a well-oxidized and stable affluent. The use of coarse material allows much larger quantities to be treated than with sand filtration, although in time the voids become filled with solids and the material has to be renewed. The affluent from contact beds is usually non-putrescible and inoffensive, but is not as good as that from a sand filter. Contact beds, however, can be operated at a rate of 500,000 gallons per acre per day, while the best a sand bed can do is 100,000 gallons. The cost of operation is also much less

A sprinkling filter is essentially a bed of broken stone 5 to 8 feet in depth, placed over a concrete floor. The floor is covered with an under-drainage system for the rapid removal of the affluents and for ventilation. The sewage is applied to the surface of the filter in the form of a fine spray through a series of sprinkler nozzles, spaced symmetrically over the bed, these nozzles being fed by a system of distribution pipes connected with some sort of dosing apparatus. In passing through the air the sewage absorbs oxygen, and as in the other methods described, the bacteria growing on the filter stones, use their oxygen to oxidize the organic matter. On account of the continuous application of sewage and the constant supply of oxygen, the rate of filtration with a sprinkling filter is very high, running from one to three million gallons per acre per day. Usually final settling basins are provided for after treatment with this type of filter.

These basins are needed to collect the solids which wash out from the filter at periodic intervals. Unlike the contact bed, the sprinkling filter does not require to have the filtering media renewed on account of the clogging because at certain times of the year the clogging solids are washed out naturally and the media becomes absolutely clear. If fresh sewage is applied to sprinkling filter very little nuisance arises from odor; with both sprinkling filter and contact bed previous tank treatment is usually adopted, the best type of tank being that which delivers the freshest sewage with the largest amount of settling solids removed.

None of the processes of sewage purification destroy completely the bacteria present in the sewage. Well-operated land irrigation areas and intermittent filters give the best grade of effluent but, as we have stated, are being largely superseded to-day by the more rapid methods. Under some circumstances it is desirable to obtain an effluent reasonably free from possible disease germs. In this case practical sterilization can be accomplished by the use of chemicals; hydrochlorite of lime or bleaching powder being most commonly used. This chemical, when dissolved in water, liberates active oxygen which is extremely efficient as a germicide. About 99% of the bacteria in sewage effluents can be killed by adding 75 pounds of strong bleacher per million gallons. Raw sewage can also be largely freed from bacteria by larger quantities of the bleach. Other methods have been proposed by sterilization, such as the use of ozone and of chlorine gas. The use of the former in sewage work is probably prohibited on account of its cost. There seems to be a good field for chlorine gas and several types of machines are devised for using liquid chlorine from cylinders.

STEEL WHEELS FOR MOTOR TRUCKS.

One of the most interesting developments in the steel casting business recently has been the increase in the use of steel wheels for motor trucks. Automobile engineers have turned their attention to steel because the high quality of wood required for truck wheels is being rapidly exhausted. Also, wood wheels cause a good deal of trouble by variation of size, and cannot be used successfully in very dry climates.

While the cast-steel wheel overcomes all of the above objections, it has the disadvantage of excessive weight, the development of cracks, and it is not as resilient as wood. The proper design of truck wheels of very thin section is helping to overcome this to a great extent, and a few steel casting concerns are building up a large business on cast-steel wheels.

The annual purchases of British electrical goods, exclusive of machinery, by Australia have risen within five years from £350,000 to £858,000; in the case of India, from £223,000 to £330,000; South Africa, from £99,000 to £307,000; New Zealand, £78,000 to £153,000; and Canada, £49,000 to £278,000; while the demand on behalf of countries outside the empire is hardly less remarkable, as exemplified by Japan, which last year purchased British electrical goods, exclusive of machinery, to £375,000, against £126,000 in 1908; Egypt, £395,000, compared with £23,000 in the former period; the Argentine, £268,000, contrasted with £148,000; and Brazil, £167,000, against £86,000. The United States last year bought British goods of this class to no less than £169,000, against only £9,000 five years ago.

TYPICAL SPECIFICATIONS FOR STEEL HIGHWAY BRIDGES.

THE Office of Public Roads of the United States Department of Agriculture has just issued a set of typical specifications for the fabrication and erection of steel bridges for highways. The bulletin, compiled under the direction of L. W. Page, is offered as a suitable guide for highway officials in fixing requirements to which bridge structure should be made to conform with a view to eliminating the prevalence of poorly constructed bridges, indicative of a lack of information on the part of highway officials concerning proper specifications for this class of work.

Two classes of bridges are considered under these specifications—those which carry suburban or interurban electric cars and those which carry highway traffic only. The former are designated as class A and the latter as class B bridges.

Types of Bridges.—It is recommended that the type of bridge employed be selected as follows:—

For spans up to 30 feet—rolled beams.

For spans from 30 to 40 feet—plate girders or rolled beams.

For spans from 40 to 80 feet—riveted low trusses or plate girders.

For spans from 80 to 200 feet—riveted high trusses.

For spans over 200 feet—pin-connected high trusses.

All parts of the superstructure except the floor shall be of rolled steel.

In computing the stresses the length of span for the trusses or girders shall be taken as the distance from centre to centre of the end bearings; and for the floor beams, from centre to centre of the trusses.

Width of Roadway.—For Class A bridges the clear distance between the centre line of the car tracks and the nearest truss shall be not less than 7 feet, and on one side the clear distance betwen the centre line of the car track and the truss shall be at least 12 feet. The width from centre to centre of trusses shall in no case be less than one-eighteenth of the span.

The clear head room for a width of 6 feet on each side of the centre line of the bridge shall be not less than 15 feet.

The ratio of depth of span shall be not less than the following: For rolled beams, 1/20; for plate girders, 1/12; for trusses, 1/10.

Loads.—The assumed dead load shall be not less than the total weight of the completed structure. The following unit weights shall be used in computing the dead loads:

Steel	490 pds. per cu. ft.
Concrete	150 " "
Brick	150 " "
Macadam	130 " "
Asphalt	135 " "
Sand or earth	100 " "
Stone	160 " "
Timber:	
Creosoted	5 pds. per ft. b.m.
Oak, untreated	4½ " "
Pine, untreated	4 " "

Class A.—For the floor and its supports and for the trusses of spans less than 50 feet in length the live load shall be assumed as follows:

On each car track a concentrated load of 24 tons evenly divided between two axles, spaced 10 feet centre to centre with wheels spaced 5 feet centre to centre on axles, shall be assumed to occupy a width of 6 feet on each side of the centre line; on the remaining floor surface, exclusive of sidewalks, a uniform load of 125 pounds per square foot and on sidewalks a uniform load of 100 pounds per square foot.

For the trusses of spans between 50 feet and 100 feet in length, a uniform load of 1,800 pounds per linear foot for each car track (assumed to occupy a width of 12 feet) and 100 pounds per square foot of remaining floor surface including sidewalks, shall be assumed. For the trusses of spans greater than 100 feet in length, the live load per linear foot for each car track and per square foot of remaining floor surface may be reduced, respectively, 50 pounds and 2 pounds for each additional 10 feet of span, provided that in no case shall these loads be reduced below 1,200 pounds and 80 pounds, respectively.

All class A bridges shall be assumed as also subject to the loading specified for class B bridges.

Class B.—For the floor and its supports and for the trusses of spans less than 50 feet in length, the live load shall be assumed as follows:

On any part of the floor surface a concentrated load of 15 tons on two axles spaced 8 feet centre to centre, with wheels spaced 6 feet centre to centre on axles two-thirds of the load on one axle, shall be assumed to occupy a space 16 feet in the direction of traffic by 12 feet at right angles to that direction. On the remaining floor surface, exclusive of sidewalks, a uniform load of 125 pounds per square foot and on sidewalks a uniform load of 100 pounds per square foot, shall be assumed.

For the trusses of spans between 50 feet and 100 feet in length a uniformly distributed load of 100 pounds per square foot of floor surface shall be assumed. For the trusses of spans greater than 100 feet in length the uniform load per square foot may be reduced 2 pounds for each additional 10 feet of span, provided that in no case shall the assumed live load be less than 80 pounds per square foot of floor surface.

Distribution of Stresses Due to Concentrated Loads.—In considering the concentrated load under Class A, each wheel load shall be assumed distributed over an area of floor surface 5 feet square. In considering the concentrated load under class B, each wheel load shall be assumed distributed as follows: For reinforced concrete floors, protected by a wearing surface, 3 feet in the direction of traffic by 5 feet at right angles to that direction; for wood floors at least 3 inches thick the distribution in the direction of traffic shall be neglected in designing the joists and the distribution at right angles to the direction of traffic shall be taken as 4 feet.

The top lateral bracing in deck bridges and the bottom lateral bracing in through bridges shall be designed to resist a lateral wind load of 300 pounds per linear foot, and one-half of this shall be treated as a moving load.

The bottom lateral bracing in deck bridges and the top lateral bracing in through bridges shall be designed to resist a lateral wind load of 150 pounds per linear foot.

Provision shall be made for stresses due to a change in temperature of 150°F.

For class A bridges provision shall be made for a longitudinal force equal to 20 per cent. of the weight of the heaviest electric train which could reasonably be expected to come upon the bridge.

Impact and Centrifugal Force.—The maximum live-load stress in each member shall be increased to provide for impact by an amount to be determined from the formula $I = \frac{100\ S}{L + 300}$, where

I = impact or dynamic increment due to the effect of moving loads;

S = computed live-load stress; and

L = loaded length of bridge in feet which produces maximum live-load stress in the member under consideration.

When curved tracks occur on class A bridges, the centrifugal force produced by two cars coupled together moving at 50 miles an hour shall be considered as an additional live load in designing the lateral bracing.

Proportions and Unit Stresses.—All members shall be so designed that the stresses coming upon them may be accurately computed, and shall be so proportioned that the sum of the maximum stresses produced by the loads herein specified shall not exceed the following amounts in pounds per square inch.

Axial tension on net section—16,000; axial compression on gross section—$16{,}000 - 70\frac{l}{r}$, where l is the length of the member in inches and r is the least radius of gyration of its cross section in inches.

For class A bridges no compression members shall have an unsupported length exceeding 100 times its least radius of gyration for main members, or 120 times its least radius of gyration for laterals. For class B bridges no compression member shall have an unsupported length exceeding 120 times its least radius of gyration for main members, or 140 times its least radius of gyration for laterals.

Bending stresses on extreme fibres of rolled floor beams, joists, and girders, 12,500; on extreme fibres of built-up girders, 16,000; and on extreme fibres of pins, 20,000.

Shearing—

Pins and shop-driven rivets	10,000
Field-driven rivets	7,500
Plate-girder webs (gross section)	9,000

Bearing—

Shop-driven rivets	20,000
Pins and field-driven rivets	15,000
Wall plates on concrete masonry (1 : 2½ : 5)	500
Wall plates on stone masonry (ashlar)	500
Wall plates on stone masonry (rubble)	400
Expansion rollers (per lineal inch)	500d

where d is the diameter of the roller in inches.

Alternate Stresses.—Members subject to alternate tensile and compressive stresses shall be proportioned to resist each kind of stress, and each stress shall be considered as increased by an amount equal to eight-tenths of the smaller stress in determining the sectional area. The connections shall be proportioned for the arithmetical sum of the stresses.

Combined Stresses.—Members subject to a combination of direct and bending stresses shall be designed so

that the greatest unit fibre stress shall not exceed the allowable unit stress for the timber.

Counters.—Wherever the live and dead load stresses are opposite in character, only two-thirds of the dead-load stress shall be considered effective in counteracting the live-load stress.

For class A bridges counters shall be so provided and proportioned that an increase of 25 per cent. in the specified live load would not increase the unit stress in any member more than 25 per cent.

Net Section at Rivets.—In proportioning tension members the diameter of the rivet holes shall be taken ⅛ inch larger than the nominal diameter of the rivets.

Proportioning Plate Girders.—The flanges of plate girders shall be assumed to take all the bending moment, and the web shall be assumed to take all the shear. The compression and tension flanges shall have the same gross section.

The Floor System.—All floor beams shall be rolled or riveted steel girders and shall be rigidly connected to the trusses or side girders. They shall, when practicable, be placed at right angles to the direction of traffic.

All joists shall be rolled or riveted steel girders and shall be rigidly fastened to the floor beams. When wood floors are used, the joists shall be riveted to the webs of floor beams by means of connection angles. The spacing of joists centre to centre shall be not greater than 3 feet.

Wood floors shall be constructed of first-quality timber of the kind specified by the engineer in writing or indicated on his drawings. For oak floors the minimum thickness of plank used shall be 2½ inches, and for pine the minimum thickness shall be 3 inches. In no case shall the thickness of the floor plank be less than one-twelfth of the distance, centre to centre, between joists. All plank shall be laid with the heart side down at right angles to the direction of traffic. Spaces approximately ¼ inch shall be left between adjacent planks.

Wood floors shall be provided with a wheel guard on each side of the roadway. Wheel guards shall be constructed of timbers having a cross section of not less than 6 inches by 4 inches, spliced with 6-inch lap joints, and shall be securely bolted to the joists at intervals not to exceed 5 feet.

Adequate provision shall be made for draining all parts of the floor, and the water drained off shall go clear of all metal work.

Details of Design and Construction.—The minimum thickness of metal used in any part of the structure, except that used for fillers and other minor parts, shall be 5/16 inch. For class B bridges, however, this specification may be modified by the engineer in writing to permit the use of standard channels and I-beams having web thicknesses of less than 5/16 inch, provided that the modification is made as a supplementary clause to these specifications before the contract is awarded or is indicated on the engineer's general drawings.

Truss spans shall be given a camber by making the horizontal projection of the top chord longer than the bottom chord by 3/16 inch for each 10 feet of span.

All connections shall be designed to develop the full strength of the connecting members and shall be of the character indicated on the engineer's drawings or by the engineer in writing.

Angles subject to tensile stress shall be connected by both legs, otherwise only the section of the leg actually connected will be considered effective.

The neutral axes of connecting members shall meet in a point.

Rivets and Rivet Spacing.—Rivets shall be either ⅞ inch, ¾ inch, or ⅝ inch in diameter, except when used in minor parts.

The maximum pitch in the line of stress shall not exceed 6 inches or 16 times the thickness of the thinnest outside plate. The minimum pitch shall not be less than 3 inches for ⅞-inch rivets, 2½ inches for ¾-inch rivets, and 2 inches for ⅝-inch rivets. For plate girders the rivet spacing in the vertical legs of the flange angles shall be determined from the formula, $p = \frac{rh}{s}$, where p is the pitch in inches, r the permissible stress in one rivet in pounds, h the distance between lines of rivets in inches, and s the maximum shear in pounds at the section under consideration. In no case, however, shall the pitch exceed 4 inches.

The minimum distances from centre or rivet holes to the nearest edge shall be not less than 1½ inches, 1¼ inches, and 1 inch for ⅞-inch rivets, ¾-inch rivets, and ⅝-inch rivets, respectively. The maximum distance from any edge to the centre of rivet holes shall not exceed 8 times the thickness of the thinnest outside plate or 6 inches.

Unless otherwise specified in the engineer's drawings or by the engineer in writing, ⅝-inch rivets shall be used for all flanges less than 2½ inches wide, ¾-inch rivets for flanges between 2½ and 3½ inches, and ⅞-inch rivets for all flanges over 3½ inches wide.

At the ends of built compression members the pitch of rivets in the line of stress shall not exceed 4 diameters for a distance equal to twice the maximum width of the member.

The grip of rivets shall, in general, be not greater than 4 diameters. When it is necessary to make the grip greater than 4 diameters, the allowable unit shearing strength shall be decreased 1 per cent. for each 1/16 inch of additional grip.

Pin Connections.—All pins shall be sufficiently long to furnish full bearing upon the turned body of the pin for all connecting parts. All pins shall be secured by chambered nuts and the screw ends shall be sufficiently long to admit of burring the threads after the nuts are set.

No pin shall have a diameter less than three-fourths the width of the widest eyebar attached to it.

The several members attaching to a pin shall be so placed as to produce as little bending movement as practicable upon the pin; and they shall be held in place by means of filling rings.

All pin holes shall be so bored that when the pin is in place it shall be perpendicular to the axial plane of the truss, and each connecting member shall bear uniformly upon the pin. The diameter of the hole shall not be more than 1/32 inch greater than that of the pin.

Pin holes shall be sufficiently reinforced to distribute the stresses properly over the full cross section of the members. Where "pin plates" are used, they shall contain a sufficient number of rivets to transmit their proportion of the bearing pressure, and at least one plate on

each side shall extend not less than 6 inches beyond the edge of the nearest batten plate.

Riveted tension members having pin connections shall have a cross sectional area through each pin hole 25 per cent. in excess of the net sectional area of the members. The sectional area of the metal between the pin hole and the end of the member shall not be less than 75 per cent. of the sectional area through the pin hole.

Batten Plates and Lattice Bars.—The open sides of compression members shall be stayed by batten plates at the ends and by diagonal lattice bars at intermediate points. Batten plates shall be used at intermediate points when, for any reason, the latticing is interrupted.

Batten plates shall have a thickness of not less than ¼-inch nor one forty-fifth the distance between the lines of rivets connecting them to the flanges. They shall have a width parallel to the axis of the member not less than the maximum width of the member.

Lattice bars shall have thickness not less than 5/16-inch nor less than one forty-fifth their unsupported length. They shall be inclined to the axis of the member at an angle not less than 60° for single latticing nor less than 45° for double latticing. Double latticing shall be riveted at the intersection points.

The width of lattice bars shall not be less than 2 inches nor less than on-sixth the width of the member of which they form a part.

Abutting ends in compression members shall be planed true to the angle of the joint and shall be sufficiently spliced on four sides to hold the connecting parts accurately in place. All joints in tension members shall be fully spliced.

Where splice plates are separated from the parts which they connect by intervening plates or fillers, the number of rivets on each side of the joint shall be increased by 33⅓ per cent. of the number theoretically required for each intervening plate.

The thickness of eyebars shall not be less than ⅝-inch nor less than one-seventh the width of the bar. Heads of eyebars shall be formed by upsetting and forging, and never by welding. The heads shall be so proportioned as to develop the full strength of the bar.

Eyebars shall be perfectly straight at the time they are bored, and all bars which work together as one member shall be piled, clamped together, and bored in one operation.

The eyebars composing a member shall be so arranged that their surfaces are not in contact. The inclination of individual eyebars to the axis of the member which they compose shall not be greater than 1 inch in 16 feet.

No rod shall be used which has a cross sectional area less than ¾ square inch.

All roads having screw ends shall be upset, previous to threading so that the net sectional area at the root of the threads shall be greater by at least 17 per cent. than the net sectional area of the rod.

Compression members shall be so designed that any part of segment of a member will be proportionately as strong as the member taken as a whole.

No web shall have a thickness less than one-thirtieth the distance between the lines of rivets connecting it to the flanges, and no cover plate shall have a thickness less than one-fortieth the distance between rivet lines.

Flanges of built members which have no cover plates shall have a thickness not less than one-twelfth the width of the outstanding leg.

Lateral System.—All lateral and portal bracing shall be made of shapes capable of resisting both compression and tension, and shall have riveted connections to the chords.

Laterals shall be as nearly in the plane of the axes of the chords as practicable. When eccentricity is unavoidable, however, provision shall be made for the maximum bending stresses which would be produced in the connections with the member fully loaded.

Portals for through bridges shall be as deep as the specified head room and depth of truss will permit. They shall consist of top and bottom struts and stiff intermediate bracing. All portals shall be provided with curved knee or corner braces.

Intermediate top struts in through bridges shall have a depth not less than that of the top chord, and, if the engineer so requires, they shall be provided with curved knee or corner braces.

End struts shall be provided at the ends of all bottom chords.

All deck bridges shall be provided at each panel point with sway bracing made of shapes capable of resisting both tension and compression. The sway bracing shall extend the full depth of the trusses, and at the end of the trusses ample provision shall be made for transferring all wind loads to the piers or abutments.

A substantial hand railing not less than 3½ feet high and of appropriate design shall be constructed on the outside of footwalks, or, when footwalks are omitted, at the outside of the roadway.

Expansion and Contraction.—Provision shall be made for all bridge structures to change in length owing to temperature changes at least ⅛-inch for each 10 feet of span, and joints shall be provided at such points in the floor and pavement as may be indicated on the drawings furnished or approved by the engineer.

For all beam and girder bridges expansion bearings shall be designed for motion to take place by sliding. For all truss bridges the expansion bearings shall preferably be provided with rollers or rockers, though for spans less than 80 feet in length the engineer may, in his discretion, permit the use of sliding bearings. All rollers or rockers shall have a diameter of at least 3 inches. In all cases the bearings shall be so designed that motion can take place in a longitudinal direction only, and shall be so placed at the time the bridge is erected that the shoe or bolster will occupy a central position on the bearing at the atmospheric temperatures specified by the engineer in writing.

Shoes or bolsters shall be so designed as to distribute the load over the entire bearing, and shall be securely stayed against lateral or upward motion by anchor bolts. Fixed bearings shall be rigidly anchored to the masonry.

Bedplates shall be designed to distribute the load over an area sufficiently great to keep the pressure upon the masonry within the hereinbefore specified limits. All bed and bearing plates on masonry shall be set on sheet lead not less than ¼-inch thick and the same size as the plate.

DESIGN FOR THE FOUNDATION OF 150-TON SHEAR-LEGS.

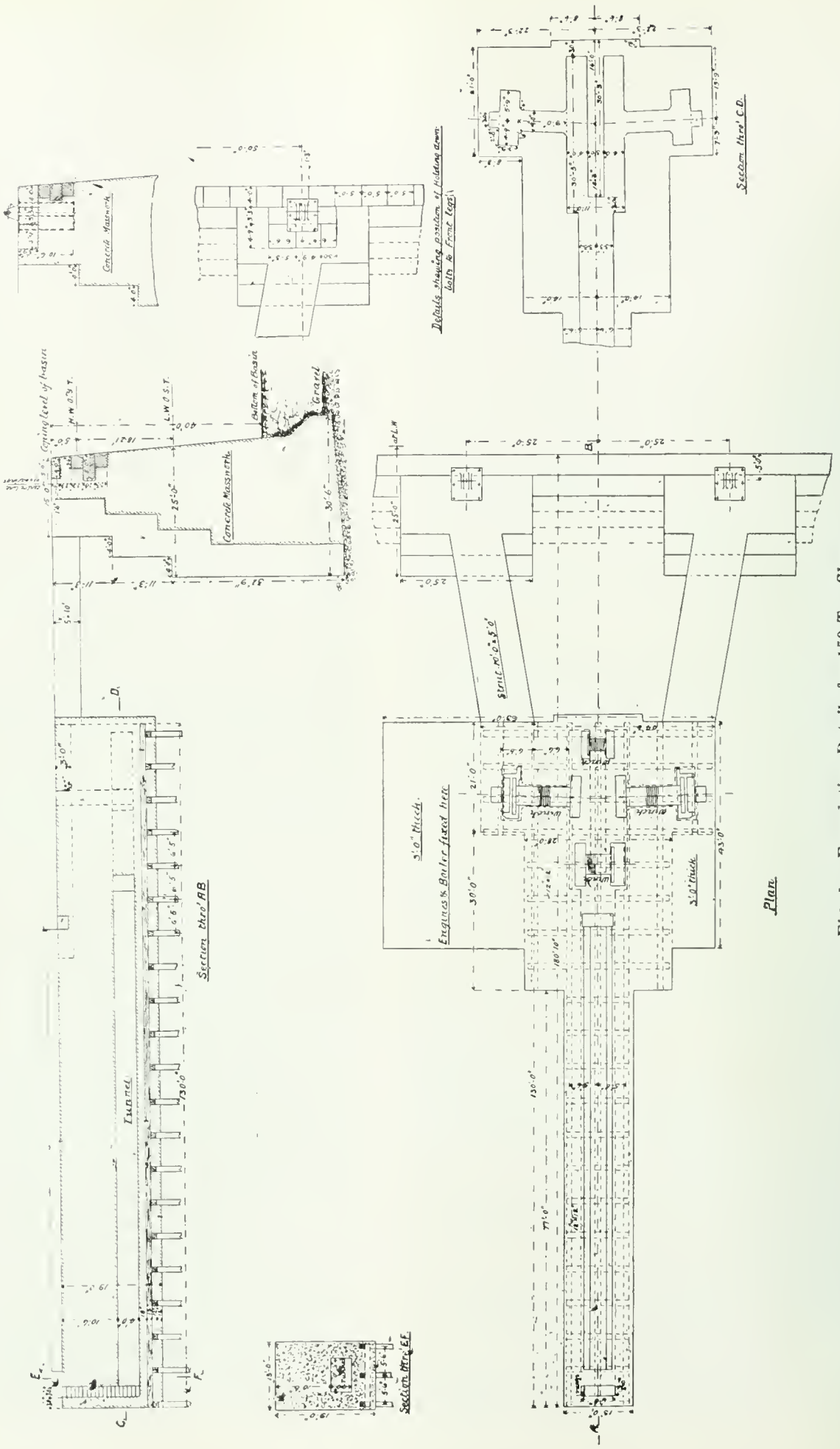

Fig. 1.—Foundation Details for 150-Ton Shears.

DESIGN FOR THE FOUNDATION OF 150-TON SHEAR-LEGS.

By Leonard Goodday, C.E., M.E.
Late of the British Admiralty.

A FEW years ago the writer was associated with the construction of some new docks and basin accommodation in England. The work included the design and erection of shear-legs for the support of hoisting tackle, a most essential factor in dock yards where heavy weights are to be hoisted over the side of a wharf or lowered to the deck of a vessel. Guns and heavy machinery are easily and comparatively quickly handled by this means, and this manner of hoist is also frequently used in "stepping" masts.

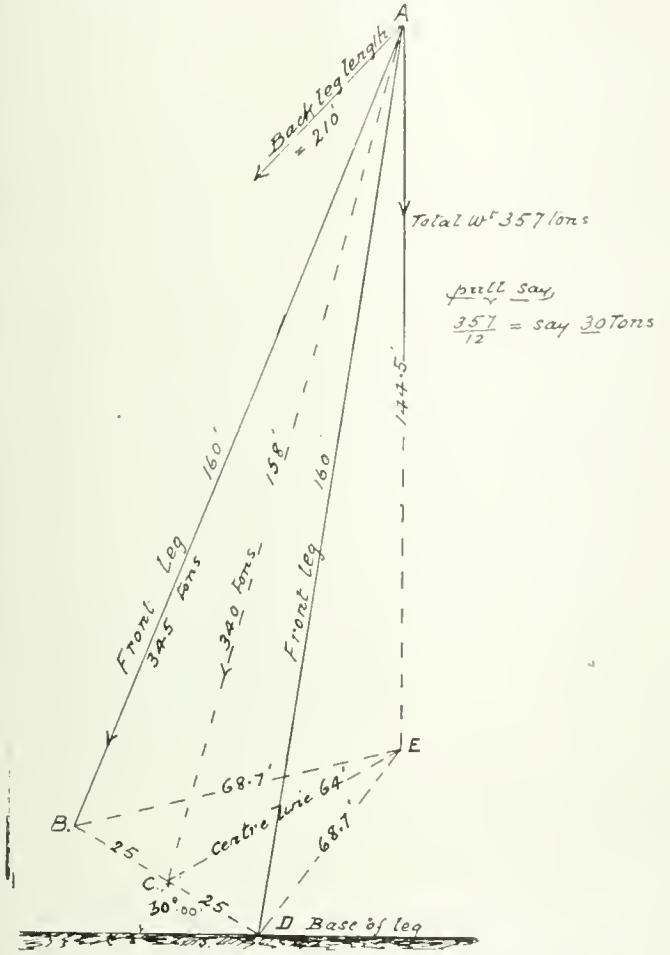

Fig. 2.—Isometric Sketch Showing Deduced Dimensions of Shear-legs.

The two front legs are necessarily close to the edge of the wharf; in the instance under consideration the distance therefrom being five feet. This necessitates a very solid wall and foundation, well tied in to counteract the outward thrusts from the toe of each front leg, while the rear leg is in compression. These foundations are connected to the concrete pit foundations for the back leg screw and thrust block gear by two counterforts, as shown on the plan in Fig. 1. The longitudinal and cross-sections illustrate the piling necessary in this particular case on account of the foundations resting upon "made" ground. The piles were carried down to gravel, as were also the foundations for the counterforts and basin wall, as will be seen in the drawing. Generally the back leg foundations are carried down in concrete unless the solid bed is of too great a depth, in which case footings, proportioned in size to the weight to be supported, would be used. Piling is not used unless absolutely necessary.

In the design the first step consists in fixing the maximum height required. This estimate is based upon the largest weight, the highest lift anticipated, the depth of load, and length of blocks, including tackle. The height, as shown in the diagram, of the case under consideration is 144 feet 6 inches, measured from the ground.

The necessary width between the footings for the front legs and the greatest overhang from the vertical are next deduced. These are found to be 50 feet and 64 feet respectively.

Referring to the isometrical sketch of Fig. 2: $\sqrt{CE^2 + CD^2} = \sqrt{64^2 + 25^2} = 68.7$ feet $= DE$; and $\sqrt{DE^2 + AE^2} = \sqrt{68.7^2 + 144\frac{1}{2}^2} = 160$ feet $= DA$, which is the length of front leg from point D to point A. $\sqrt{CE^2 + AE^2} = \sqrt{64^2 + 144\frac{1}{2}^2} = 158$ feet $= CA$. (See Fig. 2).

The weight of one front leg is arrived at by computing the volume from the dimensions given and the weight at 20.5 lbs. per sq. ft.

Weight of front leg =	51,520 lbs.
Weight of four ribs =	9,280 lbs.
Weight of blocks =	13,120 lbs.
	73,920 lbs. or 33 tons, approximately, (2,240 lbs.).

Allowing for the weight of end blocks, etc., the estimate for each front leg may be considered 40 tons.

The weight of the back leg will be found by proportion to be 52 tons, its length being 210 feet.

The load increased by 50% over load is considered as a test weight = 150 + 75	= 225 tons
Tackle - - - - - - - - - -	= 10 tons
Half the weight of the front legs (considered twice) - - - - - - - - -	= 40 tons
Half the weight of the back leg - -	= 26 tons

making a total approximating 300 tons.

In considering the blocks themselves the double "purchase" must be taken into account, the test weight being $\frac{225}{12} = 19 \times 2$ = 38 tons

Friction, etc. (reckoned at 50%) = 19 tons

making a total of 57 tons, double "purchase," and a grand total of 357 tons, as the weight. The pull would therefore approximate 30 tons, or 1/12 of this.

Resolving the load when overhanging 64 feet, the tension on the back leg reaches 350 tons, and on the front legs 680 tons thrust, or 340 on each, if both were on the centre line (for calculation only), and 345 tons on each when splayed 50 feet apart at base.

Taking the pull into account, a block of concrete of sufficient weight to resist the tension of the back leg at its foot when the weight is at its greatest overhang, 64 feet, must be of the following depth:

$$\frac{189 \text{ tons, vertical pull, } \times 16 \text{ cu. ft. per ton of concrete}}{32 \text{ feet, length, } \times 13 \text{ feet width}}$$

= 7.3 feet. Therefore, the dimensions of the block might be 32′ 0″ × 13′ 0″ × 7′ 6″ depth.

This gives 3,024 cubic feet of concrete required. In the actual case the chosen depth of the block was 10′ 6″, affording an excess volume of 1,344 cubic feet.

The front leg thrust equals 315 tons; 285 tons vertically and 140 tons horizontally. The sectional area of the top block of the counterfort, about 11′ 3″ below the coping, as shown in the diagram, is about 400 sq. ft. (dimensions 16 × 25). This gives, therefore, 0.35 tons per sq. ft. as the force tending to cause the block to slide. As 1 ton per sq. ft. is safe against this shearing, the factor of safety is sufficient.

Referring again to the diagrams of Fig. 1, one shows the shear-legs run in until the weight hangs over the centre of the track. The stresses at intervals from Fig. 1, 1a to 7, as the thrust block is run backward on the screw, are given. In this case the pull from the winches is taken into account, thereby increasing these stresses. At the points 1a to 7 are shown the resultant vertical stresses, 26 tons, or one-half the weight of the back leg being deducted when the leg is in tension, and added when in compression. This gives the lines *BC* and *CD* when in compression and tension respectively, *C* being the neutral point.

The diagram thus supplies the following data: The block 37′ 0″ in length represents the amount of concrete affected, which also must shear before failing. The pyramid is really a trial block giving a factor of safety of 3.

There are 1,200 cubic yards of concrete in each counterfort wall of the actual case to which this design applied. This includes the basin wall between it and its face. The concrete for the back leg foundations and the two connecting struts amounts to 1,180 cubic yards.

The plan in Fig. 1 also shows the position of boiler, engines and steam winches. They are equipped with centre tunnels, as shown, to provide access to bolts and plates in their foundation beds, it being most important to have all hoisting apparatus carefully and properly fixed in position.

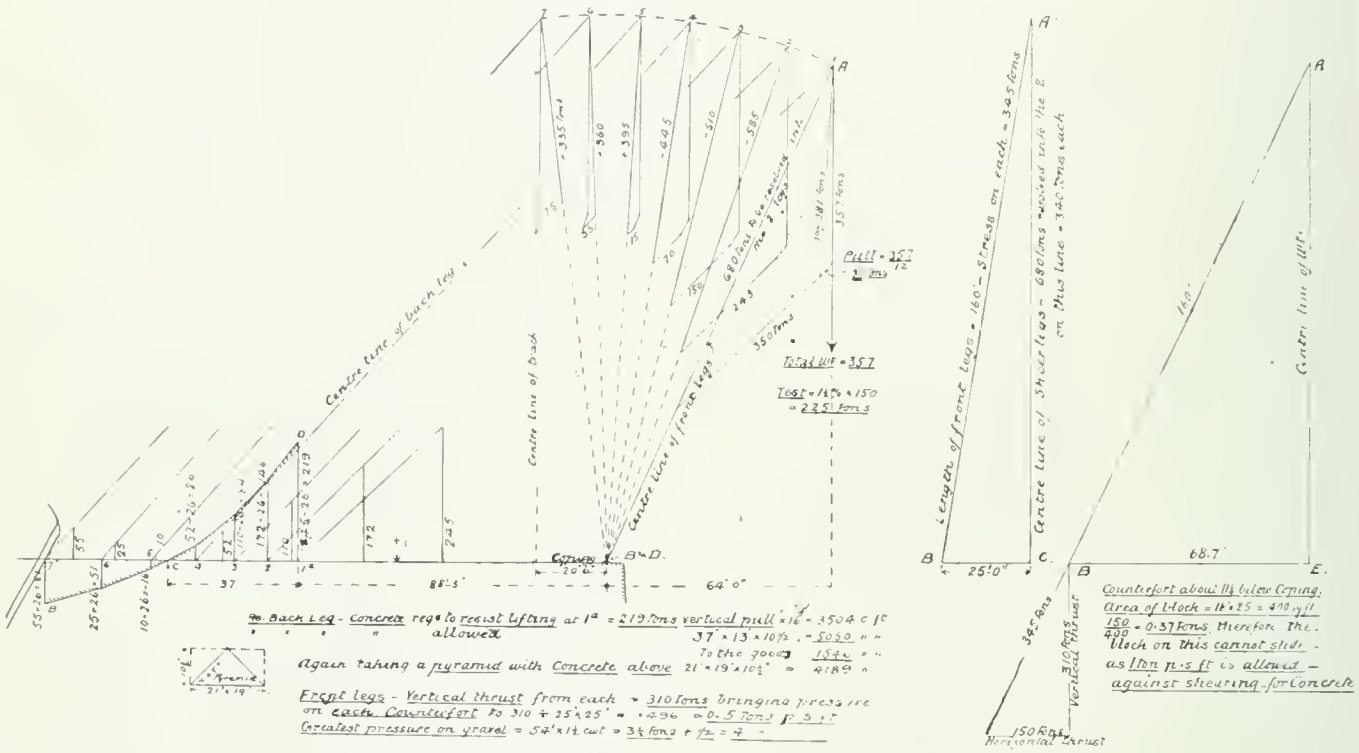
Centre line of back leg
Centre line of front legs
Centre line of track
Coping
B & D
37
88·5'
64'0"
Pull = 157 / 2 tons
Total lift = 357
Test = 14½ × 150 = 2251 tons
Again taking a pyramid with Concrete above
Except legs - Vertical thrust from each = 310 tons bringing pressure on each Counterfort to 310 ÷ 25 × 25' = ·496 = 0.5 Tons p. S. ft
Greatest pressure on gravel = 54' × 1¼ cwt = 3½ tons + ½ = 4 "
Centre line of Shear legs
Length of front legs = 160 - Stress on each = 345 tons
Counterfort about 11½ below Coping.
Area of block = 16 × 25 = 400 sq ft
150 / 400 = 0·37 Tons. Therefore the block on this cannot slide - as 1 ton p. s. ft is allowed - against shearing - for Concrete
150 Tons Horizontal thrust
310 Tons Vertical thrust
68.7'
25'0"

Fig. 3.—Stresses in Members, Including Pull of Winch.

GERMANY'S IRON AND STEEL EXPORTS.

The scale of progress which Germany is making as an exporter of iron and steel is illustrated in the following table, where quantities are in kilograms per head of population, and show a fast increasing margin between home consumption and total output:—

January to May.	Output of blast furnaces.	Home consumption.
1907	85.87	60.64
1908	81.77	52.83
1909	81.69	51.50
1910	92.05	56.28
1911	98.60	59.71
1912	107.83	62.88
1913	119.13	68.08

The most notable example of existing train ferries in Europe are those which have been established by the Danish State railways. The geographical conditions in Denmark have made train ferry transport a necessity for through communication. These ferries give unbroken railway transport over distances ranging from 1½ miles to 26 miles. One, the Sallingsund ferry, has been in operation since 1872, and that across the Storabelt, at a point where the arm of the sea is 16 miles wide between Korsoer and Nyborg since 1883. There is a train ferry between Copenhagen and Malmoe, a distance of 19 miles. The longest of the ferries, that which crosses the Baltic between Warnemunde and Gjedser, carries trains for 26 miles over waters where heavy seas are not infrequent. Some of the Danish ferries provide uninterrupted railway communication only between the separated parts of Denmark; others, of which that from Gjedser to Warnemunde is the most important, provide through railway connection with the railway systems of Europe, with all the accompanying advantages of unbroken goods and mail transport and sleeping-car accommodation for passengers.

A WATER SUPPLY FOR WINNIPEG

A REPORT CONCERNING SHOAL LAKE AS A SOURCE OF SUPPLY FOR THE GREATER WINNIPEG WATER DISTRICT—BY AN OFFICIAL BOARD OF CONSULTING ENGINEERS.

WINNIPEG'S chief problem is that of water supply, and municipal authorities have for years been studying the question of a sufficient supply of safe and desirable water for domestic and industrial use. A year ago *The Canadian Engineer* (issue of Sept. 19th, 1912) published, in part, a report presented by Prof. C. S. Slichter, of Madison, Wis. Shoal Lake was recommended by him in preference to the other possible sources, viz., Winnipeg River, the Poplar Springs, the Crystal Springs, and the artesian well system which, up to that time, was the source of supply. This source provided a water of high mineral content, corrosive and destructive to plumbing, boilers, etc., and generally considered too hard for domestic use, as well as being unsatisfactory from a health point of view. The report referred to pronounced Shoal Lake as a supply not requiring treatment before consumption. Readers are referred to the article mentioned for a concise résumé of Prof. Slichter's recommendations.

This source had already been suggested in 1907 by a commission, but, judging such a project as being too expensive, Winnipeg River was recommended instead. No procedure was made, however.

Mr. H. N. Ruttan, city engineer, suggested last year that steps be taken to have a thorough investigation of the Shoal Lake project, as the question had resolved itself largely into one of cost and an accurate estimate of the expenditure which such a proposal would entail, was necessary before proceeding further. This investigation has been carried on since early spring by Rudolph Hering, Frederic P. Stearns and James H. Fuertes, the board of consulting engineers, and who have just presented their report, which we publish herewith in part:

Quantity of Water Required.—The population of the Greater Winnipeg water district is about 225,000, about 200,000 being in the city of Winnipeg. The rapid growth is shown by the fact that the present population is twice that of seven years ago, and five times that of fifteen years ago. The city and district are now so well established that it is not advisable to adopt a hand-to-mouth policy if it can be shown to be more economical in the long run to provide works of large capacity at the present time. The population of Winnipeg and the amount of water supplied in each year beginning in 1902, is given in Table I.

Year.	Population as shown by assessment records.	Water supplied per day* Imperial gallons.	Imperial gals. per inhabitant.
1902	48,411	1,550,000	32
1903	56,741	1,860,000	33
1904	67,262	2,340,000	35
1905	79,975	3,280,000	41
1906	101,057	3,500,000	35
1907	111,729	4,580,000	41
1908	118,252	4,880,000	41
1909	122,390	5,820,000	48
1910	132,720	5,930,000	45
1911	151,958	6,510,000	43
1912	166,553	7,750,000	47

*The table does not include the small quantity of water pumped at the high pressure fire station for other than fire purposes.

This table shows that the amount of water used per inhabitant is increasing, which is a result to be expected with the increase in the facilities for using water and one which accords with the experience of other cities. The increase is likely to continue until it reaches about double the present amount now used per inhabitant, if the present meter system of selling water is continued, as we believe it should be, or a much larger quantity provided the water is not metered to the consumers.

We believe that 85 gallons per inhabitant is a proper quantity to adopt for estimating the future needs of the district as an average for the year, but in some months the rate will average as high as 100 gallons per inhabitant. Therefore an aqueduct to provide for a considerable time in the future should, in our opinion, be designed with a capacity of 100 gallons per inhabitant, and even with this provision a large reservoir should be built near the city, in the future, to provide for a still higher rate of water consumption during short periods.

The consumption of water at the present time is somewhat restricted by the limited capacity of the sources of supply and will undoubtedly increase to a considerable extent when a new supply with a better water is furnished. For the next ten years, however, the consumption is likely to be less than 85 gallons per inhabitant.

As already indicated, we have found that the best structure for conveying water for the greater part of the way from Shoal Lake to Winnipeg is a concrete aqueduct laid with a continuous down grade, and as such a structure can be built of large capacity for a moderate additional cost, we have designed this structure to carry 85,000,000 gallons in 24 hours, sufficient, on the basis assumed, for a supply throughout the year for 850,000 inhabitants.

This may seem to be an unnecessarily large provision for future years, but it must be born in mind that the additional cost of making such a structure of liberal size is comparatively small while the cost of duplicating such an aqueduct would be large.

We adopted the capacity of 85,000,000 gallons daily after giving due consideration to the many demands for money for public works in a growing city like Winnipeg; otherwise we should have recommended a larger aqueduct, say one having a capacity of 100,000,000 gallons in 24 hours.

From the point near Transcona where the concrete aqueduct ends, to the existing McPhillips Street reservoirs, a pipe is recommended; and a single pipe line of the sizes which now seem desirable will convey by gravity 25,000,000 gallons of water in 24 hours, or nearly three times the quantity of water now used. When necessary, the flow through this pipe can be increased by pumping, or a second pipe can be laid.

Assuming a continuous growth for the Greater Winnipeg Water District, based upon the past growth of the district and the rate at which other somewhat similarly situated cities have grown, the 85,000,000-gallon aqueduct would have sufficient capacity for supplying the district until 1944. Assuming further the introduction of water from Shoal Lake at the earliest practicable date, the aqueduct would supply the requirements of the district for

about 25 years after its completion, and the 25,000,000-gallon pipe line would supply by gravity the quantity of water required for two or three years; but, as already stated, the capacity of the pipe line can be increased by pumping.

Quantity of Water Available from Shoal Lake.—Shoal Lake has a drainage area of about 360 square miles and a water surface of 107 square miles, and is at the same level as the Lake of the Woods, with which it connects at Ash Rapids. No direct measurements of the quantity of water which this lake will furnish have been made, but the probable quantity of water may be inferred from the amount of rainfall in this vicinity and the size of the drainage area and of the lake surface.

Shoal Lake, if separated from the Lake of the Woods, would derive its supply from the rainfall upon the surface of the lake and upon the land included in its drainage area. The rain which falls upon the surface of Shoal Lake is offset in part by the evaporation from the lake, but under all ordinary conditions there is probably a considerable supply to the lake from the excess of the rain over the evaporation. A part of the rain which falls upon the land surrounding the lake is lost by evaporation from the surface of the ground, but such evaporation is not as great as from the lake surface, so that there is a larger yield of water per square mile from the land surfaces.

Shoal Lake is so large that in case the supply to it in any year were unusually small, water stored in it in previous years could be used to make up the deficiency. For example, the quantity of water in a single foot of Shoal Lake is equivalent to about 8.5 months' supply for 850,000 people, at the per capita rate of water consumption before stated.

Quality of Water in Shoal Lake.—Physical and chemical examinations of water taken from Shoal Lake show that it is practically free from contamination, that it is clear and practically without color and that it is free from odor and has an agreeable taste. It is very soft in comparison with the water at present supplied to Winnipeg, and was, at the time we examined the water, of excellent quality for a domestic water supply. The chemical analyses show that it is well suited for boiler and general manufacturing purposes.

Microscopic examinations of the water show, as is the case with the water of all lakes and reservoirs, that the water contains a variety of minute animal and vegetable organisms which can be discerned with the microscope and some of them with the naked eye. The total number of organisms per cubic centimeter has ranged from 249 to 1,776, and averaged 833, which is no more than the amount usually found in small lakes and the better class of reservoirs used for water supplies.

So far as the examinations have been carried, the water has had no disagreeable taste or odor at any time, but it is sometimes the case that these minute organisms increase greatly in numbers and give the water a pondy or even a disagreeable taste. This is not as likely to be the case in large lakes as in small ponds and artificial reservoirs. Many cities take water from the Great Lakes, from Lake Superior to Lake Ontario, and there has been no complaint from bad taste or odors from such waters, although they are not free from microscopic organisms.

There are many other reservoir supplies which contain a much larger number of organisms than has been shown by the recent examinations of Shoal Lake water, and which are nevertheless used without serious complaint on the part of the water takers.

We cannot, in the absence of definite knowledge as to the history of Shoal Lake water, affirm that growths will not occur to cause at times unpleasant tastes and odors, but the results of recent observations and all of the conditions indicate that troubles from bad tastes and odors should be infrequent, and not very serious, if they occur at all.

Having made such an extended reference to these organisms, we wish to state positively that they have no relation whatever to disease germs and there is no evidence that they render the water unwholesome.

Should is ever become desirable to filter the water, either completely, or to the more limited extent required to remove the microscopic and larger organisms, this can be provided for at the site of the proposed reservoir east of Transcona, where an opportunity is also presented for the aeration of the water should this be found advantageous.

Description of Proposed Works.—The main features of the work for immediate construction are:

1. A dyke and channel for the diversion of the Falcon River into Snowshoe Bay.

2. A concrete masonry aqueduct, having a continuous down grade for 84.73 miles from an intake at Indian Bay to a point just south of the Grand Trunk Pacific Railroad, about one mile east of Transcona, the aqueduct having a capacity of 85,000,000 gallons of water daily.

3. A pipe 5 feet in diameter, extending from the end of the masonry of the concrete aqueduct, most of the way through streets to Victoria Park on the west side of the Red River in Winnipeg, this pipe to be of steel except under the Red River, where cast-iron pipe laid in a tunnel is recommended.

4. A 48-inch cast-iron pipe through the streets of Winnipeg from Victoria Park to the McPhillips Street reservoirs. The pipe line will, as stated, have a capacity of 25,000,000 gallons daily.

Estimates of Cost.—Detailed estimates of the probable cost of construction, excluding land acquisition, installations of branch pipes to adjoining communities along the line, water damages, interest charges, etc., are summarized in the report as follows:

85 miles of construction railway	$1,020,000
Clearing	55,000
Ditching	90,000
Telephone line	25,000
12,000 lin. ft. 4-foot cast iron pipe from McPhillips Street reservoirs to Victoria Park at $23.17	278,000
900 lin. ft. tunnel under Red River, including the shafts and the 5-foot cast-iron pipe laid in shafts and tunnel, at $144.44	130,000
43,200 lin. ft. 5-foot steel pipe, extending from the easterly shaft of the Red River tunnel to the junction with the concrete aqueduct about one mile east of Transcona, at $20.74	896,000
447,300 lin. ft. concrete aqueduct, extending from the end of the stel pipe to Indian Bay, with all appurtenances, at $19.51	8,729,000
Falcon River diversion	121,000
	$11,344,000
Add for administration, engineering and contingencies, 15 per cent.	1,701,600
Total estimated cost	$13,045,600

The annual cost of maintenance of the aqueduct and the expense connected with its operation is estimated at $40,000.

Conclusions.—"Briefly summarized the conclusions and recommendations are as follows:

"1. Shoal Lake, without help from the main Lake of the Woods, can be depended upon to furnish, even in the driest years, a large part, if not all, of the water needed

for Winnipeg until the population shall have reached about 850,000, and with the help of the Lake of the Woods can furnish a practically inexhaustible supply.

"2. The water of Shoal Lake was, when we examined it, of excellent quality for domestic and manufacturing purposes, being soft, practically free from contamination, without noticeable color, free from odors and of an agreeable taste. The results of recent examinations of the Shoal Lake water, and all of the local conditions, indicate that the occurrence of bad tastes and odors in the water, from growths therein, should be infrequent, and may never occur at all.

"Should such troubles occur in the future the opportunity to correct them by suitable treatment may be availed of when necessary without interrupting the supply of water to the city or making expensive changes in the works as built.

"3. The best point to take the water is from near the west end of Indian Bay, an arm of Shoal Lake, as the depth of the water and the configurations of the bottom and shores in this neighborhood are favorable.

"4. In order to avoid the dark colored water discharged by Falcon River, and cut off the shallow flowage at the extreme westerly end of Indian Bay, we propose the construction of a dyke across the end of the bay and a canal leading therefrom to Snowshoe Bay, through which to divert the undesirable waters.

"5. We find that the best way to get Shoal Lake water to Winnipeg is to bring it down first through a concrete aqueduct 84.75 miles in length, laid with a continuous down grade to a point about a mile east of Transcona, and then in a 5-foot steel pipe to the Red River. A 5-foot cast-iron pipe, in tunnel, is to convey the water under the river, and thence a 4-foot cast-iron pipe, laid in the city streets, will deliver it to the reservoirs at McPhillips Street. The total length of the aqueduct is 95.35 miles.

"6. We recommend that the concrete portion of the aqueduct be given a capacity of 85,000,000 imperial gallons per day, but that the pipe line portion be given the smaller sizes above stated, capable of discharging 25,000,000 gallons per day by gravity into the McPhillips Street reservoirs.

"7. We recommend taking the water out of Shoal Lake by gravity rather than pumping it over the summit in pipe lines.

"8. We estimate that the total cost to the Greater Winnipeg Water District of building the intake, Falcon River Diversion Works, concrete aqueduct and steel and cast-iron pipe lines, including crossings of streams and rivers, waste weirs, and other appurtenant works, will be $13,045,600.

"This estimate does not include the cost of acquiring land, or of branch pipes to the different communities; neither does it include any allowance for water damages, and for interest charges.

"9. We recommend as a part of the plan, but not for immediate construction, that a new storage reservoir, holding about 250,000,000 gallons, and estimated to cost between $300,000 and $400,000, be built at a point about a mile east of Transcona, and that a main pumping station be there established to force the water to the city through the 5-foot steel pipe, and through branches to be laid to the different sections of the city and district requiring the water. This reservoir and pumping station should be completed and ready for use before the demands for water shall have reached the capacity of the pipe line."

It remains to state that the report has been adopted by the administration and work will proceed without further delay, Winnipeg thus hoping to have, at the end of the five years which it will take to install, a healthful and plentiful water supply.

THE POWER PLANT OF THE CALCUTTA ELECTRIC SUPPLY COMPANY.

There is probably no local undertaking which has contributed more to the comfort and well-being of the residents, in a climate like that of Calcutta, than the supply of electricity for lighting and power purposes. The supply was first started in Calcutta in 1899 from a small non-condensing station. The advantages of electricity were quickly realized, and extensions have been found necessary from time to time. Although branch power stations have been erected at Alipore, Ultadanga, and Howrah, the demand has increased so regularly that it was found necessary to go further afield for a suitable site, one essential being that there should be an ample supply of water for condensing purposes.

The site now used is situated on the banks of the Hooghly at Cossipore, about two miles north of Calcutta, and it is large enough to allow for any further extensions that may be necessary. The distance of the generating station from its main area of supply made a high-tension scheme necessary, the generating being done at a pressure of 6,600 volts, supplying power to various substations in the city.

In the main building there are three 4,000 b.h.p. Oerlikon turbine-driven alternating generators, one mixed pressure turbo of 1,000 b.h.p., and one motor convertor of 600 b.h.p. In the wing are being erected four interpole direct current generators by Crompton and Company, driven by Bellis and Morcom engines of 600 b.h.p. The turbines, of the impulse type, are particularly remarkable for the simplicity of the governing arrangements by which the speed is kept absolutely constant automatically, and can be raised or lowered from the switchboard. The bearings are also self-oiled under a pressure of 60 lbs. of oil, and are so arranged that any interference with the oiling arrangements will immediately bring the machine to rest without damage. The mixed pressure turbine can be used to work from the exhaust steam from the Bellis and Morcom engines, or live steam from the boilers, or a mixture of both, as required.

The switchboard arrangement is a unique piece of work, being fitted with the very latest pattern switches and recording instruments.

In the boiler-house there are five water-tube Stirling boilers, each of the rapid evaporative capacity of 25,000 lbs. of water per hour, at a working steam pressure of 175 lbs. per square inch, with a grate area of 105 square feet and 5,856 square feet of heating surface. They are fitted with the automatic underfeed system of mechanical stokers. In this method of firing the green coal is fed from below and distributed from the centre over the sides of the fire-grates into ash trays which are dumped periodically. Unscreened slack coal of a low grade is being burnt quite smokelessly, even though the chimney is only 100 feet high. When completed the station will have some 18 of these machines installed, capable of burning 300 to 350 tons of coal each 24 hours. Forced draught is used, and there are installed Green's Economizers of 750 tubes in six blocks, three on each side, being in series, with a total heating surface of 7,200 square feet.

DISTRIBUTION OF EXPENDITURES ON COLEMAN TOWNSHIP ROADS FOR SEASONS 1909, 1910, 1911, 1912.

THE following table is an indication of the development of roads in the Cobalt-Haileybury region of the province. The records of expenditures for highway improvement made by the township of Coleman are quite complete as indicated by the data, which we have obtained from the report for 1912 of the township engineer.

Name.	1909.	1910.	1911.	1912.	Total.
Timiskaming Road:					
(a) Overhead Bridge to Giroux Lake Corners	$ 8,328.96	$ 2,592.70	$ 3,136.68	$ 987.80	$ 14,956.14
(b) Giroux Lake Corners to Drummond Siding	(no record)	800.00	nil	2,041.03	2,841.03
(c) Drummond Siding to Timiskaming Mine	4,944.07	1,397.67	4,531.92	8,240.18	19,113.84
Nipissing Road	5,393.27	1,503.12	2,405.74	800.00	10,162.13
Kerr Lake Majestic Road	4,145.03	1,357.00	1,003.25	1,062.60	7,567.88
Cobalt Central Road	2,500.55	1,199.15	nil	1,610.97	5,310.67
King Edward Road	2,252.26	3,005.03	nil	nil	5,257.29
Kerr Lake Road	500.00	2,353.14	nil	1,174.44	4,027.58
Ophir Road	1,365.13	1,866.51	1,475.11	nil	4,706.75
Foster-Savage Road	204.10	2,342.25	625.91	nil	3,172.26
Haileybury Road, Coleman	nil	872.38	3,473.16	nil	4,615.54
"104" Road	nil	2,457.88	51.82	nil	2,509.70
Coleman Firstbrook Road	1,904.22	933.13	891.56	4,091.07	7,819.98
Latchford Road	nil	1,548.80	18,413.24	5,425.98	25,388.02
McKinley-Darragh Road	nil	1,133.04	1,000.00	837.67	2,970.71
Cobalt Town	nil	(no record)	5,161.59	8,555.07	13,716.66
Portage Bay Road	nil	nil	nil	1,290.88	1,290.88
Gillies Depot Road	nil	nil	nil	883.62	883.62
West Cobalt Ditch	nil	nil	110.38	64.03	174.41
Cart Lake Road	nil	nil	nil	887.62	887.62
Waterworks Extension	nil	nil	nil	3,378.96	3,378.96
Short Street	nil	nil	nil	134.12	134.12
Giroux Lake School Grounds	nil	nil	nil	129.32	129.32
Cobalt Athletic Grounds	nil	nil	150.00	352.34	502.34
Tool account	nil	(no record)	1,240.84	1,864.45	3,105.29
General maintenance	nil	316.08	654.24	2,991.85	3,962.17
Sidewalks	nil	(no record)	521.98	958.94	1,480.92
Giroux Lake walks	nil	nil	nil	1,593.02	1,593.02
Haileybury Road in Bucke	nil	nil	613.43	14,141.24	14,754.67
Cemetery Road	nil	nil	436.08	nil	436.08
Street on Silver Queen	nil	nil	165.37	nil	165.37
Streets in "104"	nil	598.04	nil	nil	598.04
Total	$31,537.59	$26,335.92	$47,062.30	$63,497.20	$168,433.01

Fig. 1.—Cobalt-Haileybury Road, Showing Permanent Wall Construction.

Fig. 2.—Section of Roadway Typical of Difficulties in the Construction of Northern Roads.

In his report of work accomplished during 1912, Mr. H. T. Routley, until recently township engineer, outlines in a very interesting way the methods of construction, and data relating to them, of some important roadways in the township. An interesting feature of the report is the exceedingly small requirements for maintenance and repair of the main roads in comparison with conditions pertaining to the cheaper earth roads. The divergence in cost is explained by the fact that all main roads during the past three years were laid with water-bound trap-rock macadam. The rainy season of 1912 is stated to have forcibly demonstrated the fact that where a road is being

Fig. 3.—The "Square," Cobalt, Showing Rocmac Pavement.

constructed for continuous traffic, the best soon asserts itself to be the cheapest. During the greater part of this period it was impossible to keep the unsurfaced earth roads in Coleman township, and throughout the district generally, in good condition, while the main roads, which were properly surfaced when constructed, were in excellent shape throughout the entire unfavorable season.

A few of the difficulties encountered in the construction of these roads is best described by illustrations as

Fig. 4.—Cobalt-Latchford Road.

shown herewith. Fig. 1 illustrates a piece of permanent wall construction on the Cobalt-Haileybury Road. During the year about 2,000 feet of retaining walls from 5 to 10 feet in height were constructed for this purpose.

With the exception of a very small piece of work the construction of these roads and other development work has been done directly on the day-work system. The plan followed was that of engaging carefully picked men and retaining them season after season.

PROGRESS IN THE INVESTIGATION OF THE WATER POWERS OF BRITISH COLUMBIA.

THE fourth annual report of the Commission of Conservation contains the report of its consulting engineer, Mr. Arthur V. White, respecting the work that was accomplished up to the close of 1912, in the Commission's investigation of the water-power resources of British Columbia. As stated some little time ago in *The Canadian Engineer*, Mr. White and his men are at present engaged in a continuation of the undertaking.

According to the report no other province of Canada is confronted with the problem of adjusting so complex a water situation as exists in British Columbia. In the early "fifties," water rights and privileges for mining operations began to be taken up, and, subsequently, other rights and privileges were granted for irrigation in connection with the development of large agricultural areas. All of these rights are now represented by upwards of 5,000 water records, issued under various terms and conditions. In addition, there are others, given later, for water-powers. The applications for waters for all purposes are on the increase. The whole situation is a difficult one, and, until adjudication upon conflicting interests can be had, patience and consideration will be required on the part of the record-holders, and caution, wisdom and courage on the part of the administration. These problems are now being dealt with by the Provincial Government.

The co-operation which the Commission is receiving from the province is worthy of much commendation. Through the Minister of the Department of Lands a great deal was gained by the co-operation of forces, the province advancing $3,450 to cover its portion of the co-operative work. In connection with this Mr. White states that in the United States, much water investigation work is carried on co-operatively between the Federal and State authorities. For example, during the fiscal year 1912, the Water Resources Branch of the United States Geological Survey received for such co-operative work, from the state authorities of California, $25,500; from Minnesota, $16,000; from New York and Oregon, each over $13,000; from Idaho, $12,500, and from Washington, $4,400; while a number of other states contributed lesser sums. All the contributing states thus gave a total of nearly $114,000, and this co-operation has proved of mutual benefit.

It might add a little to the clearness of the report to state that the authorities which exercise jurisdiction over water-powers in British Columbia, are first, the Water-power Branch of the Department of the Interior, which has jurisdiction over the Railway Belt; and second, the Department of Lands of British Columbia which has a Waters Branch dealing with irrigation, and also a separate Lands Department dealing with water-powers.

Railway Belt Water-Powers.—In the report of the third annual meeting of the Commission, it is stated that in initiating the water-power investigation in British Columbia it was decided to begin systematically to cover the territorial area of the province. The area south of the Railway Belt, together with the Railway Belt itself, contains the bulk of the population of the province; it also comprises the water-power possibilities of more immediate economic importance, and, consequently, the investigation was commenced in these districts. A large part of the province south of the Railway Belt, in 1911, was examined by the engineers of the Commission.

Through the courtesy of the Water-power Branch of the Department of the Interior, the hydrographer of the Railway Belt has, during 1912, carried forward an investigation in his territory, and the principal field data respecting the water-powers in this area have been assembled. Most of these data have been reduced to a form readily adaptable for inclusion in the proposed water-power report.

The Kamloops hydrographic office has had a heavy task with its own irrigation and other work, and notwithstanding this, extra effort was made by its staff to further the early collection of water-power information that had been requested. They have secured hydroghaphic data, including measurements of stream flow, for some of the large rivers, such as the Fraser, the North Thompson, the South Thompson, the Columbia, and the Adams.

Columbia River Survey.—The Department of Public Works, Canada, in 1912, commenced an instrumental survey of the Columbia River around the "Big Bend." Through the courtesy of the Department, it was arranged that the Commission of Conservation might attach a man to this survey party, that he might make water-power investigations of the tributaries of the Columbia, using the main survey party as a base for operations. Meantime, however, a new water-power organization had been effected in the Lands Branch at Victoria, which has commenced instrumental surveys of the Pend 'Oreille and Kootenay Rivers, and the results will later be available for our report upon the water-powers of Western Canada.

Further Co-operation.—The Forests Branch of British Columbia has just organized an extensive, systematic survey of the forests of the province, and the chief forester, has arranged to have the skilled men engaged upon this special survey, report specifically upon water-powers observed.

The Surveyor-General of the province has instructed British Columbia land surveyors, who are executing the provincial land surveys, to send in information relating to water-powers. It is to be supplied upon special forms, returnable to the Surveyor-General, when the surveyors are handing in their survey reports.

In the Waters Branch, British Columbia, there is now being compiled a complete, brief tabular synopsis of all records and water reservations issued in the province. These water records, as above intimated, constitute really the underlying basis of the water situation and, in many cases, they conflict with the possible development of power on streams to which they appertain. This tabulation will be available for our proposed report, and will constitute a valuable basic record.

The electric energy inspection branch of the Department of the Attorney-General of British Columbia, is also co-operating to secure some desirable information relating to the hydro-electric power companies now operating in the province.

During 1912, a firm of engineers were conducting a railway survey and taking levels down the North Thompson. It was not possible to send a party into this territory, but through the kindness of one of the members of the firm, data was obtained respecting tributaries of the North Thompson.

The Commission has likewise been fortunate in obtaining a co-operation of engineers engaged upon stream gauging in the United States. The water-power investigations that are being conducted throughout the Western States will afford a considerable body of data. The State of Washington, for example, purposes investigating the rivers in that portion of the state adjoining British Columbia, and the results will be available for the report of the Commission. They will be valuable since they are derived from territory corresponding in physical characteristics to portions of British Columbia.

During 1912 the engineers of the Commission covered a very considerable amount of territory embracing the tributaries of the Fraser River, as far north as the Grand Trunk Pacific Railway. In all about 3,300 miles were travelled by the Caribou party. Work was also carried on along the mainland coast, northwards from Powell River, an examination being made of all streams entering the various inlets. It is estimated that the coast party covered about 3,000 miles, much of which distance was necessitated by the trips in and out of the long inlets.

The season, during which it is profitable to carry on reconnaissance water-power investigations in British Columbia is comparatively short, and it is almost impossible for observers to avoid over-estimating the power possibilities of streams observed during high stages. Engineers doing similar work in the United States experience the same difficulty, and have therefore been endeavoring to do the work, as much as possible, when the streams are approaching their lower stages of flow.

In his report Mr. White strongly recommended a careful survey of the water-powers on Vancouver Island. Some of the streams are important, notably Campbell River. A territory so well confined and relatively of such limited extend should not be subjected to the class of reconnaissance investigation that would be justified for larger areas. Vancouver Island presents an excellent opportunity to make an investigation of its rivers in a manner to yield data of higher standard and thus leave the work more complete, and an example of what might be striven for in other parts of the country.

In the United States there is an increasing tendency to do preliminary work of investigation of power rivers in a more detailed manner; the streams are profiled, and possible dam sites, and storage reservoirs, are contoured. This results—without undue increased cost—in the production of permanent survey records of enhanced value.

In the northern portion of the state of Washington much greater outlay is now being made for water-power investigation and surveys, and it is especially desirable to make corresponding investigations in this country, especially upon waters which flow across the boundary.

The work which is underway during the present season is an investigation of the territory tributary of the Grand Trunk Pacific and the Pacific and Great-Eastern Railways, along with the balance of the west coast, Vancouver Island, and a part of the province lying well to the northward of the Grand Trunk Pacific Railway.

THIRD AMERICAN ROAD CONGRESS, DETROIT.

It now seems assured that the heads of every State highway department, from Maine to California, will personally take part in the Third American Road Congress, in session at Detroit during the week of September 29th, and as a result of this unusual interest, the demand for exhibit space by manufacturers has been unprecedented. All available space has been reserved by nearly one hundred manufacturers, who will display their products, including every kind of road-making machinery, engineering instruments, concrete machinery, bridges, culverts, concrete, wood block, asphalt, tar, and oil preparations.

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CONTENTS OF THIS ISSUE.

	PAGE
Editorial:	
Geology in Engineering Work	437
Clay in Concrete	437
Coal Resources of the World	438
A Tunnel in the English Channel	438
Leading Articles:	
The Development of Sewage Disposal Practice	421
Typical Specifications for Steel Highway Bridges	424
Design for the Foundation of 150-Ton Shear Legs	429
A Water Supply for Winnipeg	431
The Power Plant of the Calcutta Electric Supply Company	433
Distribution of Expenditures on Coleman Township Roads for Seasons 1909, 1910, 1911, 1912	434
Progress in the Investigation of the Water Powers of British Columbia	435
Irrigation in Oregon	439
Economics in Central Station Heating	441
Concrete Dam Construction Near Trenton, Ontario	443
The Efficiency of the Autoclave Tests for Cement	444
Coast to Coast	450
Personals	452
Coming Meetings	452
Railway Orders	75
Construction News	76
Market Conditions	92-94
Technical and Municipal Societies	94

GEOLOGY IN ENGINEERING WORK.

Engineers and contractors are in the habit of considering a knowledge of geology as having little or no bearing upon their work and, therefore, an unnecessary part of their equipment. Consequently, they are not as well versed in the science as they should be, and few have stopped to estimate how closely it is allied to their own work.

Of course, the mining engineer familiarizes himself with enough geology to give him a working knowledge of the earth's formation and of the characteristics of rocks. This is practical geology that is very necessary to him As some one has put it, "The geologist, purely studious, points out what he has deduced about the construction of the earth; but the engineer makes the mine pay."

For civil engineers the science of geology holds much of importance. The value of a knowledge of it has been brought home to a few by geological contingencies that have arisen in their work and asserted claims for respect. Millions are involved in engineering enterprises, the design and construction of which are greatly influenced by the geology of the country. The Panama Canal and the Catskill Viaduct are instances. In tunnelling, railroading, foundations, water supply, in fact, in nearly all of the applications of civil engineering the science of geology touches. Not exempt is the structural engineer, who finds good value in a knowledge of petrology, whereby he may select building stone free from iron to injure its appearance on exposure, or feldspar that will not disintegrate rapidly under the action of weather.

Here, perhaps, lies the reason why the science has not received more attention from the engineer. In his training the study of geology is derived almost entirely from books, and later he experiences difficulty in recognizing the ordinary formations he encounters, and is unable to foretell with any reasonable assurance what a proposed cutting may contain.

It is geology of such practical value as this which appeals to the engineer and a knowledge of which should be fostered.

The world-renowned Twelfth International Geological Congress came to Canada and its last excursion is nearing its destination. With the close of this month its members will have dispersed, and the Congress will be known as the greatest.

But the event did not receive the attention of the engineers that it should have received. The reason has already been defined. But geology should not be overlooked. Conditions of earth and rock strata in connection with excavation work, qualities of sand and stone used in concrete, the condition of river beds, etc., demand attention. The startling revelations of the excavator emphasizes the diversified tendencies which prehistoric glacial volcanic action has left to be contended with. A little of the indefiniteness of excavation might be dispensed with by a greater practical knowledge of geology and the same applies to many branches of the civil engineer's work.

CLAY IN CONCRETE.

Although the effect of clay on the strength of concrete is not definitely known, its presence is presumed by most engineers to be an element of weakness. While the sand and gravel used in concrete work often contain as

much as 5 or 10 per cent. clay, yet many specifications require a minimum of 2 per cent. Such specifications make it necessary to clean the sand, and as the expense of cleaning is great, it is a question of whether it might not be more economical to use more concrete with a high per cent. of clay, than to remove the clay in order to save concrete. The lack of reliable data along this line suggests the value of more systematic experiments to determine the effect of clay in sand and gravel upon the strength of concrete and mortar.

A few years ago the results appeared of a series of tests performed by Messrs. Richey and Prater in the laboratories of the University of Illinois. They had used cubes containing respectively 0, 6 and 12 per cent. of clay, each series of which were seasoned for 1, 4 and 12 weeks respectively before crushing.

In general, the results of the tests indicated that up to 5 or 6 per cent. the weakening influence of clay is not great. Beyond 5 or 6 per cent. the injurious effect increases more rapidly than the amount of clay. Tests on mortar agreed more closely than those on concrete and indicated that clay up to 5 or 6 per cent. is not only not injurious but is even beneficial to the strength of mortar.

The results with natural cement were less erratic than those with Portland, but this was probably due to differences in conditions rather than to the difference in the kind of cement employed. In the natural cement tests not only was the proportion of cement greater, but the mixtures were wetter than in those with Portland. It is probable that the latter is the more important factor, and the suggestion was made by these men that in future experiments more uniform results would probably be obtained by using moderately wet mixtures rather than dry ones.

The tamping of concrete has much to do with its strength, and in considering the effect of clay in the mixture, it may be well to note that a difference may be observed in the action of different mixtures under the tamping iron. The ease of tamping was greater in the experiments mentioned for the 4 or 6 per cent. clay mixtures than for either the clean or 10 or 12 per cent. Tamping the clean material more nearly approaches the case of tamping marbles, not because the voids are not filled but because the adjacent surfaces are clean and the friction is thus reduced so that it becomes difficult to compact the mass. In the 10 or 12 per cent. mixtures clay was present in excess of the amount required to prevent the slipping of the aggregate under the tamper, and as a result some of the clay was forced toward the surface and clung to the tamper so that tamping became a difficult, as well as a disagreeable task.

From their results the experimenters concluded that since the strength of concrete is not much impaired by even 6 per cent. clay, and since the cost of cleaning sand and gravel to contain only a small per cent. is comparatively great, it is probably more economical to use a little more concrete in the work for the sake of avoiding the trouble and expense of removing all the clay contained in the materials available. In other words, the tests indicated to them that it was unwise to specify for any concrete work a minimum of less than 4 or possibly 5 per cent. clay in the sand and gravel used, when any considerable expense would be incurred to obtain cleaner material.

"COAL RESOURCES OF THE WORLD."

One of the outstanding features of the Twelfth International Geological Congress was the presentation of the monograph on the world's coal resources. It comprises three large volumes and an atlas, specially prepared, and closely related to "Iron Ore Resources of the World," which was published under the auspices of the Eleventh Congress.

The coal resources of the world, as compiled from the reports received from a total of sixty-four countries, amounted to 7,397,533,000,000 tons. Of this total, nearly 4,000,000,000,000 tons are bituminous, nearly 3,000,000,000,000 brown coals of various grades and nearly 500,000,000,000 anthracite. Of the anthracite, Asia with the great Chinese fields has by far the largest supply of any of the great continental divisions, furnishing 407,637,000,000 tons. In bituminous, America leads by a wide margin with 271,080,000,000,000 tons, and is also first in the various grades of brown coals. The world's production for the year 1910 was about 1,145 million tons. Making due allowances for loss in mining and for areas that cannot be economically worked, it will be many hundred years before the exhaustion of the supply may be looked for, though considering individual countries the end is in sight in more than one case.

A TUNNEL UNDER THE ENGLISH CHANNEL.

The question of constructing a tunnel between England and the main land is again engaging the attention of the British Government. The question has a fair amount of history connected with it, as in early days the project was favored by both the French and English Governments. As far back as 1874, the British Foreign Office expressly approved of the idea, but a few years later the military and strategic aspects came to the front, and the general conclusion was reached that the project was not likely to promote, but might seriously hamper, the best interests of the country when considered from a military point of view. Since that time the scheme has been resolutely opposed by every government in office, and it is only during the past few years that it has been gaining favor, and the interest in it reviving.

Expert engineers have expressed the opinion that unbroken rail communication between England and France may be successfully carried out by a bridge, a tunnel, or a train ferry. It has been estimated that $10,000,000 would establish an efficient ferry service whereas a tunnel could not be constructed for less than $40,000,000 and the cost of a bridge would be likely to reach $100,000,000. It is the tunnel, however, that is being most dwelt upon.

EDITORIAL COMMENT.

Owen Sound has received a report from the Hydro-Electric Power Commission to the effect that Eugenia Falls, on the Beaver River, will furnish 1,400 h.p., or with the use of storage basin, 4,000 h.p.

IRRIGATION IN OREGON.*

By John H. Lewis,
Irrigation Engineer, State of Oregon.

IN the state of Oregon, we have but recently passed from the pioneer stage of irrigation development into the more complicated stage of expensive works, shortage in water, and numerous controversies. With only seven people to the square mile (over 500 to the square mile in one county) it is apparent that there is yet much room for development. We expect in the near future to reach that stage of irrigation development where the ordinary summer flow of our streams will be augmented many fold through the release of stored water, as is the case in a number of the older irrigation states.

This transition from the pioneer period of unregulated diversions to that of strict public control of all diversions is not easy of accomplishment. The entire thought and life of the water user must be adjusted to the new order. He must abandon the indefinite miner's inch and think of water in second feet and acre feet. He must respect public and private rights to water and suffer the penalty for violating law. Until the new water user, the courts, and public generally, understand the reasons for each feature of the new system, and appreciate the general benefits to be derived from a strict enforcement of its provisions, it will be difficult for the administrative officials to attain the best results.

The Need of Irrigation.—Irrigation is necessary in Eastern and Southern Oregon, but until recently has not been considered necessary in the northwestern, or more densely populated section of the state. The annual precipitation is unevenly distributed, as illustrated by the government record at Glenora, 135 inches; Portland, 45 inches; Government Camp, 90 inches; The Dalles, 15 inches, and Umatilla, 8 inches; each point being approximately 50 miles west of the one preceding.

In the extensive and fertile Willamette Valley only three inches out of the 45 inches of annual precipitation falls during the summer months, while about 20 inches fall during the winter months. Already several irrigation projects are being constructed with a view to supplement this summer deficiency.

Throughout much of central Oregon, which ranges in elevation from three to four thousand feet above sea level, the precipitation varies from about eight to fifteen inches. This district, which has long been famous as being the largest area in the United States without any railway transportation, is now being rapidly settled, due in part to the active railway construction now under way, to the reduction from five to three years' residence required for homestead entry, to the increase from 160 to 320 acres allowed to each entryman, on non-irrigable land, and primarily to the fact that the precipitation in this vast empire is believed to be ample for dry farming purposes.

With only 686,129 acres of land irrigated out of a total of 61,200,000 acres, and with about 4,000,000 acres susceptible of irrigation, the public has become aroused to the importance of irrigation development in Oregon. It is apparent that from six to ten times the population can be supported on irrigated lands in comparison with an equal dry farming area. As the land to be irrigated is well scattered throughout the dry farming and grazing districts, it is also apparent that the value of such lands will be somewhat enhanced through the irrigation of adjoining tracts.

The courts are becoming educated to the value of water and are now less willing than formerly to grant extravagant claims in water adjudications. If twice the amount of water necessary to produce crops is allowed, it is readily apparent that the ultimate area to be irrigated will be reduced approximately one-half. For this reason the public is vitally concerned as to the duty of water. Public funds have accordingly been appropriated for the making of accurate stream measurements extending over a long series of years, for the making of topographic surveys and river profiles, and for determining the quality of the public waters. There is thus a general awakening among all classes as to the importance of irrigation.

Value of Water.—The value of dry farming land ranges from about $5 to $30 per acre. Irrigated, this land would sell from $40 to $100 or more per acre. Improved irrigated land has been known to sell at from $500 to $1,000 per acre and over. Water has, therefore, considerable value, and water rights and titles are now receiving careful consideration. In some sections one cubic foot per second of water, flowing continuously during the irrigation season, is estimated to be worth approximately $10,000.

The cost of irrigation works has increased from $5 per acre in 1900 to an average of $15 in 1910, according to the government census, and systems are now planned or are under construction estimated to cost $40 to $100 per acre. The amount of water and record evidence of water titles are, therefore, important matters, which are now given serious consideration by the investor, the water user, and the public.

Water Laws.—In 1909, Oregon adopted a water law which is similar in many respects to that now in force in the province of British Columbia. It has in general been found satisfactory to both the water user and the prospective investor, and is not burdensome to the public, as the fees, collected and paid into the State Treasury, have gone far towards meeting the appropriations for its maintenance.

The law deals primarily with (1) the adjudication and recording of rights to water which were initiated prior to its adoption; (2) the granting of new rights, after proper application and record, and (3) the protection of all recorded rights, as well as of the public interest in unappropriated waters. Its administration is in the hands of the state engineer and the superintendents of the two water divisions into which the state has been divided, each of whom has special duties to perform. All important grants or decisions are made by these officers sitting as a board.

This law declares all water within the state to be the property of the public and makes beneficial use the basis of rights to its use. In the water right certificate, which is record evidence of title, this basis is qualified by a definite statement as to (1) the priority; (2) the purpose; (3) the period, and (4) the place of use of water; also by (5) the maximum rate of flow or quantity of water. Such certificate gives also the name and address of the owner of the right, and the stream from which the water is diverted.

Owing to the peculiarities of climate and soil, and to the necessity for diverting water for irrigation and other uses, the strict common law doctrine of riparian rights established by early court decisions has been so modified in recent cases that only the faintest shadow of this conflicting doctrine remains to cloud the horizon of the in-

* Read at the recent convention of the Western Canada Irrigation Association, Lethbridge, Alta., August 5, 6 and 7, 1913.

vestor in water projects. In some of our states the common law doctrine still prevails in modified form and is a serious handicap to the adoption of modern administrative water codes. The Canadian provinces should be congratulated upon the freedom with which they can adopt laws suited to their conditions, without a long period of turmoil and expensive litigation by those who wish for some personal or financial benefit, to have streams flow undiminished to the ocean.

Administrative Problems.—Although our water code has been in effect four years, we are just reaching the point where its practical operation can be observed by the irrigator. All rights to water on a number of streams have been adjudicated and recorded, and water masters mave been in charge of distribution. These water masters are appointed by the Water Board, but are paid by the county court. They are thus not as responsive to orders of the superintendents and the board as if paid directly by such board, and subject to dismissal for cause. Another difficulty has been the requirement of law that water masters should be residents of the district from which they are appointed. This prevents the promotion of experienced men to the more complicated districts.

In defining water rights in Oregon, the Water Board has generally specified a particular rate of flow for a definite irrigation season. Where the amount of water thus decreed was too small to furnish an adequate irrigation head, rotation was authorized. In this way each man could at any time ascertain whether or not his neighbor was taking more than his share. In case of rotation among a group of neighbors, the total quantity of water used by any one should not exceed the sum of that allotted to each. Self-interest will cause each man in such rotation group to see that he gets the total quantity of water his full share of the time. Such a decree is almost self-executing, as the average water user is honest, and will not take more than he is entitled to, if he knows the water supply is now sufficient for all. In Wyoming, where they have had long experience in distributing water, it is the exception rather than the rule to call out the water master to administer such decrees.

For old rights, one cubic foot per second is usually allowed for 50 to 80 acres, depending upon local conditions. All new grants for irrigation purposes have been restricted to the rate of one cubic foot per second to 80 acres. The average irrigation season or time between the last killing frost in the spring and first in the fall, has been carefully estimated from official records, at 120 days. The above rate of flow will deliver during such a period three acre feet of water on each acre of land. This in general is sufficient for alfalfa, the ordinary crop requiring the greatest amount of water.

Much difficulty is encountered in defining and protecting rights on flood water streams. On such the floods run off early in the spring, leaving the stream practically dry during the summer months. Rather than build expensive reservoirs, the pioneer settlers flooded their lands by means of ditches or temporary diversion dams, thus storing water in the soil itself. In most cases but one crop of wild hay, yielding about one ton to the acre, is produced, but under favorable conditions one to two cuttings of alfalfa have been produced.

In such cases, a larger rate of flow is allowed and the total quantity of water for the irrigation season limited to 2.5 to 4 acre-feet per acre. The volume limitation in certain cases has been further qualified by defining the amount in acre feet which can be diverted within any period of, say, thirty days. Such a decree is difficult to enforce. No reliable and inexpensive instrument has yet been devised for automatically recording acre feet. The water master must be employed whether a controversy exists or not, and no water user will know whether or not he is getting the amount of water decreed him, unless he keep an independent record throughout the entire season.

Many water masters will thus have to be employed as each ditch will have to be measured one or more times each day. If the water master is not present when water is being run, his records will be incomplete.

Under such system it will be difficult to convict one of stealing water. It will also be difficult to convince each water user that he has received his full share of water. Such system of defining water in acre feet is more suited to large canal systems where numerous ditch riders are necessary to distribute the water, and where but little additional expense would be entailed in keeping accurate ditch records of the volume of water used each day.

Irrigation by Pumping.—Gravity irrigation under large ditch systems did not become a complete success until the common carrier canal was abolished, and water was made by law appurtenant to the land. Those planning to pump water have not forgotten the early experiences of the water user under such canals where the charge for water, after the expiration of the original short time contract, was increased by the company in accordance with the settler's ability to pay. It is believed that pumping for irrigation purposes will not reach its fullest development until both the power and the water are made appurtenant to the land benefited, either through the district or state ownership and distribution of power.

This question is of particular interest to Oregon for the reason that we have a considerable area which cannot be economically supplied by gravity canals, but which may be irrigated by pumping from adjoining streams, or from underground sources.

Along Snake River, in eastern Oregon, a pumping plant was recently installed for the irrigation of 6,000 acres where the maximum lift was over 100 feet. An irrigation district has been formed for the irrigation of 20,000 acres adjoining the above project where the lift will be 200 to 300 feet, and the land about 2,300 feet above sea level.

In central Oregon there are great interior basins, each containing several hundred thousand acres of level land, where the rain fall does not exceed the evaporation. In most of these basins a limited supply of water is found from 20 to 40 feet below the surface. With a permanent supply of cheap power this water could be pumped for at least partial irrigation of these districts.

Public Interest.—It is the duty of the state engineer to refer to the state water board any application wherein the proposed use conflicts with determined rights, or is a menace to the safety or the welfare of the public. This board can direct the refusal of such application after full hearing, if public interest demands. This feature of the law has recently been upheld by our Supreme Court and marks a distinct advance in water legislation.

In Oregon, we have a number of large irrigation projects which can be developed at reasonable cost. Unfortunately the early settlement in these districts has occurred along the streams and there is a strong natural tendency to complicate and delay the construction of the larger projects through the construction of power plants in the stream channels, or the building of railway lines through available storage basins. If the entire stream

basin were owned by an individual, he would compel the power plants to locate a few miles distant on some tributary of the stream where the water could be used for irrigation after passing through the power wheels, although such construction would be perhaps a little more expensive. He would also compel the railroads to locate their lines around and above feasible power and reservoir sites, in order that the large projects which must eventually be built will not be unnecessarily encumbered, and their construction correspondingly delayed.

The state is endeavoring to look somewhat to the future in these matters as indicated by the above authority granted to its administrative officers for the protection of the public interest.

Public Investigations.—Recently a further step in this direction was taken by our legislature. The sum of $50,000 was appropriated for the making of detailed plans and estimates of cost of a number of these projects, and authorizes co-operation with the United States. The government has allotted an equal amount from the reclamation fund and the investigations are now being carried on jointly. The necessary land and water rights are withdrawn so as to prevent further complications, and it is the intent to assign such plans, and rights to the people forming themselves as a district for the construction of the project, or to private capital, who will undertake to carry out the public plans on terms satisfactory to the people. Failing in this, the legislature has submitted a constitutional amendment for vote of the people in 1914 authorizing the issuance of bonds equal to two per cent. of the assessed valuation of the state for the construction of irrigation and power projects, and for developing the cut over timber and other lands of the state.

In other words, the state is now authorized to make water filings, and to gather all necessary information relative to these large irrigation and power projects, which may be necessary in promoting their construction by either private or public funds. It has also taken the first step looking towards construction with public funds if such action is found necessary.

Speaking for the West generally, water is of more value than land. It is highly important that the people be aroused to the value of public water surveys, and the necessity of securing more complete information as to the duty of water.

NEW SLIDING CAISSON FOR H.M. DOCKYARD, PORTSMOUTH.

Last month Messrs. Swan, Hunter & Wigham Richardson, Limited, launched from their new shipyard at Southwick-on-Wear a large sliding gate or caisson for one of the Admiralty new graving docks at Portsmouth. The caisson was launched on its side owing to the great draft of water required when in an upright position. It was then towed to the shipyard, where it was set upright by adding ballast, and then made ready for the voyage to Portsmouth. The caisson is an interesting steel structure about one hundred feet wide at the top and about fifty feet deep. At the side of the entrance to the graving dock a chamber is built of masonry, and into this the caisson is hauled, when the entrance to the graving dock is to be opened. This chamber is covered by a moveable camber deck fitted with apparatus for lifting or lowering it. The camber deck was shipped in pieces to Portsmouth, and where it will be erected and placed in position.

ECONOMICS OF CENTRAL STATION HEATING.*

By Byron T. Gifford.

THERE are three important branches of central station heating: (*a*)the production of heat units; (*b*) the distribution of this product; and (*c*) making the service attractive to the consumer.

The first of these, the generation of heat, may be handled by three distinct methods: by direct firing, or "straight fuel burning" plants; by an electric generating plant with heating as a by-product; and by a combination of a by-product plant and a heating plant.

Owing to many causes the heating plants of the future will be of the last type. In an arrangement of this kind, electricity, for instance, can be produced much more cheaply than is possible in the most economical electric plant, and there are a number of ways of disposing of this by-product: It may be sold to an existing electric plant at a wholesale rate; a market may be made for it by creating industries requiring a fairly large amount of electricity at a comparatively low price. The author has in mind the case of an industry which has supplied to it 400 kw.-hr. of electricity 20 hours per day, 365 days per year, at less than 1 cent per kw.-hr. The net income to the heating company from this by-product is more than sufficient to meet the payments of the bond interest, taxes and insurance of the entire property. This additional income, amounting approximately to $11,000, is being handled with an increased operating cost of $2,200, as compared with the operation of the plant the year previous when no electric current was generated. With a simple or a twin Corliss engine a kilowatt of electricity can be generated under conditions which exist in the average central heating plant with 45 lb. of steam. Assume, for example, a heating plant serving 200,000 sq. ft. of steam radiation. This load gives an average demand on the boilers of about 40,000 lb. per hour, which, if sent through a simple or twin Corliss engine, will develop 880 kw.-hr. of electricity. Assume that this electricity is sold to some consumer for 1 cent per kw.; at this price 1 cent would be realized for every 45 lb., or 22 cents for every 1,000 lb. of steam delivered to the heating mains before it had left the station. The history of central station heating has proved that a rate averaging 60 cents per 1,000 lb. for steam is reasonable and can be procured from any heating consumer. This would mean 82 cents per 1,000 lb. for the steam generated, which is a good return on the investment.

Heating plants in America at present vary in size from a connected load of 10,000 sq. ft. of radiation to a connected load of 1,750,000 sq. ft. of radiation. These plants are built in towns of upward of 1,000 people.

There are few electric generating plants that can put a kilowatt-hour of electricity on their switchboard below a cost of ½ cent per kw.-hr., and there are also few electric plants that can generate and distribute to the primary side of their transformers for a cost of 1 cent per kw.-hr., especially when the overhead and fixed charges are considered. Heating plants, with electricity as a by-product can do this, and this fact alone will make a place for central heating plants. Some of the larger operating

* Abstract of paper read before the Chicago Section of the American Society of Mechanical Engineers, April 9, 1913.

companies are doing this at the present time and others are building properties to operate along this plan.

Regarding the second point, distribution, in waterworks or in gas properties the losses from distribution consist of leaks and pressure drops due to friction which is caused by insufficient pipe capacities. In central heating there are these two losses to contend with, and in addition the loss from radiation, called "line loss" by central heating engineers. Leaks are a decided detriment to heating pipe line, and the loss from this source is probably more serious than was at first supposed. Assume, for example, a hole ¾ in. in diameter in a pipe line containing steam at 5 lb. pressure. With an evaporation of 7 lb. of water per lb. of coal, this leak will cost 23 tons of coal per month. A leak of this size is equally as detrimental in a hot-water heating system. The loss from friction affects, of course, the initial pressure to be carried on the heating mains, and consequently affects the back pressure to be carried on the engines.

As to the detriment of too high a friction loss, in a 3-in. steam line 1,000 ft. long, carrying 1,000 lb. of steam per hour, the friction loss will be equal under average conditions approximately to 1,460 B.t.u. per hour. This same load carried 1,000 ft. in a 3½-in. line will show a friction loss equal approximately to 500 B.t.u. and a 4-in. line under the same conditions will lose only 240 B.t.u. from friction.

The radiation loss from central heating is even more important than friction loss, from the B.t.u. standpoint. There is a number of styles of underground insulation in use to-day, which lose anywhere from 0.03 lb. to 0.38 lb. of steam per sq. ft. of underground surface per hour.

In order to determine the most economical line to install it is necessary to combine the friction and radiation losses. Take, for example, a demand of 1,000 lb. of steam per hour which must be carried 1,000 ft. A 3-in., 3½-in., 4-in. or 4½-in. pipe will do this work, but the most economical size must be determined. The loss from friction would be 1,460 B.t.u. per hour on the 3-in. line; 500 B.t.u. on the 3½-in. line; 250 B.t.u. on the 4-in. line and 130 B.t.u. on the 4½-in. line.

Assume a radiation loss of 0.05 lb. of steam per sq. ft. of underground surface per hour; the radiation loss from the 3-in. line will be approximately 45,000 B.t.u. per hour; 3½-in. line approximately 52,000 B.t.u.; 4-in. line approximately 58,000 B.t.u.; 4½-in. line approximately 65,000 B.t.u. Combining these two losses, it is seen that the 3-in. line is the most economical to install, provided it does not affect the heating station conditions by causing excessive back pressure on the engine.

Experience has shown that a 3-in. line carrying this load the given distance will have a drop in pressure of about 7 lb., and as it is necessary to have 1 lb. pressure at the end of the line, it means that the back pressure at the station would be approximately 8 lb. If this pressure is excessive it would be necessary to run a 3½-in. line, which would give a back pressure of less than 5 lb. The difference in cost between a 3-in. and a 3½-in. line is comparatively small. The cost of material is somewhat less for a 3-in. line; the cost of labor is approximately the same.

To show the value in dollars and cents of efficiency in underground insulation, a piece of line insulated with a construction that will lose 0.05 lb. of steam per sq. ft. of underground surface per hour may be compared with a line insulated with a construction that will lose 0.14 lb. per sq. ft. per hour. Both constructions are found in everyday practice. For this purpose an 8-in. line 1,000 ft. long will be considered. Such a pipe has 2.25 sq. ft. of surface per lineal foot. In the first case the line loss will amount to 112 lb. of steam per hour; in the second case to 215 ft. Assuming a generation cost of 30 cents per 1,000 lb., in a season's operation (from October 1 to June 1, or 5,832 hours) a line loss in the first case will equal $195 per year and in the second case $550 per year.

The money saved, therefore, will be the difference between these two figures, or $355 per year. This is 10 per cent. on $3,550, an amount which can be spent to install the more efficient construction. Since the difference between these line losses is 0.09 lb. of steam per sq. ft. of underground surface per hour, and since the example assumed consisted of 1,000 ft. of 8-in. line, which is 2,250 sq. ft. of surface, it is seen that for every 0.01 lb. of steam saved on this 8-in. line, approximately $400, or 20 cents per sq. ft. of underground surface, can be spent.

Another interesting example is the comparison of two insulations on an entire underground heating installation. This installation consists of approximately 800 ft. of 12-in. pipe line, 1,200 ft. of 10-in. pipe line, 3,600 ft. of 8-in. pipe line, 4,200 ft. of 6-in. pipe line, and 7,300 ft. of 4-in. line and surface. The number of square feet of underground surface in this system is equal approximately to 30,000 sq. ft. Comparing two insulations, one with 0.04 loss and one with 0.09 loss (difference 0.05) by the following formula which the author has derived, the more efficient insulation in this case will be worth $30,000 more than the less efficient:

$$N \times S \times L \times C$$

where N = the difference between the two insulations in hundredths of a pound of steam lost per hour
S = the number of square feet of surface per lineal foot of pipe
L = the length of pipe
C = a constant based upon the cost of steam per thousand pounds and the number or hours in the heating season.

Where the steam costs 30 cents per 1,000 lb. and the heating season is 5,900 hours, the value of C is 21 cents.

Regarding the third point, making the service attractive to the consumer, it is not necessary, perhaps, to wrap it up in a good looking package, but it is necessary to have it attractive in price and quality. That this class of service is attractive is shown by the fact that central heating plants, with few exceptions, have had no trouble holding their consumers. It is this one fact, as much as anything else, that has put many heating plants into trouble. They have been tempted to serve a larger territory or more consumers than their plants could economically handle, and they have been tempted also to extend their service without due regard to the economics of the proposition.

As to the best method of selling the heating service, experience has shown that the meter basis is the most equitable. The rate will depend upon local conditions. A number of companies are selling steam on the meter basis, with a sliding scale rate; others have devised a maximum demand or readiness to serve rate, both of which work out admirably in practice. The quality of the service is always sufficiently attractive to obtain a large percentage of the possible consumers.

CONCRETE DAM CONSTRUCTION NEAR TRENTON, ONTARIO.

A NEW concrete dam, recently completed on the Trent River, near Trenton, Ont., has some features that may be of interest both in the matter of design and difficulties encountered during its construction. Work was commenced in September of 1912, and the structure was completed early in July of this year, covering a total period of about 10 months. Owing to the mildness of the winter of 1912-13 in that locality the Trent River did not decline to its usual minimum flow for this period, and was, in fact, at flood stage several times during the winter months. This naturally caused difficulty which was unexpected, the most acute being in the last closure of the dam.

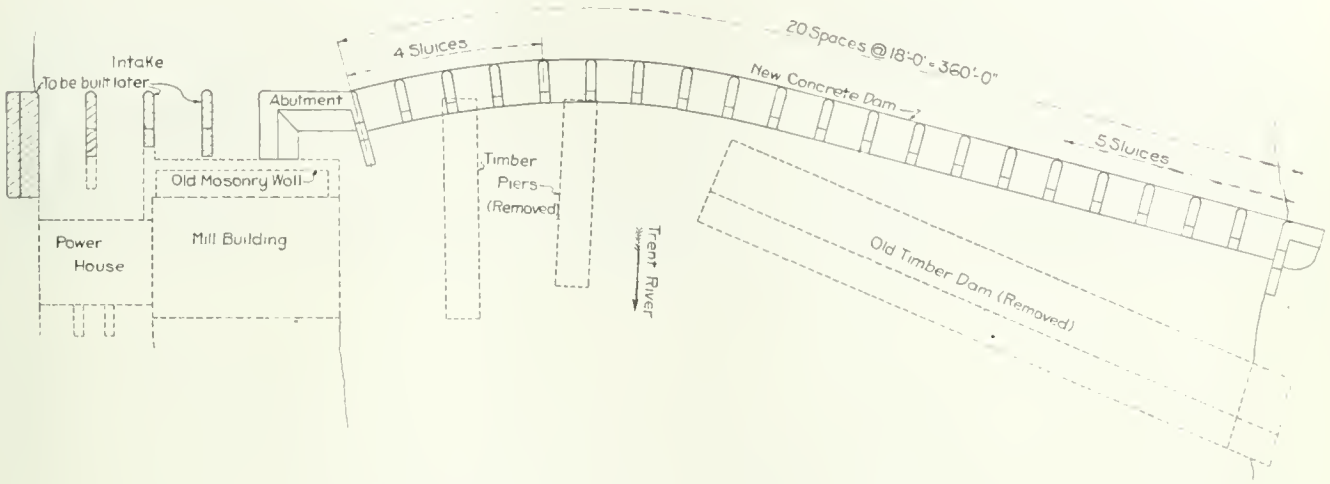

Fig. 1.—Plan of Concrete Dam Across Trent River.

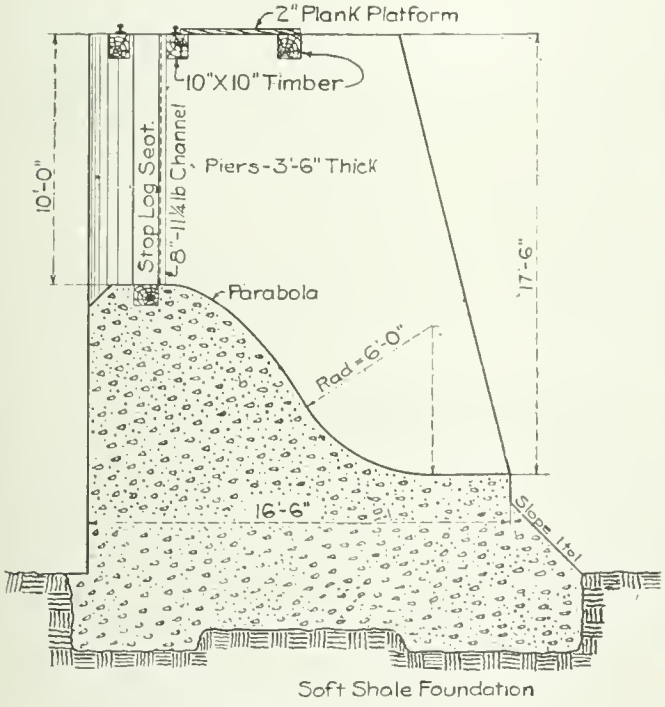

Fig. 2.—Section of Trent River Dam.

The accompanying drawings and illustrations are self-explanatory and need little description of details. The total length of the dam over all as constructed is 425 feet. There are twenty piers, each of which are 3 feet 6 inches and placed 18 feet between the centres. These piers are reinforced with corrugated steel bars which are also extended into the main still-way section. The design is such that stop-logs can be used between the piers to regulate the head as required.

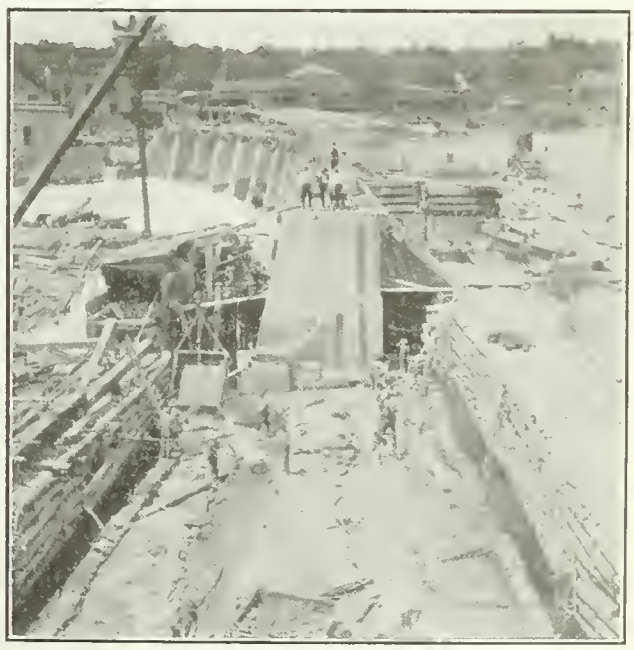

Fig. 3.—Showing Cofferdam After Pumping.

The new structure replaces an old wooden dam that had furnished power for running a paper-box mill at the site. One of the construction problems was that of maintaining sufficient head during the construction of the new dam to keep the mill in continuous operation. This feature was successfully carried out, although it increased the cost of construction somewhat on account of the required extra height of coffer-dams required. The extra outlay was fully justified, however, as otherwise the prospective loss that the mill would have sustained, had it been obliged either to close down operations or to install steam machinery and equipment for the power, would have amounted to many times the sum.

Fig. 1 shows the general layout of the new dam and its position relative to the old structure.

In order to give a greater latitude for operations and to increase the amount of water which may be safely carried over at plug stages there are four openings in the section of the dam adjacent to the mill and five at the opposite end, as the drawing illustrates. These openings have a crest whose elevation is 3 feet lower than that of the remainder of the still-way.

Fig. 2 shows a section of the dam and Fig. 3 gives a general view showing the first section of the proper dam completed. A section of the old wooden dam is shown in the foreground with 2 feet of flash boards in place, in order to maintain the operating head at the mill wheels.

Fig. 4 is a view looking west from the top of the eastern bank of the river and shows clearly inner cofferdam unwatered and excavation for the foundations of the dam in procedure.

The dam was designed and constructed for Miller Bros., Limited, of Montreal, by Walker & Company, Limited, also of Montreal. Mr. W. F. Farley, A.M.Am.Soc.C.E., was responsible for the details of design and Mr. F. E. Cushman superintended the construction, both under the direction of Mr. G. R. Heckle, M.Am.Soc.C.E., who has courteously supplied us with the information and illustrations forming this article.

Fig. 4.—General View, Showing Method of Procedure.

THE EFFICIENCY OF THE AUTOCLAVE TESTS FOR CEMENT.

A greater part of the volume of the consideration which has been given throughout the past year to the application of Portland cement, has dealt with the so-called Autoclave or high pressure steam test as specified for construction work on the Delaware Lackawanna and Western Railway. The attention which this method has received from engineers, cement manufacturers and various technical and scientific associations crystallized into a most important discussion at the convention of the American Society of Testing Materials at its meeting in Atlantic City last June. A paper entitled "The Results Obtained with the Autoclave Tests for Cement," was presented by Mr. H. J. Force, chemist and engineer of tests for the above company and the lengthy discussion which followed his outline of the latest results obtained in the laboratories of the road has added somewhat to the information on the subject although no basic conclusions were arrived at, but rather a clear intimation displayed that no results yet obtained have been sufficiently authoritative as to demonstrate its value. And although the discussion of the test has not been allowed to become dormant, the consideration given it has not disclosed many opinions favoring it, other than the few expressed at that time.

The paper was considered one of the most interesting of the meeting, the discussion following it was unusually thorough.

As described by Mr. Force the autoclave test is made as follows:—

Three neat briquettes are made up, using water which gives a normal consistency on the Vicat needle of from 7 to 10 mm. The briquettes are kept in the damp closet for twenty-four hours, at the expiration of which time they are removed from the molds and placed in the autoclave. Sufficient water is added to partly or wholly cover the briquettes, and the instrument closed. The burners are of sufficient size to raise the pressure to 295 lb. in not more than one hour and this pressure is maintained for one hour longer, or a total time of two hours. The pressure is then gradually released, the briquettes are taken out and placed in the moist closet for one hour. They are then broken in the standard cement testing machine in the usual manner. The results from the various mills are the average of three briquettes.

Table 1—Results of Tests on Cement from Mill 3

Number of cars represented	Tensile strength, neat, at 24 hr., lb. per sq. in.	Autoclave test: Tensile strength, lb. per sq. in.	Autoclave test: Change in tensile strength, per cent: Increase	Autoclave test: Change in tensile strength, per cent: Decrease	Autoclave test: Expansion, per cent	Tensile strength of 1:3 briquettes, lb. per sq. in.: 7 days	28 days	3 months	6 months
1.....	318	40	....	87.39	5.58	332	382	...	...
1.....	297	487	64.00	....	0.75	372	447	...	...
2.....	330	597	80.90	....	0.25	347	390	448	422
1.....	375	472	26.00	....	0.53	295	387	...	...
3.....	392	387	....	1.27	0.41	326	350	432	482
1.....	300	305	1.66	....	1.02	315	397	...	...
1.....	405	528	30.37	....	0.31	346	408	431	...
2.....	392	513	30.89	....	0.10	352	457	450	...
5.....	335	205	....	28.80	1.28	357	...	...	...
Av'ge	349	393	38.96	39.15	1.13	338	402	440	452

A 1 x 6-in. expansion bar is made up with the briquettes and at the end of twenty-four hours is measur-

ed and placed in the autoclave. The bar is removed with the briquettes at the end of the two-hour test. The final measurement is made after the bar has remained in the moist closet for one hour.

The tables show the results of all tests on the cements from Mills 1 to 5 respectively. (Two of the tables, showing tests of cements from Mills 1 and 2, are omitted here. All samples, representing 344 cars of cement, passed the autoclave test.) For purposes of comparison, there are shown in Table 4 the averages of the results of all tests from each mill.

Results of Tests.—Each shipment from Mill 2 showed a large increase in tensile strength in the autoclave test and with one or two exceptions the expansions were all very low. The chemical composition of the cement from this mill is about normal. The tensile strengths for the sands on the 7 and 28-day and the 3- and 6-month tests were all excellent.

Mill 1 shows, perhaps, the most uniform results of any of the five mills. This is the first mill in the United States to attempt the manufacture of autoclave cement and is the plant at which many of the early experiments were conducted. From the day that they started to make shipments of autoclave cement up to the present time there has not been one single cause for rejection and this is indeed a most remarkable showing. Mill 1, like Mill 2, shows a continual increase in the tensile strength up to six months.

Mills 4 and 5 also show a wide variation, some of the shipments passing the test, others failing; some showing little expansion, others showing considerable expansion. The results of the 7 and 28-day and the 3 and 6-month tests are lower in this case than in either Mill 1 or 2.

The method of making briquettes used in the laboratory of the Lackawanna Railroad is one of tamping. About 9 per cent. of water is usually used and the briquettes are well tamped in the molds by placing an iron die thereon and striking it several times with a wooden mallet. This gives higher results on the 7 and 28-day tests, but when the briquettes are very firmly packed in with the thumbs there appears to be very little difference in the long-time tests, except possibly that more uniform results are obtained by tamping.

Reasons for Failure Under Autoclave Test.—To all large users of cement the figures from the various mills are certain to be interesting. The question naturally arises as to why a cement which passes the ordinary boiling test in many cases, from some of the mills, shows a decrease in tensile strength or goes entirely to pieces in the autoclave test.

Samples of cement which have failed in the autoclave test, when re-tested again after a period of 30 days, 2 months, 6 months and over a year, in most cases pass the autoclave test. In one or two cases samples which were approximately 15 months old still continued to show no increase in tensile strength; in a few other cases a decrease in tensile strength was shown, while others showed an increase, due to the seasoning process, of over 100 per cent. This points very clearly to the fact that these particular samples were not properly manufactured, for with certain mills any cement which has not passed the autoclave on the first test has in practically every case passed the test after the cement is held for a period of time.

Fine Grinding.—Further investigation as to why some of these cements fail to pass this test after a period of time shows that the raw material was more coarsely ground than in other samples which did pass the test after seasoning. The grinding of the raw material and the proper burning play a most important part in the quality of Portland cement; and the author believes that the failure of cement to pass the autoclave test is due very largely to the coarser granules which do not become hydrated when the cement is set up and that the failure of these granules to become fully hydrated is due to their chemical composition. That is, the granules are composed largely of dicalcium silicate ($2CaO\ SiO_2$), with a smaller proportion of tricalcium silicate ($3CaO\ SiO_2$). Granules of this composition fail to properly hydrate in the period of twenty-four hours and consequently, when brought in contact with the heat and pressure, together with moisture, slaking of the dicalcium silicate is quickly brought about, with the result that a large percentage of expansion occurs, together with a proportionate decrease in tensile strength. On the other hand, if the proportion of tricalcium silicate is largely in excess of the dicalcium silicate, then we may expect a more stable product and one which will show considerably less expansion under the autoclave test and remain constant in volume in after years.

Table 2—Results of Tests on Cement from Mill 4

Number of cars represented	Tensile strength, neat, at 24 hr., lb. per sq. in.	Autoclave test: Tensile strength, lb. per sq. in.	Autoclave test: Change in tensile strength, per cent: Increase	Autoclave test: Change in tensile strength, per cent: Decrease	Autoclave test: Expansion, per cent	Tensile strength of 1:3 briquettes, lb. per sq. in.: 7 days	28 days	3 months	6 months
6.....	275	508	84.72	....	0.20	406	493	535	414
5.....	402	232	....	42.29	2.77	373	461	478	469
4.....	332	297	....	10.54	1.20	401	471	462	482
2.....	435	555	27.58	....	0.50	331	359	475	476
3.....	473	192	....	59.40	1.87	370	418	483	483
9.....	370	146	....	60.53	3.68	342	399	470	428
4.....	410	525	28.05	....	0.31	373	440	408	452
2.....	350	345	....	1.42	0.25	307	412	406	425
3.....	427	367	....	14.00	0.70	328	352	424	...
1.....	420	27	....	93.57	Soft	408	402	...	...
1.....	364	270	....	26.00	1.97	327	435	...	...
1.....	307	475	54.72	....	...	410	505	...	...
2.....	385	602	56.40	....	...	348	452	544	...
9.....	392	9	....	99.24	Soft	413	443	483	...
2.....	369	64	....	80.00	3.10	355	390	454	...
3.....	378	257	....	31.50	1.92	413	461	470	...
1.....	296	459	16.00	....	0.39	390	473	...	...
1.....	237	630	87.00	....	0.20	416	492	...	...
2.....	429	495	15.40	....	0.80	238	433	...	...
3.....	396	447	13.01	....	1.07	390	453	...	...
Av'ge	372	345	42.54	47.13	1.31	367	437	468	453

In order to produce a large excess of tricalcium silicate two things are necessary—the raw material must be more finely ground and the cement must be burned at a higher temperature. Most of the cement in Mill 2, as well as in Mill 1, shows very little expansion and a comparatively low loss on ignition. It is also known that in both Mills 1 and 2 the raw material was very finely ground. In some of the other mills—for example, Nos. 3 and 4—while the burning was good, the raw materials were not so finely ground; in Mill 5 there was not only fairly coarse grinding of the raw material but there was also a much higher loss on ignition. From the report of Mill 5 it is evident that the cement from this mill could not be as constant in volume as that from Mills 1 and 2.

In order to manufacture a cement which will pass the autoclave test it is necsssary to grind the raw material very much finer than is customary and to have the clinker well burned. The manufacturer, however, can greatly increase the output of his mill by grinding his raw material coarser and burning his clinker not quite so hard. This produces a cement which contains a very large percentage of dicalcium silicate, which may not be constant in volume, and which would more than likely fail to pass the autoclave boiling test. This cement would probably require seasoning in order to make it pass the regular boiling test.

Future Tests.—Briquettes for tensile strength from the various mills have been made up on most of the samples shown to one year. It is to be expected that the results on cement for longtime tests will be equally as high, if not higher, than on the standard-specification cements. On the long-time tests for expansion very little difference or variation has been noted to date. A number of expansion bars have been kept under observation and measured at frequent intervals. It is believed that some time must elapse before any difference will be noted in these bars.

A large number of cylinders and cubes have been made up for compression tests. The results to date indicate that higher compressive strengths are being obtained, as a rule, on autoclave cement. A large number of 2-in. cubes of the various brands have been made up for compression tests, to be made during a period of from one to five years. The number tested to date is not sufficient to draw any definite conclusions, except as stated above, that in many cases the autoclave cements show higher strength in compression. The results obtained on autoclave cements are more uniform than on other cements.

Discussion of the Paper.—Dr. A. S. Cushman, director of the Institute of Industrial Research, Washington, in presenting his discussion gives some historical data in connection with the autoclave test. It appears that the high-pressure steam test on Portland cement was first recommended in Germany in 1881 by Dr. Erdmenger. His test was fully investigated by some of the leading German authorities on cement and was rejected by them as inadequate and misleading. The International Association of Testing Materials is also mentioned by Dr. Cushman as having reported against the test because it had been found to lead to erratic and inconsistent resource. He likewise refers to a number of researches on the subject, tending to condemn the test as irrational and one not to be used as a method of judging behaviours in construction work of a given brand of Portland cement. He cited tests which go to show that the autoclave process is not able to distinguish between the strength developing qualities of cement up to six months under normal exposure to out-of-door conditions.

In conclusion Dr. Cushman says:—"A careful examination and analysis of all the data obtained in various laboratories and the experience of the Institute of Industrial Research, gained during a systematic investigation of the autoclave test, show that it yields erratic results and is not to be depended upon for determining a quality or condition of any brand of cement either for immediate or future results in service. The conclusion which must be reached as the result of these investigations is that the test is not dependable as a method of distinguishing cement which will give successful results from the cement which may be expected to fail under service conditions."

Table 3—Results of Tests on Cement from Mill 5

Number of cars represented	Tensile strength, neat, at 24 hr., lb. per sq. in.	Autoclave test: Tensile strength, lb. per sq. in.	Autoclave test: Change in tensile strength, per cent: Increase	Autoclave test: Change in tensile strength, per cent: Decrease	Autoclave test: Expansion, per cent	Tensile strength of 1:3 briquettes, lb. per sq. in.: 7 days	28 days	3 months	6 months
2....	347	504	45.24	....	0.60	385	466	553	491
3....	310	562	81.29	....	0.60	306	362	457	467
6....	242	388	60.33	....	0.75	251	315	407	425
6 ..	365	392	7.39	....	1.00	345	355	431	452
5....	347	83	....	76.36	4.83	248	287	312	450
18....	233	260	11.50	....	0.91	290	358	416	430
3....	292	472	61.22	....	0.63	312	320	395	396
4....	343	267	....	29.82	2.50	309	380	442	486
4....	275	135	....	60.00	0.40	281	370	407	430
6....	195	410	110.00	....	0.86	328	385	430	446
7....	270	62	....	96.55	2.82	248	355	395	...
4....	268	350	30.70	....	1.20	273	373	472	...
6.. ..	288	80	....	76.60	3.12	305	352	417	...
5....	250	337	53.00	....	0.48	273	346	440	...
7....	193	235	23.68	....	1.50	312	402	483	...
4....	340	435	28.00	....	0.48	339	398	438	...
39....	272	Soft	Soft	....	Soft	352	415	550	...
8....	285	142	....	50.00	1.70	309	372	472	...
1....	370	565	53.00	....	0.23	347	477	...	...
6....	340	Soft	....	Soft	Soft	372	433	504	...
19....	378	Soft	....	Soft	Soft	301	371	532	...
8....	371	Soft	....	Soft	Soft	317	382	509	...
30....	365	25	....	90.41	3.44	328	345	453	...
6....	360	10	....	97.00	4.00	308	363	468	...
16....	275	Soft	....	Soft	Soft	388	438	410	...
6....	352	Soft	....	Soft	Soft	307	435	456	....
6....	385	432	25.90	....	0.52	332	441	524	...
1....	387	532	37.20	....	0.43	355	334	...	...
4....	342	500	46.15	....	0.30	382	424	...	...
6....	372	94	....	80.00	5.40	430	490	430	...
4....	299	70	....	76.60	5.00	413	445	484	...
1....	358	143	....	44.57	3.23	332	390	...	...
2....	261	462	80.00	....	0.52	258	380	...	...
5....	261	374	33.00	....	0.70	233	412	...	...
6....	216	75	....	65.30	No Bar	217	457	...	...
1....	309	494	59.80	....	0.06	...	...	...	...
3....	282	410	45.30	....	0.81	311	395	...	...
2....	387	403	11.10	....	0.68	327	390	...	...
2....	216	440	137.00	....	0.48	361	410	...	...
3....	293	430	47.30	....	0.54	368	466	...	..
1....	308	432	40.26	....	0.36	310	426	...	...
4....	407	325	....	25.23	2.24	370	385	...	...
Av'ge	310	314	49.06	66.80	1.52	320	392	453	447

Mr. Rudolph J. Wig, Assistant Engineer of the United States Bureau of Standards, stated in his discussion that his criticism was based upon tests made by that Bureau over a period of nine months. He drew the following conclusions from these tests:—

1. Of the 48 brands tested, 88 per cent. passed the autoclave requirement upon some tests; 52 per cent. passed upon all tests; and 6 brands failed upon all tests.

2. There is no difference in linear expansion between set cements of types 2 and 3 (unsound and sound, respectively, under autoclave test) which are exposed in the atmosphere for 6 months.

3. Nor is there any difference in linear expansion in these cements when exposed to fresh water for 6 months.

4. The linear expansion of different cements varies from 0.135 to 4.2 per cent. of the original length when exposed to steam at pressures between 180 and 300 lbs. per square inch. The Type 3 cements had an expansion below 0.2 per cent., and the Type 2 cements had an expansion above 2 per cent.

5. The linear expansion of set cements exposed to steam increased slightly as the steam pressure was increased. (Samples tested show an average increase of 0.02 of 1 per cent. for pressures ranging from 100 to 275 lbs. per square inch.)

6. Set cements shows very little change in volume upon storage in air or water after being subjected to high-pressure steam.

7. Samples of apparently sound cements and concretes have been taken from structures 1 year or more old, and found to disintegrate upon being subjected to high-pressure steam. Samples of concrete of poor quality have been taken from structures 1 year or more old and found to show no physical change upon being subjected to high-pressure steam, while other samples of concrete of apparent poor quality entirely disintegrated.

8. The expansion of a 1:1 or 1:2 cement sand mortar made with Type 2 cement exposed to high-pressure steam, shows more than 50 per cent. of the expansion of the same cement neat exposed to high-pressure steam.

9. Of cements which are normally unsound in the ordinary atmospheric steam or autoclave steam test, if the finer size particles are removed, they will be found more sound if tested in the same manner as the original cement, and in many cases entirely sound. While fineness is not essential to soundness, it is the coarser particles of a normally unsound cement which cause the expansive action.

10. A cement originally unsound in the autoclave test will usually become sound in 2 to 6 months.

11. If the cement hydrated and formed into a test piece while it is unsound, it will not become sound upon aging for several months, even though the test piece is stored in water.

12. The maximum tensile strength of sound cement exposed to steam appears to be attained at a pressure not exceeding 150 lbs. per square inch.

13. The compressive strength of concretes made from the three types of cement—No. 1 cement failing to pass the standard atmospheric steam test; No. 2 cement passing the standard steam test, but not passing the autoclave test; No. 3 cement passing both the standard steam test and the autoclave test—show a tendency for Type 1 cements to develop the least strength and Type 3 cements the greatest strength, although the range of values is not very great, and these results should be considered somewhat tentative.

Sufficient data has not been advanced to justify a conclusion as to the merits of the proposed autoclave test of cement, or to warrant its adoption into a specification; but further investigation should be made and due consideration given to a hot test of greater severity than the present standard steam test.

Mr. L. R. Ferguson, Assistant Secretary of the Association of American Portland Cement Manufacturers, and Mr. Henry S. Spackman, consulting engineer, both of Philadelphia, Pa., also took an important part in the discussion, their remarks indicating that those cements which failed under the autoclave show a higher strength in 6 months than those which passed the test. In other words, the very paper advocating the new test has internal evidence which indicates that the increase in strength in the autoclave has no relation to the strength in a structure. Moreover, the results obtained by the experimenters are exactly what were to be expected, for the Germans, after an experience with the high-pressure steam test, concluded many years ago that it was of no value.

While, therefore, those participating in the discussion did not entirely condemn the test, and indicated that they would pursue their studies farther in order to determine its value, those who have been disturbed by recent agitation as to the adequacy of the present specifications

Table 4—Average of Results of Tests from Mills 1 to 5

Mill No.	Tensile strength, neat, at 24 hr., lb. per sq. in.	Autoclave test: Tensile strength, lb. per sq. in.	Autoclave test: Change in tensile strength, per cent: Increase	Autoclave test: Change in tensile strength, per cent: Decrease	Autoclave test: Expansion, per cent	Tensile strength of 1:3 briquettes, lb. per sq. in.: 7 days	28 days	3 months	6 months
1.....	416	687	57.71	....	0.13	393	450	475	463
2.....	407	631	54.53	....	0.27	380	447	486	463
3.....	372	345	42.54	47.13	1.31	367	437	468	453
4.....	349	393	38.96	39.15	1.13	338	402	440	452
5.....	210	314	49.05	66.80	1.52	320	392	453	447

may rest assured that the autoclave method has so far failed to demonstrate its value. There is nothing to prove that a cement bought under autoclave specifications is superior to one passing the standard specifications but failing under the autoclave test.

ALUMINIUM INDUSTRY IN INDIA.

The working of aluminium in India is making rapid headway, and promises to become one of the most important industries of the country. The most important potential use of aluminium in India is in making vessels for carrying water to the native houses from the village taps or hydrants or from wells and rivers. On account of caste rules or prejudices, natives of different castes living in the same neighborhood must often go long distances apart in order to secure water not defiled or monopolized by other castes or outcastes, and as a rule not only the poverty of most of the people, but also their religious prejudices prevent the connection of their houses with central taps. When the natives are extremely poor they use earthenware vessels, but as their means increase they adopt the use of metal ware for carrying their water. In a prosperous community the vessels are commonly of copper or brass, but the advantages of aluminium for this purpose are becoming recognized, as it is not only much lighter to carry, but also much cheaper. An aluminium vessel of carrying capacity equal to one of brass or copper would be much cheaper, even if the same prices per pound were charged for the metal. Many metal dealers are now specializing in aluminium goods, and it is said that their profits are very large. Generally speaking, they can allow themselves a much wider margin of profit than is obtainable for brass or copper ware. Another important and rapidly extending use for aluminium in India is in manufacturing cooking utensils, especially kettles, gridirons, saucepans, stew pans, frying pans, etc.

Lockwood, Greene & Company, architects and engineers for industrial plants, with headquarters in Boston, have incorporated a Canadian company, and are opening an office in Montreal.

A COAL TESTING PLANT FOR THE SASKATCHEWAN GOVERNMENT.

A plant is about to be erected by the Saskatchewan government at Estevan for the purpose of developing and testing the lignite coal of that district. The plant will be in charge of Mr. S. M. Darling. The following short account of what he has accomplished with North Dakota lignite is especially interesting to us in view of the fact that the lignites of Southern Saskatchewan and of North Dakota are of the same cretaceous character.

The chemical composition of these lignites precludes their being successfully briquetted in their natural condition. To market the lignite commercially in a large way it must be destructively distilled, carbonized or partially carbonized, and the resulting gas, oil or tar, ammoniacal liquor and carbon residue utilized separately.

Analysis of a large number of samples of North Dakota lignite averaged on a dry basis; volatile matter 40.67, fixed carbon 53.33, ash (practically no sulphur) 6.00.

On carbonization, the products in round numbers are:—

1. Gas, per ton of lignite ..... 10,000 cubic feet.
2. Oil or tar per ton ..... 20 gallons.
3. Ammoniacal liquor ..... 35 gallons.
4. Carbon residue ..... 1,200 pounds.

The yields of gas and oil depends largely upon the temperature and rate of carbonization. With a high temperature and quick carbonization the yields of gas will be high and of oil low; while with a lower temperature, and longer time in which to carbonize. there will be less gas and more oil.

The gas has a heating value of 450 British thermal units per cubic foot. It contains a good percentage of illuminants, but has about fifteen per cent. of carbon dioxide, which almost entirely destroys the illuminating power. This carbon dioxide can be removed by passing the gas through lime, but the process is too expensive for commercial application. The gas can be used as an illuminant by burning it in a mantle, but it is serviceable principally for fuel and power.

There is more gas in one ton of lignite than is required to carbonize the next ton. In practice only sufficient gas is removed to supply the requisite fuel to carry on the process. The remaining portion of the volatile is left to add heating value to the carbon residue.

There is therefore no charge for fuel in the process.

On distillation the oil yields:—

Light oils, benzine, toluene, etc.	11.5 per cent.
Carbolic, oils, some naphthaline	11.5 per cent.
Creosote oils	36.1 per cent.
Anthracene, some paraffine	18.4 per cent.
Pitch, hard	22.4 per cent.

This oil or its distillates can be put to many uses—fuel oil, creosoting oil, leather preservative, waterproofing, pitch, etc. Upon exhaustive distillation it yields aniline dyes, carbolic acid, and in varying proportions all the other coal tar products.

The ammoniacal liquor yields some acetate of lime, or if desired, acetic acid, and about 15 pounds of sulphate of ammonia per ton of lignite. There is a growing market for all of these materials, particularly the sulphate, as fertilizer.

The lignite crumbles on carbonization, which renders possible a continuous carbonizing process, obviating the laborious charging and drawing of retorts, as practised in coal gas plants.

The cretaceous lignites retain largely their original woody structure, and hence do not break up so finely during carbonization. After removing by means of screens the small percentage of fines after carbonization, there remains practically lump charcoal of one-half to two inches in size. This can be used in gas producers, under boilers, and for domestic purposes. This lump charcoal is of about the same analysis as anthracite and has about the same heating value, but is not so dense in structure and therefore has somewhat more bulk per ton than the anthracite.

The fines have to be briquetted, or still further pulverized and burned as powdered fuel, a practice which is rapidly gaining favor.

Actual briquetting and burning tests of this fuel in carload lots demonstrate that satisfactory briquettes can be made with not to exceed 2 per cent. of starch and 6 per cent. of coal tar or lignite pitch as binder.

The briquettes burn with a short flame, no odor, no smoke and no clinker. They can be used wherever anthracite or bituminous coal is burned. They retain their structure in the fire until completely burned. They do not disintegrate or lose value in the weather, and can therefore be shipped any distance without loss.

The lignite coke is an ideal gas producer fuel. A satisfactory gas producer generating gas for power purposes from fuels containing a large amount of volatile, as does the raw lignite, is not available. But with the volatile removed, this lignite coke, transformed into producer gas and used in a gas engine to generate electricity, effects an enormous saving over the present method of producing electricity by means of boilers and steam engines. The gas producer requires only about one-fourth the fuel necessary with boiler and engine to produce an equal amount of horse-power. This producer gas also is an exceptionally good fuel for burning brick, tile, etc.

The matter of a large central power plant at the mines to generate electricity for transmission over a wide radius is essentially one of the quantity of current that can be sold, distance that it must be transmitted and evenness of load. If the current must be transmitted a long distance to a large centre of population there must be intermediate towns at which substantial quantities can be sold. This is simply a question of population. Of course, with cheap power available manufactories and people. to use it will come rapidly But, while the time is near when such a central power plant will be the logical thing, heed must be given also to the large demand for solid fuel, for gas producers, boilers and domestic purposes. Any large installation, therefore, would have as products not only electrical current, but coke, briquettes, fuel oil and other by-products resulting from the carbonizing process.

To defray the cost of carbonizing and briquetting there is the revenue from the by-products, and it is known that the income from this source will at least meet that charge. But aside from this, there is to be derived from this carbonizing process the enormous benefit afforded by the possibility of mining and shipping lignite the year round because the product is put into a condition which prevents deterioration no matter how long the fuel is stored or how far it is shipped.

The Lancashire Dynamo and Motor Company of Canada, Limited, have moved to new premises at 107 Duke Street, Toronto.

A French process of "electrocuting" timber is declared to give perfect seasoning in a single night. With lead plate electrodes on each side the timber is placed in a solution containing 10 per cent. of borax, 5 per cent. of resin and a little soda, and application of the current expels the sap and fills the wood cells with the borax and the resin.

EXPERIMENTAL MINE EXPLOSIONS.

Coal dust explosion tests in an experimental mine are dealt with in Bulletin No. 56 of the United States Bureau of Mines for the purpose of placing before mining men an account of the objects sought in the establishment of the experimental mine of the bureau. A description is given of the arrangement and equipment, and a detailed account of the first series of explosion tests, with explanatory notes concerning recording apparatus, etc.

Particularly interesting is the information which. the bulletin contains concerning the mine and its operation. The requirements considered in connection with the selection of the mine site were:—

It should be in a coal bed, the dust of which was inflammable; the mine should be naturally dry and self-draining; its openings should be drifts to avoid complications of shaft-wrecking; the mine should be practically free of explosive gas; a supply of natural gas should be available, so that tests with gas could be made if desirable; a good boiler-feed water supply should be available; and mine should be near a railroad, but at some distance from dwellings.

These requirements were met in the selection of the site at Bruceton, thirteen miles from Pittsburg. Development was begun in December, 1910. The mine at the time the first tests were made, which were considered to be preliminary tests, consisted of two main parallel entries a little over 700 feet long, nine feet wide, with a forty-one foot pillar between them. The entries were connected with cut-throughs every 200 feet. A diagonal heading 198 feet long connected the air-course at a point 117 feet from its mouth to a third. opening. Ventilation was furnished by a small fan at the top of an air-shaft, which is offset six feet from the air course fifty-five feet from the opening.

The main entry was lined with reinforced concrete for the first 169 feet, and a strongly reinforced concrete portal constructed at the main opening. Five rows of shelves, three inches wide, were installed on each side of the main entry. The explosions in the first series were originated by blown-out shots of black powder from a cannon at the face of the entry or a pipe embedded in the coal. The shock wave from the shot would blow up the coal dust from a bench in front of the shot into a cloud and ignite it. Beyond this point the coal dust previously placed on shelves in like manner would be thrown into a cloud in advance of the flame and in turn be ignited.

At various points along the main entry instrument stations had been constructed in the coal rib, which were separated from the explosion gallery by heavy steel plates. Four types of instruments were used in recording the results of the explosions. Pressure manometers were used to give a record on a revolving smoked paper of the variation in pressure at the particular point. Pressure circuit breakers, installed in the stations, were connected to recording apparatus in an outside observatory by means of wires passing through a pipe embedded in concrete in a groove in the coal rib. When the circuit breakers were acted upon by a certain pressure the circuits were broken, the time of the breaks being recorded on a moving paper strip in the recording instrument at the surface. This permitted the determination of the velocities of the pressure wave between different stations. In like manner the velocity of the flame is obtained by a series of flame circuit breakers installed in the various stations. In addition, maximum pressure gauges measured, by the compression of copper cylinders, the maximum pressure exerted at various points.

The first series consisted of fifteen tests. Several of these were given before large numbers of spectators, that of December 30th, 1911, before about 500 persons. A large part of the value of this series was the educational work performed in convincing many persons who still doubted the explosibility of coal dust, that violent explosions could occur without the assistance of inflammable gas in the air. Apart from this result the tests were chiefly valuable in trying out the mine conditions and the various pieces of recording apparatus. Practically all of the tests were made for the purpose of obtaining information with respect to the phenomena accompanying the explosions. For this reason there was little opportunity for studying preventatives. The Taffenel barrier, with a load of shale dust, was not tried in the direct path of the explosion, but was installed a number of times in the air-course parallel to the main entry. The results were inconclusive as to its value.

Each of the explosions is described in detail in the bulletin as to origin of explosion, character of igniting shot, quality and quantity of coal dust used, nature of preventative, outside manifestations of the explosion, inside observations after the explosion, length of flame, and character of records obtained. Analyses of coal dust after the explosion, soot, coked dust, and mine air before and after the explosions are included in the description of the tests.

CHANGE OF NAME FOR NOVA SCOTIA FIRM.

The William P. McNeil and Company, Limited, of New Glasgow, N.S., have announced a change of name to that of the Maritime Bridge Company, Limited. The executive and directorate of the new firm is as follows:—Executive—Walter McNeil, president; Kenower W. Bash, vice-president and manager; Robert C. Grant, secretary. Directors—Francis C. McMath, president Canadian Bridge Company, Limited; Phelps Johnson, president Dominion Bridge Company, Limited; G. H. Duggan, general manager Dominion Bridge Company, Limited.

The old company was incorporated in 1908, although it existed for some time previous to that, in which time it has built up a considerable business. A good market for the products of the company was developed and in the spring of 1912 it was deemed advisable to place the plant and business in the most advantageous position possible for the handling of its requirements. This resulted in the joint purchase by the Canadian Bridge Company, Limited, of Walkerville and the Dominion Bridge Company, of the control of the organization.

In the fall of last year the plant was thoroughly overhauled and extensions made. Better facilities for fabrication work were introduced by more efficient routing of material, etc. The growth of the business in the eastern provinces and the development of the plant under the impetus of the changes made has been very marked.

DURABILITY OF TIES.

The average life of untreated ties as reported by the steam roads is as follows: Cedar, 9 years; tamarack, 8 years; hemlock, 7 years; Douglas fir, 7 years; jack pine, 6 years; spruce, 6 years. As recent statistics bear evidence, cedar is the species pincipally used, because of its durability, but the supply of cedar is rapidly becoming exhausted. Unless preservative treatment of ties is introduced, the short-lived species will have to be used untreated, which, on account of the necessary frequent renewal, will increase the cost of mileage maintenance. If treated ties were used, which would cost 30 cents extra per tie for creosoting and equipping with tie-plates, the inferior species, which are very plentiful and cheap in Canada, could be used with economy. With such a treatment, these woods would last at least fifteen years, and if protected from wear would probably last much longer, and would effect a very considerable saving.

COAST TO COAST.

Fort William, Ont.—The city of Fort William will take over their end of the electric street railway this coming fall. Heretofore the city of Port Arthur controlled the street railway under a joint board, made up of representatives from both cities. Formal steps have already been made in connection with the operation and interchange service between the two cities.

Toronto, Ont.—Superintendent Bennett, of the Colonization Roads Department, has arrived at the Parliament Buildings after an inspection of the districts recently visited by forest fires. The damage to bridges, he said, was very slight. In the Sudbury district a $25,000 colonization road nine miles in length was completed last week. The colonization road work had not been seriously delayed by the fires, and the extent of territory benefited this season was likely to make a new record.

Ottawa, Ont.—A great improvement has been made to the Richmond Road between the city limits and Westboro. Employees of the Bytown and Ottawa Road Company have covered the road with tarvia. As it is now almost a dustless road, it is certainly a great improvement, and one that is much appreciated by those residents living along the way. For some time the residents of Westboro and all along the Richmond Road have been urging the road corporation to take action in the matter, and at one time they suggested that the road through the village should be treated at the expense of private parties. It is understood that the road company intends to cover the road with tarvia for several miles west of Westboro. This will also meet with the approval of farmers in that locality.

Victoria, B.C.—The city officials are paying about $8,000 a month to the Esquimalt Waterworks Company for the purchase of water from Goldstream, judged on the basis of last month. It is intimated by a prominent city official that the yearly cost will run to $80,000. It is frequently stated that the city is making a profit by buying water at half its retail cost, to sell again to consumers, the observation being based on the fact that the Esquimalt Company is selling five million gallons of water per day at six cents a thousand gallons. However, of that amount at least 30 per cent. never is retailed to consumers, the loss in the mains, evaporation at the reservoir, water for city services, and the amount lost in other ways absorbing the difference. Besides, the city has to maintain a distributing service for its consumers. Those in touch with the matter expect that the profit and loss account on this purchase will not show a large margin for the city when the whole information is tabulated for the consideration of the council.

Toronto, Ont.—Sir William Mackenzie, president of the Canadian Northern Railway, has secured the money necessary for the fulfilment of the Canadian Northern Railway Pacific Coast terminal plans, and they are to be proceeded with without delay. In a recent interview Sir William stated that, of the capital he had secured in London—an issue of $2,000,000 of 4½ per cent. terminal bonds, and an issue of $7,500,000 of five per cent. five-year notes—a large portion would be immediately used for western terminal development and the remainder for the building of an extension of the Canadian Northern Railway lines in Western Canada. Included in the Canadian Northern Railway Pacific Coast plans are large yards and shops to be erected at Port Mann; terminal stations, etc., at Victoria and New Westminster, and at the city of Vancouver a project which involves an expenditure of $10,000,000, and which will take five years to carry out. In consideration of the conveyance to the railway by the citizens of Vancouver of what is known as False Creek, the Canadian Northern Railway are building the main Pacific terminals thereon, including a big passenger depot at a cost of $1,500,000; the erection of a modern hotel, and the absolute reclamation of False Creek. The plans further called for making the railway's own entrance into Vancouver by way of a tunnel from New Westminster, the construction of which will cost in the neighborhood of $4,000,000.

Ottawa, Ont.—The Commission of Conservation, under the chairmanship of Hon. Clifford Sifton, has issued an exhaustive and carefully prepared report on the general question as to the giving of power rights on the St. Lawrence River to private corporations, with special reference to the application pending before the United States Congress from the Long Sault Development Company for rights to dam the St. Lawrence at the Long Sault Rapids, near Cornwall. The enormous importance of the power franchises, involving the whole industrial development of Eastern Ontario, Western Quebec and the bordering American States, is fully pointed out in the preface to the report, and the logical conclusion is reached from a study of all the conditions that the plain duty of the Federal Government is to maintain public ownership and control of all the power rights on the river absolutely unimpaired. The Commission strongly urges that public interests in power development on the St. Lawrence should be conserved for all time, and that the persistent efforts of the merger company to secure monopoly rights should be firmly resisted.

Toronto, Ont.—It is rumored in the city that the farmers in the County of York are concluding that the good roads provided by the Commission do not meet the requirements of vehicular traffic. Not only is it stated that the good roads so far supplied are not so constructed as to stand the wear and tear of traffic, but macadam roads are being declared a failure. There are many who have reached a conviction that the only solution of the good roads problem is to construct asphalt pavements, the same as in the city. Such is the condition of public sentiment upon the results shown by the Commission that a reorganization of the good roads movement in the near future is likely to be demanded.

Toronto, Ont.—The Toronto Board of Trade is preparing for an active year in civic improvement and the general development of Ontario and Canada, and will in October resume the publication of The Board of Trade News, the official publication of the organization, which is not issued during the months of August and September. The members and officials of the organization are naturally proud of the things accomplished in the past, and point with pride to the creation of the Board of Railway Commissioners, the Harbor Commission, the work on the new Welland Canal, the agreement for a railroad viaduct on the water front, and the initiation of the movement for good roads with an appropriation to date of $600,000. The scope of the future work of the Board of Trade may be understood from the appointment of special committees to give attention to the subjects named, viz., harbor and Welland Canal, railway and transportation, legislation and education, good roads, civic and social service, Ontario development, express rates and parcel post, viaduct, publicity, Federal square, foreign trade, membership and conference committee of one hundred. The organization was incorporated in 1845, and now has a membership of 2,800.

Toronto, Ont.—Toronto will have the finest freight terminals in the world before this time next year. The Canadian Pacific Railway has just completed plans for additional buildings to be erected at the corner of King and Simcoe Streets, on the old Government House site, and the Grand Trunk Railway also is planning the erection of more buildings at the corner of Wellington and Simcoe Streets. City Architect Price and the division engineers of the Canadian Pacific Railway declare that the Toronto freight terminals will

be the most modern anywhere. The large new building which the Canadian Pacific Railway will erect at King and Simcoe Streets will cost over half a million dollars. It will be used by the freight department and the Dominion Express Company, which will leave the Union Station altogether. Following is a partial list of the works the Canadian Pacific will carry out in connection with its new freight terminals: Solid brick and steel warehouse, fronting on King Street, 500 by 75 feet, to be used by the freight department and the Dominion Express Company, cost $500,000. Freight house for inbound freight, 900 by 50 feet; freight house for outbound freight, 900 by 50 feet; covered transfer platform, 900 by 50 feet; offices on Simcoe Street connecting both freight houses, size 40 by 185 feet. All buildings will be of solid brick and steel construction, and the total cost of erecting them is estimated at $1,200,000. This does not include the cost of track-work, paving, real estate, legal and other general expenses. The real estate alone cost over $2,000,000; a retaining wall to support the south side of Front Street will cost $49,000; it will cost $43,000 to pave roadways, and the track-work, grading and incidentals will cost $132,000. There will be fifteen railway tracks in connection with the Canadian Pacific Railway terminals and three granite-block-paved team roads with alternate tracks.

Victoria, B.C.—Costing $4,000,000, and unquestionably to be the largest shipbuilding drydock and ship-repairing plant in Canada, the scheme of the Amalgamated Engineering Company for North Vancouver has been approved by Hon. R. Rogers, Minister of Public Works. Work will be started as soon as the necessary formalities are arranged with the Government. The plant will be situated in D. L. 265, and will include a floating drydock, a shipbuilding plant and ship-repairing works of the most modern type. The immense basin will give a depth of thirty feet at low tide. The floating dock will have a lifting capacity of 20,000 tons, which will provide a wide margin over the present requirements of shipping in Burrard Inlet. A second dock will be built to the west of the basin capable of accommodating smaller vessels. Building berths will also be erected. Four in number, two will be 750 feet long and 100 feet wide, and two will be 350 feet long and 75 feet wide. Shops will be constructed in connection with the works and with the railway facilities of the North Shore. Electric cranes and the latest machinery will be the features of these. Construction of the plant will require three years. When in full working order it is expected to give employment to an average of 2,000 men. Plans are now being hurried forward, and, when ready, will be forwarded to the Dominion Government so that the necessary Order-in-Council may be passed. Mr. C. J. V. Spratt, of Victoria, is managing-director of the company, which includes Col. Sir Henry Pellatt, Col. Sir John M. Gibson, Lieutenant-Governor of Ontario; Mr. D. B. Hanna, and Mr. E. J. Palmerm, of the Victoria Lumber and Manufacturing Company, Chemainus. Also, there is an advisory board of directors—men of high standing in Great Britain. The site, which was purchased from the Lonsdale estate, covers an area of eighty acres—which is quite sufficient for the establishment of a great and flourishing industry. The original idea was to invest $2,500,000 in the scheme, but after further consideration it was felt that a more comprehensive plant was needed, and enlargement was accordingly effected. The company acquired the property on especially favorable terms on the understanding that they would complete the construction in a given time, and that they would give employment to a certain number of men within a specified period.

Montreal, Que.—An appropriation of $1,500 to cover the expenses of a specially qualified man to report on the whole plan of municipal ferry-boats running to St. Helen's Island is recommended to Council by the Controllers. They favor municipal ferries rather than a renewal of the present contract, which expires on May 1st, 1915. There may be some opposition to this recommendation as there is standing in abeyance just now a scheme for another report of a somewhat similar character. The Council approved of the idea of having a report from two engineers, appointed by the city and Harbor Board, respectively, on the suitability of the Island for an exhibition and the possibilities in the way of developing sufficient means of access. The city has appointed a man but the Harbor Board has not as yet. The report now desired by the Board of Control is to be on the kind of boats required, their probable cost, best places for docks, and probable cost of the whole scheme.

Montreal, Que.—The corporation of Montreal is employing 10,000 men, outside of the permanent staff. More than half of these are engaged in laying concrete and asphalt pavements and sidewalks. The weekly payroll is more than $100,000. The work commenced early in the spring and will be continued until the snow comes. The demand for unskilled labor has long since far exceeded the native supply, and the importation of foreign hands is steadily increasing. The Italians and other Southern Europeans who do this kind of work were formerly of a nomadic character, but employment has been so steady and there is so much in sight that they are becoming permanent residents. This season a large number of Russians have been added to the labor population of the city and suburbs.

New Westminster, B.C.—Mr. F. J. McKenzie, M.P.P. for Delta, took a seventy miles trip over Langley and Surrey Roads recently, and found that the work was being speeded by both government and municipal employees in order to put as much of the road improvement through as possible before the rainy season begins September usually sees the end of the season, but there is no question that the roads on the south side of the Fraser will be in much better condition for traffic this winter than they were last. A great amount of road grading has been done, which is now being ballasted, and a start has been made with rocking the road between Murrayville and Langley Prairie. This is the beginning of rock work in Langley Prairie, and in future rocking will supplant gravel in that municipality. The route taken by Mr. McKenzie was through Port Mann, Port Kells, Jericho, Clayton and Colebrook, and returning by the Scott Road and the hill there, about which so much complaint has been made, is now in good condition.

Vancouver, B.C.—The greatly improved roads of North Vancouver are beginning to exert a great attraction for Vancouver automobilists. Most striking testimony of this is the fact that fines imposed on motor car owners and drivers by the North Vancouver district police courts are far greater than they were two years ago. The latest move in the good roads project across the Inlet was the application by the Vancouver Automobile Club recently to the District Council asking that the remaining two miles of Keith Road to Deep Cove be surfaced by the municipality. Mr. Ford, the secretary, in his communication, showed the advantages in increase of trade an increase in automobile traffic would entail. It was said that the cost of the work would be proportionately trifling. The Council replied that it had the matter under consideration for some time, but that finances did not permit the letting of the contract. When the revenues increased, it would be possible to take up the project again. In the meantime the letter was referred to the Board of Works. Automobilists from Vancouver have opportunities for three splendid tours in North Vancouver. By far the best, and the one most frequently travelled is the Capilano Road. The Lynn Valley Road has been macadamized, and presents a good surface for automobiling from the North Vancouver Ferries entrance to the Rice Lake intake. The Dundarave Road contains less hills, and furnishes a beautiful view. Part of

this thoroughfare runs through West Vancouver, where the "boulevard" is the pride of the residents. All three routes run through pleasant stretches of woods and near wonderful stretches of water. The West Vancouver highway will, it is expected, some time be a business street throughout the greater part of its length. In the three municipalities the greatest expenditure is for this road.

Montreal, Que.—In a report to the Harbor Commission, F. N. Cowie, engineer of the Commission, reports a serious state of affairs in regard to the pumping station for sewage being erected near the Place Royale. The site selected adjoins the Sailors' Institute and the Birmingham Building. It was necessary for the contractor to go down a considerable distance for the foundations. For fourteen feet good soil was found, but below that clay and quicksand, very wet, has been met with. Mr. Cowie advises the Harbor Commission to assume no responsibility whatever for the work, as the city of Montreal made the selection, the station being needed for the diversion of sewage from the Elgin basin. The work is being done at the joint expense of City and Harbor Commission. Mr. Cowie declares that the Birmingham Building will have to be taken down, as the walls are in a state of collapse, and the walls of the Sailors' Institute are none too safe. The excavation, states Mr. Cowie, is in a deplorable condition. The timbering has collapsed and the lower portion of the ground is caving in. The depth of the excavation is held responsible by Mr. Cowie for the condition of the Birmingham Building and the Sailors' Institute.

Prince Albert, Sask.—An exhaustive report on the power situation by F. A. Creighton, power manager, which has been in the hands of the aldermen for some time, was read at the last meeting of the city council, at which P. H. Mitchell, the consulting engineer, was present, and made a number of explanations on various points. The estimated cost of completion of the scheme on the basis of a 4,000 horse-power capacity is $1,700,000, and of this sum $771,111 was spent up to June 30th. One of the most important points in the report was in regard to the flow of water at La Colle Falls during the dry season of the year. According to a gauging taken last year, the only one available, that flow is only 1,500 second feet during January, February and March, and with such a flow only 3,360 horse-power could be generated. Mr. Mitchell emphasized the handicap they had from the lack of sufficient and reliable data on those gaugings, and it was decided to petition the Dominion Government to make arrangements twice a week from November till May.

PERSONAL

M. B. WATSON, B.A.Sc., has been appointed Assistant Engineer to the Ontario Highway Commissioners.

GEO. H. POWER, of Chipman and Power, Consulting Civil Engineers, is returning this week to take charge of the Winnipeg office, after spending several months in Toronto.

J. H. BILLINGS, B.A.Sc., has accepted a position in the Department of Mechanical Engineering of the University of Missouri, Columbia, Mo., as instructor in thermodynamics.

GEO. CONDON has accepted an appointment from the National Steel Car Company, Ltd., of Hamilton, Ont., to represent them in Montreal. The new offices are in the Shaughnessy Building.

V. A. E. GOAD, B.A.Sc., has gone to Montreal where he will take permanent charge of the Montreal interests of the Chas. E. Goad Company. Mr. Goad has been associated with the main office in Toronto for the past three years.

ISHAM RANDOLPH, C.E., of Chicago, announces that he has removed his offices to Suite 1807 Commercial National Bank Building, north-east corner of Adams and Clark Streets, where he will continue his practice as consulting engineer.

F. D. MANNING has been appointed Canadian sales manager for the Continental Car Equipment Company, Inc., of New York City and Louisville, Ky., manufacturers of dump cars. Mr. Manning will have his offices in the C.P.R. Building, Toronto.

WM. C. WILLARD has been appointed Assistant Professor of Railway Engineering at McGill University, succeeding Professor Smart, resigned. Mr. Willard is a graduate of Lehigh University, an associate member of the American Society of Civil Engineers and a member of the American Railway Engineering Association. He leaves the position of Assistant Civil Engineer, Panama-Pacific International Exposition, San Francisco, California, to come to Montreal. Among other positions of importance held by Mr. Willard are those of Instructor in Civil Engineering and Director of the Summer School of Surveying, University of California; Assistant Engineer, construction department, Southern Pacific Railway; Professor of Railway and Highway Engineering, State College of Washington, and Assistant City Engineer, Oakland, California.

COMING MEETINGS.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Tenth Annual Meeting will be held at Cleveland, Ohio, September 17th and 18th. Secretary, W. P. Blair, 824 Engineers' Building, Cleveland, Ohio.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Third Annual Meeting in Regina, September 18th, 19th and 20th. General Secretary, Major Lorne Drum, Ottawa; Local Secretary, R. H. Murray, C.E., Regina.

ILLUMINATING ENGINEERING SOCIETY.—Annual Convention to be held at Pittsburg, Pa., September 22nd to the 26th. Secretary, I. D. Israel, 29 West 39th Street, New York City.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20117—August 16—Authorizing the C.N.R. to cross with its lines and tracks the spur to the Manitoba and Saskatchewan Coal Co., and to cross and join with the spur to the Western Dom. Collieries, in the S.E. ¼ of Section 19, Tp. 2, Rge. 6, W. 2 M., Sask.

20118—August 18—Further extending until March 1st, 1914, the time for the use of the connection of the C.N.O.R.'s tracks with the tracks of the C.P.R. at Meadowside.

20119—August 14—Authorizing the G.T.P. Branch Lines Company to construct its railway across Eighteenth Avenue East, Strathcona Avenue, Laurier Avenue, Rupert Avenue, Connaught Avenue, 1st Avenue West, 4th Avenue West, Sixth Avenue West, and 8th Avenue West.

20120—August 15—Approving revised location of G.T.P.'s main line, Yellowhead Pass West, mileage 43.24 to mileage 49.26, District of Cariboo, B.C.

20121—August 15—Authorizing the G.T.P. to construct, maintain and operate branch line of railway, or industrial spur for the town of Tofield, Sec. 36, Tp. 50, Rge. 19, W. 4 M., Dist. of North Alberta, Prov. of Alta.

20122—August 19—Authorizing the G.T.P. to construct highway across its main line of railway in Lot 14, Parish of Headingly, mileage 13.21, Mun. of Assiniboia, Dist. of Winnipeg, Prov. of Man.

20123—August 15—Authorizing the C.P.R. to operate their trains over the crossing at Delson Jct., without their first being brought to a stop.

20124—August 14—Approving proposed changes in the location of the G.T.R. Co.'s tracks leading to its coach yard in the vicinity of St. Marguerite St., St. Henri, Montreal.

20125—August 18—Authorizing the G.T.P. Branch Lines Company to construct its line of railway across and divert the highway in the N.W. ¼ of Sec. 12, Tp. 11, Rge. 17, W 1st M, at mileage 10.4, Rural Mun. of Elton, Dist. of Brandon, Man.

20126—August 16—Authorizing the G.T.P. Branch Lines Company to construct, maintain, and operate the branch line of railway or spur, turning out from its Yorkton Branch to the Power House in the town of Yorkton, Sask.

20127—August 18—Authorizing the G.T.R. to construct, maintain and operate branch line of railway, or siding, Parish of St. Anne de Bellevue, Co. Jacques Cartier, Que., commencing at a point on its railway east of the station, known as St. Anne de Bellevue, thence extending in a westerly direction to the premises of the MacDonald Agricultural College, on Lot 302.

20128—August 19—Authorizing the Lake Erie and Northern Railway Company to construct its tracks under the tracks of the G.T.R. by means of an undercrossing, at station 1192+42.9, near the town of Simcoe.

20129—August 14—Authorizing the Lake Erie and Northern Railway Company to construct its railway across Townsend Street, McCall Street, Wilson Street, and Victoria Street in the town of Simcoe, Ontario.

20130—August 14—Granting leave to the Lake Erie and Northern Railway Company to raise the tracks of the Grand Valley Railway Company two feet to meet the elevation of the L.E. & N. Railway at the County Line between the Co. of Brant and Co. of Waterloo at station 868+97.

20131—August 16—Authorizing the Edmonton, Dunvegan and British Columbia Railway Co. to construct its railway across the highway between Secs. 36 and 1, Tps. 68-69, Rge. 2, W. 5 M., Alta

20132—August 18—Approving revised location of the E.D. & B.C. railway from mileage 112.33, through Twps. 68-69, Rge. 2, W. 5 M., Alta.

20133—August 15—Ordering the C.N.O.R. to restore the former connection between Napanee and Tamworth, Ont.

20134—August 16—Authorizing the T.H. & B. Railway to divert highway between Lot 14, 10th Con., and Lot 14, 11th Con., Tp. of Pelham; to divert highway between Lot 1, 13th Con. and Lot 1, 14th Con., Tp. Pelham; to divert highway between Lot 9, 11th Con. and Lot 9, 12th Con., Tp. Pelham; to divert highway between lot 5, 12th Con. and lot 5, 13th Con. Tp. Pelham.

20135—August 15—Dismissing application of the Empire Limestone Company, Limited, for authority to construct a tunnel under the right-of-way belonging to Carroll Bros., on Lot 5, Con. 1, Twp. of Huberstone, Ont.

20136—August 11—Refusing application of the Dominion Sugar Company for a readjustment of the rates on sugar, in carload quantities, from Wallaceburg to Toronto and from Wallaceburg to Hamilton, over the lines of the C.P., G.T., Pere Marquette, and Chatham, Wallaceburg and Lake Erie Railway Companies.

20137—August 21—Authorizing the V. V. & E. Ry. & Nav. Co. to construct, maintain, and operate spur to the Kilgard Fire Clay Co.'s works at Kilgard, B.C.

20138—August 19—Authorizing the New York Central Ry. Co. to remove station called Primeau, Que., from its present location to a point immediately to the east of the G.T.R. Co.'s line at the Kanawaki Golf Club grounds.

20139—August 19—Ordering the C.N.Q. Ry. to construct a suitable passenger station at Arundel, Que.

20140—August 19—Ordering the C.P.R. to install an improved type of illuminated electric bell at the Main Street crossing in Milverton, Ont., and to thereafter maintain the said bell at its own expense.

20141—August 20—Authorizing the G.T.P. to carry traffic over that portion of its railway in British Columbia between Tete Jaune, mileage 1095.3 and the second crossing of the Fraser River, mileage 1189.0, a distance of 93.7 miles.

20142—August 15—Approving revised location of portion of the C.P.R. from mileage 37.35 at a point in Sec. 14, Twp. 23, Rge. 18, W. 5 M., thence in a southeasterly direction to a point in Lot 11114, East Kootenay District, B.C., at mileage 57.18, on the C.P.R.'s Kootenay Central Branch.

20143—August 19—Approving locations of the Esquimalt and Nanaimo Ry. Co.'s stations, Union Bay and Courtenay, British Columbia.

20144—August 20—Approving revised location of the G.T.P. Branch Lines Co.'s Tofield-Calgary Branch through the North Half of Section 10, Twp. 42, Rge. 21, W. 4 M., Alta.

20145—August 20—Approving revised location of G.T.P. Branch Lines Co.'s Tofield-Calgary Branch through Sec. 21, Twp. 29, Rge. 24, W. 4 M., Alta.

20146—August 20—Authorizing C.P.R. to construct bridge No. 0.16 for double tracking, over Yamaska River, near Brigham Jct., Que.

20147—August 22—Approving proposed location of shelter on the West Half of Lot 3, Con. 2, Twp. Eldon, Prov. Ont.

20148—August 20—Authorizing C.P.R. to construct Bridge No. 88.6, and an additional track at mileage 88.73 of its Toronto Subdivision, Ont. Div., across and over the tracks of the G.T.R.

20149—August 20—Approving revised location of C.P.R.'s Bassano Easterly Branch, from a point in Sec. 5, Twp. 22, Rge. 3, W. 4 M., at mileage 98.72, thence in an easterly direction to a point in Sec. 10, Twp. 23, Rge. 1, W. 4 M., at mileage 115.59; and authorizing the C.P.R. to construct its tracks (Bassano Easterly Branch) across certain highways in the Province of Alberta.

20150—August 20—Authorizing C.P.R. to construct bridge No. 37.9, Toronto Subdivision, Ontario Division of its railway, Ontario, near Bethany Jct.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

PLANS AND SPECIFICATIONS ON FILE.

The Canadian Engineer, 820 Union Bank Building, Winnipeg:—

ISSUE — CLOSE

28-8—Supplying power house machinery, Neepawa, Man. 12-9

The Canadian Engineer, 62 Church Street, Toronto:—

28-8—Supplying power house machinery, Neepawa, Man. 12-9

The Canadian Engineer, 628 Transportation Building, Montreal:—

28-8—Supplying power house machinery, Neepawa, Man. 12-9

TENDERS PENDING
in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Amherst, N.S., extension of a wharf	Sept. 22.	Sept. 4.	80
Cayuga, Ont., macadam road	Sept. 16.	Aug. 7.	88
Derby Junction, N.B., railway construction	Sept. 19.	Sept. 4.	76
Fraser River, B.C., jetty and dredging	Sept. 30.	Aug. 21.	80
Gillies Bay, B.C., wharf	Sept. 15.	Aug. 28.	80
Laprairie, Que., protection dyke.	Sept. 23.	Aug. 28.	80
Listowel, Ont., drill hall	Sept. 16.	Aug. 21.	80
Main Duck Island, Ont., construction of buildings	Sept. 16.	Aug. 28.	80
Meaford, Ont., extension and construction of revetment wall	Sept. 29.	Sept. 4.	80
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Prince Rupert, B.C., drill hall.	Sept. 23.	Sept. 4.	82
Regina, Sask., power house equipment	Oct. 1.	Aug. 28.	86
Vail's Point, Ont., construction of a wharf	Sept. 15.	Sept. 4.	80
Victoria, B.C., school building.	Sept. 15.	Sept. 4.	82
Victoria, B.C., school building.	Sept. 15.	Sept. 4.	82
Winnipeg, Man., transmission system	Sept. 20.	Aug. 28.	78
Winnipeg, Man., supplying water-pipe and hydrants	Sept. 19.	Sept. 4.	80

RAILWAYS—STEAM AND ELECTRIC.

+—Brantford, Ont.—The Lake Erie and Northern Railway Company has awarded MESSRS. WRIGHT, HAZZARD & COHEN, Buffalo, the contract for the raising of the Lorne bridge. This job is one of the most important in the construction of the entire line, as it was part of this route which required a special session of the Dominion Railway Board. The contract price is about $15,000.

Calgary, Alta.—A number of extensions of the street car system which the city had planned earlier in the season to make this year, but which were abandoned when at one time it appeared that money was going to be scarce, have been restored to the programme of improvements for this season since the million dollar loan came through. There are seven such proposed extensions running from half to three-quarters of a mile each, and aggregating about four miles, which it has now been decided to proceed with.

Chatham, Ont.—The Canadian Northern Railway has secured control of the Chatham, Wallaceburg and Lake Erie Electric Railroad. Proposed extensions will be undertaken shortly.

Kingston, Ont.—The Canadian Northern Railway have completed the work of grading between Napanee and Sydenham, and have commenced laying their rails. The company expect to start the service between the two towns before winter.

Montreal, Que.—The contract between the Montreal and Southern and Counties Railway Company and the city of Montreal has been completed at last, and was laid before Mayor Lavallee recently for signature. His Worship will await a report from City Attorney Laurendeau as to the validity of the contract before signing it.

Moose Jaw, Sask.—The Canadian Northern Railway and Grand Trunk Pacific are both busily engaged on their construction work in this city. The Grand Trunk Pacific are putting ballast on their right-of-way through the city, and the Canadian Northern Railway are working on their bridges over the river and completing the grade work between the various sections.

Nelson, B.C.—It is officially announced that arrangements are about completed for ordering four electric locomotives at an approximate cost of $75,000 each, to be used on the Castlegar to Rossland line of the Canadian Pacific Railway, which is to be electrified shortly. Though construction work has not yet actually started on the electrification of the line, preliminary arrangements are being made, and work will be commenced in a short time. Already the West Kootenay Power and Light Company has made arrangements to increase the capacity of its power plant at Bonnington Falls, and the necessary machinery is being ordered. Nine thousand horse-power is being added to the plant. The completion of the electrification of this route is expected to overcome the difficulties now experienced on the heavy grades on the Rossland hill, and a noticeable reduction in the time of the run from Castlegar to Rossland.

Toronto, Ont.—Work on the Canadian Pacific Railway east of Toronto is proceeding rapidly. The lake front line, which leaves the main track at Agincourt, is nearly completed as far as Bowmanville. The work of double-tracking between Agincourt and Toronto was begun during the month, and excavations are being made for two large bridges over the Don and West Don.

Toronto, Ont.—According to H. R. Safford, of Montreal, chief engineer of the Grand Trunk Railway, there is no doubt about a start being made on the construction of Toronto's new Union Station next spring. Mr. Safford passed through Toronto recently on his return to Montreal after a western inspection trip. "We are working hard on the Toronto station plans, and they will be ready in plenty of time to allow a commencement to be made by the spring," he said.

+—Victoria, B.C.—The Canadian Northern Railway has awarded a joint contract to MR. A. J. McDONALD and MESSRS. NETTLETON, BRUCE, ELSBACK COMPANY for the construction of the line of railway from Patricia Bay to the entrance to the Songhees reserve terminals at Victoria, which will complete the Island link in the rail and ferry service between Vancouver and the provincial capital. The distance covered by the work is about twenty miles, from Patricia Bay, formerly known as Union Bay, on the north.

Tarvia

Preserves Roads
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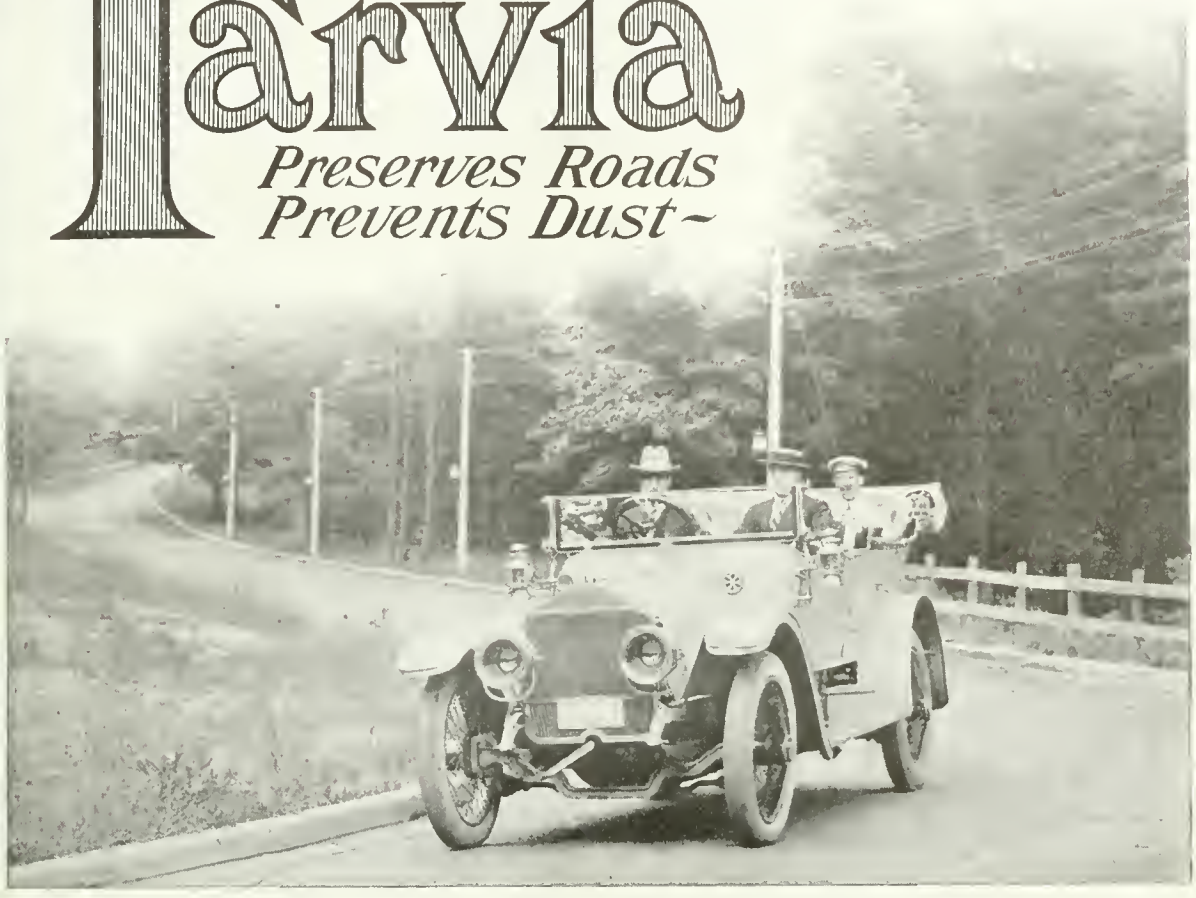

Overcomes Washing on a Heavy Grade

The above cut shows Russell Hill Road in Toronto, a water-bound macadam road with a heavy grade. Formerly great damage was done to the surface of this roadway by washing, and incessant repairs were required to keep it in satisfactory condition.

In June, 1912, a coat of "Tarvia B", at the rate of one-third gallon per yard, was applied. The Tarvia penetrated into the road surface and hardened, thus reinforcing the natural binder, cementing the surface together and making the surface shed water like the proverbial duck's back. The torrents which formerly had destroyed the surface now ran off harmlessly, and the road showed no further signs of washing. In addition, the surface remained practically dustless and gave superior resistance to automobile traffic.

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westerly shore of the Saanich peninsula to a junction with the main line of the railway. The same contract also covers the work from mile 4.7, outside Victoria, through the city and up to the approach to the terminals on the Songhees reserve. The construction on these two different portions will commence at once and will be carried on with the greatest speed consistent with good work.

Victoria, B.C.—Grading of the Canadian Northern Pacific Railway to mile 52 from the present terminus at mile 4.7 should be ready in about another month, and the whole of the work of grading up to mile 100 is well in hand. The activity along Sooke Lake has been particularly noticeable this summer, as has also that on the contracts of Moore and Pethick further north. The engineers are already preparing for the important steel work which has to be undertaken for river and ravine crossings, notably the steel viaduct over the Koksillah River, and the steel bridge over the Cowichan River, where facilities will be required to handle the material expeditiously in order that the work can go forward satisfactorily when it is commenced. A wharf has been built at Patricia Bay for the purpose of handling material. The plans for the crossing of Selkirk water have also been lodged with the proper authorities.

BRIDGES, ROADS AND PAVEMENTS.

+—Brantford, Ont.—The township council has awarded the ROYAL ARTIFICIAL PAVING COMPANY, Guelph, the contract for the construction of 38,200 square feet of sidewalk on Hamilton Road. The contract price is 12½ cents per square foot.

Calgary, Alta.—The City Commissioners will recommend to the Council that the action of the Council whereby the Mineral Rubber Company was awarded additional paving on Sifton Boulevard, be rescinded and in lieu thereof, the company be given a contract for paving on other streets where it had been decided to lay pavement since the assurance that more funds for public improvements was received. The new proposal is to give the Mineral Rubber Company a contract to pave Center Avenue from Tenth Street West to Eleventh Street A; Seventh Street West from Second to Fourth Avenue north-west; Second Avenue from Tenth Street west to connect with the present pavement near Ninth A Street north-west.

▲—Cayuga, Ont.—Tenders will be received up till the 16th of September, 1913, for the construction of 26½ miles of stone macadam road. Plans and specifications may be obtained from T. A. Snyder, County Clerk.

Haileybury, Ont.—Work on the Lake Shore Road section of the Cobalt-New Liskeard trunk road was commenced recently. The Main Street work has been completed except for the top dressing of macadam, and it is not the intention to start work on Ferguson Avenue, until everything is in readiness to complete the work in short order. On the Lake Shore Road, the street is being levelled preparatory to the gravelling after which the road will be stoned and tolled. It is altogether likely that the rock for this work and all that work from the town to New Liskeard will be brought in over the spur line.

+—Kingston, Ont.—The City Council has awarded the ONTARIO ASPHALT BLOCK COMPANY, Windsor, the contract for the additional paving of city streets. The contract price is $2.75 per square yard.

Lindsay, Ont.—The town council has received a tender from Messrs. Nasmith and Pogue for the construction of granolithic sidewalks. The contract price is 14 cents per square foot.

+—Montreal, Que.—The Dominion Government has awarded the HAMILTON BRIDGE COMPANY the contract for the construction of a steel swing bridge over the Chambly Canal at Garocques crossing. The contract price is $2,450.

Montreal, Que.—By the slow delivery of granite paving blocks, the paving operations on a number of streets have been suspended, according to a report submitted to the Board of Control, by Supt. Barlow, of the roads department. It seems that while the contract awarded last April called for 56,000 square yards of granite blocks, Mr. Barlow declares that up to date, the Elder Ebano Company, which secured the contract, has delivered but 14,752 square yards. This quantity, states Mr. Barlow, is by no means sufficient to meet requirements and in consequence, the paving operations on a number of streets have been suspended.

+—Ottawa, Ont.—The Dominion Government has awarded the HAMILTON BRIDGE COMPANY the contract for the construction of the double track railway swing bridge of the Welland Canal. The contract price is $65,800.

+—Saskatoon, Sask.—The city council has awarded MESSRS. LONERGAN AND HANSFORD the contract for fixing Long Hill. The contract price is $15,000, and calls for the removal of some 10,000 cubic yards of earth.

+—St. John, N.B.—The City Commissioners have awarded the WARREN BITULITHIC COMPANY the contract for the construction of pavement on King Street. The contract price was $6,170.95. Other firms tendered as follows:—A. R. C. Clark and Son, $7,166.90; B. Mooney and Son, $7,-882.30; Louis Corey, $6,069.85; George and Moses, $6,-751.25. Com. Agar stated that the cost of curbing, $563.90, must be added to the Warren Company's tender, as they had omitted to include this. Their tender would accordingly be $6,733.95, and Louis Corey's tender would be the lowest.

+—St. John, N.B.—The City Commissioners have awarded MICHAEL GEORGE AND MOSES the contract for the construction of pavement on Queen Street. The contract price is $5,709.60. Others firms tendered as follows:—A. R. C. Clark and Son, $6,391.00; B. Mooney and Son, $5,995.90; Warren Bitulithic Company, $5,888.00; Louis Corey, $6,-085.80.

+—Vancouver, B.C.—The Board of Civic Works has awarded the COLUMBIA BITULITHIC COMPANY the contract for the construction of pavements on Burrard Street and Fourth Avenue; from Trafalgar Street to Alma Road, to MESSRS. M. P. COTTON AND COMPANY, with the exception of one block, which it is proposed to award to MESSRS. J. R. NICKSON AND COMPANY. This step was taken in order to ensure an early start on these streets.

Victoria, B.C.—Now that the contract with the Saanich council has been signed the Warren Construction Company, which has the bulk of the contract for the 23 miles of road to be paved, is already making arrangements for assembling material and a start with operations will not long be delayed. The intention is to make a commencement while the weather remains good and to see that the work is planned so that it may be done with due regard to the comfort of vehicular and pedestrian traffic. Considerable interest centres in the road to be undertaken first. While opinion has strongly favored the main Saanich road, the company indicates that this will be a matter for the decision of the reeve and municipal engineer. The probable results of regrading, where it is necessary, will have an effect upon the road which is first to be undertaken, as the material will have to be given time to settle before surfacing. With the Automobile Association locating a country home at the head of the peninsula, the improvement of the trunk road northward out of the city is of much importance.

Walkerville, Ont.—The ratepayers of the town have passed a by-law calling for the expenditure of $8,123 for paving Victoria Road and Walker Road.

LIGHT, HEAT AND POWER.

+—Calgary, Alta.—The City Council has awarded MESSRS. BENNETT AND DEBMAN the contract for the erection of a power sub-station.

Kingston, Ont.—Tenders will be received up till 15th of September, 1913, for supplying and laying 20,000 duct feet of conduit. Plans and specifications may be obtained from Light, Heat, Power and Water Department.

Medicine Hat, Alta.—City Engineer Grimmer is getting in touch with a number of the larger cities in Western Canada and the United States for the purpose of securing data and figures which will assist him in making a report to the City Council on the question of installing an improved street lighting system for Medicine Hat. The question is one, he says, which requires a great deal of careful study and minute investigation, and it is likely to be some little time yet before he is in possession of sufficient data to enable him to make his report and recommendation.

▲—Neepawa, Man.—Tenders will be received up till the 12th of September, 1913, for supplying machinery for additions to the power plant. Plans and specifications may be obtained from *The Canadian Engineer's* offices at Winnipeg.

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Toronto, and Montreal; W. E. Skinner, Limited, Consulting Engineers, Winnipeg, and J. W. Bradley, secretary-treasurer.

+—Ottawa, Ont.—The Dominion Government has awarded MR. A. G. MARSHALL the contract for the installation of under-ground services in the Parliament buildings. The contract price is $11,995.

Port Hope, Ont.—The Seymour Power Company have been granted a ten-year franchise and will extend their electric power system. The estimated cost is $10,000.

Owen Sound, Ont.—That Owen Sound is destined to take its electric energy for power and lighting purposes from Engenia Falls, on the Beaver River, there seems to be little doubt, in view of the results of the tests for power available there at low-water mark this summer, a season that has been the driest for several years. It has been established on the investigation of a practical hydraulic engineer, Mr. T. Hogg, that there is head enough of water at the lowest water mark to generate at least 1,600 horsepower. And this is only at the lowest ebb. Normally there will be a generative potentiality of about 2,500 horsepower, and in the spring, fall and winter there will be over 4,000 horsepower to be drawn upon, and the latter amount would be constant for twelve months of the year.

▲—Regina, Sask.—Tenders will be received up till the 1st of October, 1913, for supplying equipment for powerhouse. Plans and specifications may be obtained from E. W. Bull, Superintendent of Light and Power Commission.

▲—Regina, Sask.—Tenders will be received up till the 25th of October, 1913, for supplying equipment for powerhouse. Specifications may be obtained from E. W. Bull, Superintendent of Light, Heat and Power Department.

Saskatoon, Sask.—Following a conference between J. T. Johnstone hydraulic engineer for the Dominion Government and the City Commissioners, it is understood that the government will be requested to send experts to Saskatoon to investigate one or more sites from which it is considered cheap power could be obtained. The site most favored by Mr. Johnstone, it is understood, is one in the vicinity of the forks.

Souris, Man.—At a meeting of the Town Council recently, it was decided to immediately call for tenders for the electric light plant. A special meeting will likely be held shortly for the purpose of purchasing poles for the immediate construction of the system. It is expected the system will be in operation before Christmas. Already a large number of residences and business places are being wired. A twenty-four hour light and power service will be furnished from the start.

South Vancouver, B.C.—Reports on the construction of a municipal electric lighting plant and a municipal gas plant have been prepared, and when the council convenes, Reeve Kerr will bring them to the attention of the councillors. An electrical engineer of some experience in electric light plants was engaged by the council to report on the feasibility of constructing a plant in the municipality. He also compiled figures of cost, with the intention of informing the council whether it is possible to build a plant in South Vancouver and supply ratepayers with electric light at cheaper rates than those given by the B.C.E.R.

Toronto, Ont.—Tenders will be received up till the 23rd of September, 1913, for supplying fire alarm boxes, ten-circuit protector board, one eight-circuit storage battery board, one motor generator set, three full joker sets, copper wire, etc. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

GARBAGE, SEWAGE AND WATER.

Fort William, Ont.—Tenders will be received up till the 15th of September, 1913, for laying water mains on Island No. 2, across Mission River, and hauling cast iron water pipe. Plans and specifications may be obtained from A. McNaughton, city clerk.

+—Edmonton, Alta.—Willis Chipman, Toronto, who has been appointed by the city of Edmonton as consulting engineer, has reported regarding the waterworks situation. In an interview, Mr. Chipman intimated that work would not be started until 1914 on the new filtration plant, for which the contract has been let to the NEW YORK CONTINENTAL JEWELL FILTRATION COMPANY, who were the lowest bidders. Mr. Chipman opposes the plan to "scrap" the existing plant, which was installed by the Roberts Filter Manufacturing Company some years ago. It is not a covered plant and therefore cannot be used in the winter, but aside from this fact Mr. Chipman considers the existing plant quite satisfactory, although not having sufficient capacity to supply all of the city's present requirements. It will likely be used in conjunction with the new plant.

Medicine Hat, Alta.—Recently in testing the western final sedimentation basin, City Engineer Grimmer reports, it was found that the floor of the same cracked and to date the exact cause of this has not been determined. A detailed report of this matter will be submitted to the council at an early date.

Moose Jaw, Sask.—A report has been submitted to the City Council meeting as to the condition of the sewage disposal plant. The report stated that for the first time in the history of the works two motors were in operation this month, and that while they had been shut down for repairs, the operation was approved by the Provincial Inspector. In spite of this Government endorsation as to the merits of the plant in its present capacity, however, the report recommended that the matter of new filtration beds be at once attended to as they were required.

New Glasgow, N.S.—Town Council intends to award a contract for the construction of 6,000 lineal feet of sewer, most 24 in. and 36 in., in diameter, as soon as plans and specifications are finished. D. F. McLeod, town engineer.

North Vancouver, B.C.—Steps to greatly increase the water supply have been taken by the city officials who recently made an extensive inspection trip up Lynn Creek, with the result that two available lakes were found and the water rights on one of them staked on behalf of the municipality. Those who made the trip were:—Mayor Haynes, Aldermen Wheeler, Vance, Williams, Kennedy, City Engineer West and Waterworks Superintendent George Grant. The party secured valuable data for use in planning an increased water supply for future residents of North Vancouver and vicinity.

Ottawa, Ont.—The City Council have received the following tenders in regard to the relaying of the new intake pipe: General Supply Company, $7,952; Campbell Steel and Iron Company, $4,740; Drummond McColl Company, Montreal, $3,450; Loomis, McBain and Williams, Montreal, $6,989. These were referred to City Engineer Currie for report.

South Vancouver, B.C.—In consequence of the criticism of South Vancouver's water supply recently made at ratepayers' meetings and in the press, Water Superintendent Mullett has had samples of water from each of the municipal wells and springs analysed at the government laboratory, Victoria, by Dr. E. Whittaker, the government analyst. Dr. Whittaker reporting on the water from the C.P.R. springs states:—"Both of the above waters are of good quality, being free from animal contamination, and practically free from decomposed vegetable matter. For domestic purposes you could not wish for a better water."

Stamford Township, Ont.—A by-law will be submitted to the ratepayers for the expenditure of $10,000 for waterworks.

Victoria, B.C.—Mr. R. H. Thomson, to whom was referred the plans for the proposed northwestern sewer system, will present his report to the city council shortly. The plans were prepared by City Engineer Rust in conjunction with the engineer of Esquimalt and South Saanich, but the council some time ago decided that Mr. Thomson's expert knowledge should be taken advantage of and his opinion of the proposed scheme as planned, be obtained. Mr. Thomson has been at work on the plans for some time, and his report has been impatiently awaited, as members of the council are anxious that the work, which will give employment to a large number of men, should be started at the earliest possible moment.

▲—Winnipeg, Man.—Tenders will be received up till the 17th of September, 1913, for the construction of 1,150 feet of 24 in. sewer in the municipality of Kildonan. Plans and specifications may be obtained from Mr. F. Hill Parr, Winnipeg and H. Thompson, secretary-treasurer.

+—Winnipeg, Man.—The Board of Control has awarded DRUMMOND McCALL AND COMPANY, Ltd., Montreal, the contract for supplying two 18 in. gate valves, one 30 in. gate valve and three 36 in. gate valves. These will be used for connections to the new 18,000 gallon reservoir.

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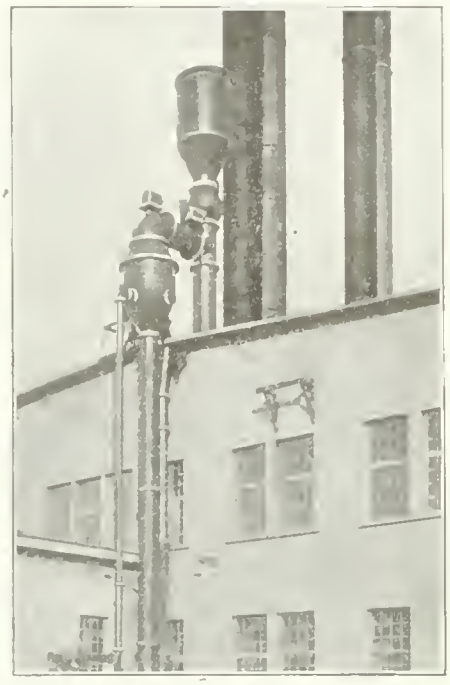

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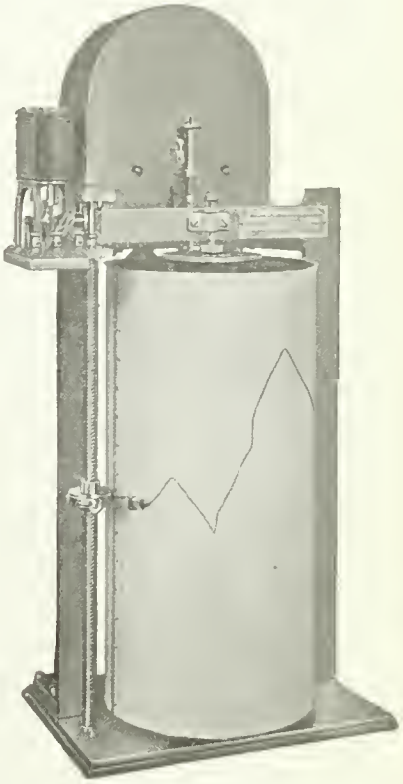

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Winnipeg, Man.—Winnipeg City Council have passed a by-law calling for an expenditure of $13,000,000, for the construction of a water system from Shoal Lake. Voting will take place on this by-law October 1.

Winnipeg, Man.—Secretary Morse, of the Winnipeg Electric Railway denies the report published last week that a contract had been awarded to J. G. White and Company, of New York, for a new power plant on the Winnipeg River. The report is also denied by J. G. White and Company at their New York office. The Winnipeg company is negotiating with the Reese interests for their rights on the Winnipeg River, but no contract has been let as yet for a new plant.

Winnipeg, Man.—Engineer Parr, of Kildonan, was instructed by the council at the meeting recently to prepare plans for a system of waterworks and sewers for the entire municipality. This work will involve the appointment of a consulting engineer.

INDUSTRIAL WORKS.

+—**Chiticamp, N.S.**—The Dominion Government has awarded the NORTHERN DREDGING COMPANY the contract for dredging required here. The contract price is $15,000.

+—**Hants Point, N.S.**—The Dominion Government has awarded the STANDARD CONSTRUCTION COMPANY the contract for the construction of an extension to the wharf. The contract price is $18,685.

+—**Kamloops, B.C.**—The Canadian Pacific Railway has awarded the REID, TODD CONSTRUCTION COMPANY the contract for the construction of a tunnel under the company's tracks here.

Medicine Hat, Alta.—The Gilbert Hunt Company, of Walla Walla, Wash., will locate a large plant here for the manufacture of threshing machines, roller feed mills and farm machinery, according to a statement made by Gilbert Hunt, head of the firm, who arrived here two weeks ago, after an extensive tour of the west.

+—**Montreal, Que.**—The Dominion Government has awarded MESSRS. QUINLAN & ROBERTSON the contract for rebuilding the head of the Grand Pier in the Soulanges Canal. The contract price is $24,238.

Nicolet, Que.—Tenders will be received up till the 15th of September, 1913, for the construction of a jetty. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

New Westminster, B.C.—Tenders will be received up till the 15th of September, 1913, for dredging required at the mouth of the Fraser River. Plans and specifications may be obtained from the Department of Public Works, New Westminster. C. C. Worsfield, district engineer.

+—**Ottawa, Ont.**—The Dominion Government has awarded MESSRS. M. J. O'BRIEN and HUGH DOUGHNEY the contract for Section 3 of the new Welland Canal. The contract price was for approximately ten million dollars. There were ten tenders under consideration, including two British and two American firms. Work will be started at once by the successful tenderers, who will make Thorold their headquarters. The contract calls for the completion of the work by April, 1917.

+—**Ottawa, Ont.**—The Dominion Government has awarded the YORK CONSTRUCTION COMPANY, Toronto, the contract for the Severn Division of the Trent Canal. The contract price was $130,278.

Ottawa, Ont.—Having cleared the decks of routine business upon his return from the west, Hon. Robert Rogers has taken up matters which claimed his attention during the trip. These matters include the making and improvement of a number of lake and ocean harbors. He has issued instructions to the engineering corps to draft plans for the greater improvement of the harbors at Port Arthur and Fort William, and at several other harbors on Georgian Bay, as well as at Toronto, Montreal, Halifax and St. John. Immense drydocks will be constructed at Esquimalt, Vancouver and Victoria. The expenditures in connection with the proposed works will total at least $100,000,000, and probably exceed that figure. It is apparently the intention of the Government to make the most of opportunity to develop the trade of Canada, and as the Minister of Public Works, a large portion of the burden of providing the facilities for handling the trade, falls upon Mr. Rogers, who is acting in conjunction with the Minister of Railways and Canals and the Minister of Marine and Fisheries.

Ottawa, Ont.—A hitch has arisen in the tenders for the big harbor works scheme at Toronto, in connection with the mode of making the deposit, and it may be necessary to call for new bids.

Petite Riviere Est., Que.—Tenders will be received up till the 7th of October, 1913, for the construction of a breakwater. Plans and specifications may be obtained from District Engineer J. T. Bertrand, Esq., of Isle Verte, Que., and J. C. Tache, Rimouski, Que., and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—**Rainy River, Ont.**—The Dominion Government has awarded Mr. J. T. HORNE the contract for the dredging required here. The contract price is $29,250.

+—**Regina, Sask.**—The City Council has awarded the STEEL FOUNDRIES, LIMITED, the contract for supplying four derail switches for use on the street railway crossings over the steam roads. The contract price is $1,440.00.

+—**Regina, Sask.**—The City Council has awarded Messrs. PEARR BROS. the contract for the reinforcement materials to be used in the walls and foundations of the new power house. The contract price is $5,400.

Regina, Sask.—The City Council passed a by-law recently authorizing the issue of treasury notes to the amount of $249,278.75, the amount of local improvement by-law No. 713. This issue of treasury stock will be put upon the market at once, and will bring the amount of outstanding treasury stock up to about $750,000.

+—**Sault Ste. Marie, Ont.**—The Dominion Government has awarded the SOO DREDGING AND CONSTRUCTION COMPANY the contract for dredging the channel between Goat Island and Little Current to a depth of 22 feet. The contract price is $90,000. This will enable the largest freighters on the lakes to dock at Little Current and it is probable that the dredging is but the first part of a big programme of terminal facilities at that point.

Sparrows Point, Md.—The Maryland Steel Company has awarded the contract for the foundations for a Bessemer mixer and Bessemer mixer building to the RAYMOND CONCRETE PILE COMPANY, New York.

St. Catharines, Ont.—Chief Engineer Weller stated that tenders for No. 2 section of the Welland Ship Canal, extending from the fourth concession line in Grantham township to near Thorold, the northerly boundary of No. 3 section, would be called for within a week. Three weeks later No. 4 section, south of Thorold, with heavy rock excavation, will be ready for the call.

St. Catharines, Ont.—Farmers residing on property expropriated by the Dominion Government, on section number two of the Welland Ship Canal, tenders for which will be called for this week, have been notified to vacate the route land by October 1.

+—**St. John, N.B.**—The council has awarded ROBERT ROBERTS' SONS the contract for the reconstruction of the ferry wharf. The contract price is $9,800.

+—**Swift Current, Sask.**—The AMBURSEN HYDRAULIC CONSTRUCTION COMPANY, Montreal, has been awarded the contract for the construction work on the new dam across the Swift Current River. This dam, when completed, will make a natural reservoir, which will conserve at the lowest estimate, 100,000,000 gallons of water, or sufficient to supply a city having a population of at least 25,000. While the location of the reservoir is such that by dredging the capacity can be increased to almost any amount.

Walkerville, Ont.—The ratepayers of the town have voted favorably on a by-law calling for the expenditure of $16,234 for the construction of an incinerator plant.

+—**Winnipeg, Man.**—The Board of Control has awarded the LINDE CANADIAN REFRIGERATION COMPANY, Montreal, for the contract for supplying a motor-driven refrigerating plant and refrigerator boxes for King Hospital. The contract price is $12,470.

MISCELLANEOUS.

+—**Amherst, N.S.**—The Dominion Government has awarded RHODES CURRY, LIMITED, the contract for the erection of the new armory building. The contract price is $81,100.

+—**Brooklyn, N.Y.**—The RAYMOND CONCRETE PILE COMPANY, of New York, have been awarded the contract for placing concrete piles for the foundations of St.

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Calgary, Alta.—The Armour Packing Company, of Chicago, will erect a plant in this city. The estimated cost is $300,000.

+—Cobalt, Ont.—The Town Council has awarded Mr. F. R. GIBSON the contract for heating, plumbing and wiring of the new town hall.

+—Edmonton, Alta.—MESSRS. G. H. ARCHIBALD AND COMPANY have been awarded the contract for the erection of an office and store building. The contract price is $150,000.

+—Edmonton, Alta.—Messrs. Nicholson and Bain have awarded FYSHE, McNEILL, MARTIN AND TRAINOR, Ltd., Calgary, the contract for the erection of a large warehouse. The contract price is $70,000.

Edmonton, Alta.—Tenders will be received up till the 15th of September, 1913, for supplying coal for the Government buildings. Plans and specifications may be obtained from the Department of Public Works, Edmonton. John Stocks, Deputy Minister.

+—Elmira, Ont.—The Dominion Government has awarded Mr. E. A. BLEAKNEY, Gananoque, the contract for the erection of a post-office. The contract price is $35,000.

Halleybury, Ont.—Tenders will be received up till the 15th of September, 1913, for the erection of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy-Minister.

Lambton, Ont.—The county has in consideration additions to court house that will cost approximately $20,000, and has issued bonds for that amount.

+—Le Pas, Man.—The Marconi Telegraph Company has awarded MESSRS. COYLE AND HUGHES, Winnipeg, the contract for the erection of a wireless station. The contract price is $75,000.

London, Ont.—Mr. John Griffin, Toronto, will erect a new play-house in this city. The estimated cost will be $100,000.

Montreal, Que.—The Lachine Council have decided to go on with work on civic improvements which had, for lack of funds, been suspended. The municipal bonds have found a market, and the town is now in a sound financial position. The council gave instructions to have plans drawn up for the extension of the power house and the roofing of the market place. The Mayor was requested to protest against the laying of gas pipes by the Montreal Light, Heat and Power Company, this being done in such a manner, it was stated, as to render likely damage to the corporation water pipes. A permit was granted to the Imperial Oil Company to erect an oil tank in Parc Descarries.

+—Nelson, B.C.—MESSRS. JAS. DANCY AND COMPANY have been awarded the contract for the additions to the Nelson Hotel.

Newport, B.C.—Tenders will be received up till the 26th of September, 1913, for the erection of a police building and lock-up. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffith, Public Works Engineer.

+—New Westminster, B.C.—The Dominion Government has awarded MESSRS. SLOAN AND HARRISON the contract for building an addition to the Government's building here. The tender was for $48,000, but the structure will cost altogether about $60,000. The building will be three stories high, with a basement, on a ground space of 32 by 54.

Ottawa, Ont.—Plans are under way for Toronto's new post-office building, which, it is estimated, will cost in the neighborhood of $2,000,000. Tenders for the new custom house will shortly be advertised. The federal square idea has gone by the board owing to the expense involved in expropriation.

+—Ottawa, Ont.—The Dominion Government has awarded the BARNETT McQUEEN COMPANY, Ltd., of Winnipeg and Fort William, the contracts for the internal storage elevators to be erected at Saskatoon and Fort William. Each of the elevators will cost almost one million and Barnett McQueen Company was the lowest of the four tenderers by nearly three hundred dollars. The successful company has just completed the erection of the Government terminal elevator at Port Arthur and the work has met with the approval of the Grain Commission. Contracts call for the completion of the elevators by December 15, 1914, which will be in time to assist in storing the crop next year. As they each have a capacity of three and a half million bushels, this will greatly add to the storage capacity. If necessary, these elevators can be increased to 20,000,000 capacity each.

Ottawa, Ont.—Plans and specifications have been submitted by the Harbor Commission of Montreal to the Marine Department for two new freight sheds at sections 24 and 25 of Montreal Harbor, at a cost of $300,000. Shed No. 24 is to be 275 feet long and 106 feet wide and two stories high, and shed No. 25, 485 feet long and 112 feet wide and also two stories high. The foundation alone will cost $100,000 and will be laid this year, while the general construction will take place in the early spring and will be available for business next navigation season

Port Arthur, Ont.—Tenders will be received up till the 18th of September, 1913, for the interior fittings of a post-office. Plans and specifications may be obtained from Mr. J. A. Hastings, Toronto, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Prince Albert, Sask.—The Bank of Commerce has awarded ROBT. CLUNIE the contract for the erection of a bank building. The contract price is $30,000.

Prince Albert, Sask.—The Imperial Oil Company will erect a warehouse here. The estimated cost is $16,000.

+—Red Deer, Alta.—The Dominion Government has awarded MESSRS. NESBIT AND MILLER the contract for the construction of an armoury. The contract price is $36,000.

+—Regina, Sask.—The W. G. Downing Company has awarded Mr. THOMAS BARNARD the contract for the erection of a warehouse. The contract price is $45,200.

Regina, Sask.—Nearly 20 delegations from all parts of the province waited upon the Hon. Dr. Roche, Minister of the Interior, during his stay here. Various requests were presented, but the bulk of them consisted of applications for the erection of public buildings in different districts. Almost the entire day was taken up with their reception and the Minister had few leisure moments during his visit. He left for the east on Saturday night.

Saskatoon, Sask.—The Saskatchewan Abbatoirs, Limited, with head office here, will shortly erect a plant here. The company is capitalized at $200,000, and has just been successful in buying out the Northern Packing and Cold Storage Company, of Prince Albert.

Sorel, Que.—Tenders will be received up till the 18th of September, 1913, for supplying 20,300 cubic feet of white pine logs. Specifications may be obtained from the Department of Marine and Fisheries, Ottawa. Alex Johnston, Deputy Minister.

+—South Edmonton, Alta.—The Canadian Northern Railway has awarded Mr. GEO. McLEOD the contract for the erection of a station and freight sheds. The contract price is $40,000.

+—Toronto, Ont.—The PETER LYALL & SONS CONSTRUCTION COMPANY, of Montreal, have been awarded the contract for the erection of express offices and sheds, corner Simcoe and King Streets.

Toronto, Ont.—The Government has cancelled the contract for the building of the new barracks at Long Branch, Toronto. Michael Sullivan, of Kingston, the successful contractor for the erection of the proposed barracks, has received back his cheque for $65,000.

Vancouver, B.C.—Tenders will be received up till the 19th of September, 1913, for supplying the interior fittings for postal station "B." Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Vegreville, Alta.—The Dominion Government has awarded Mr. A. E. JENNINGS the contract for the erection of an armoury building. The contract price is $15,000.

Victoria, B.C.—Tenders will be received up till the 24th of September, 1913, for the construction of an addition to the public building. Plans and specifications may be obtained from Mr. Wm. Henderson, Victoria, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—Winnipeg, Man.—The Dominion Government has awarded MESSRS. JACKSON & GOLDIE, LIMITED, the contract for supplying thirty additional targets for the Rifle Range. The contract price is $19,500.

+—Winnipeg, Man.—The Adanac Club has awarded the NATIONAL CONSTRUCTION COMPANY the contract for the erection of a club building. The VULCAN IRON WORKS were awarded the contract for the steel work. The building will cost $50,000.

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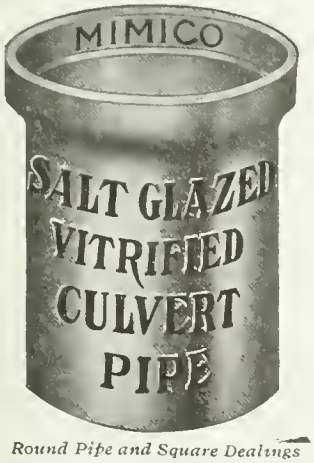

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EXTENSION OF TIME.

TENDERS FOR MACHINERY.

TOWN OF NEEPAWA, MAN.

Sealed tenders will be received up to noon September 12th, 1913, for machinery for additions to the power plant at Neepawa, as follows:—

Specification Section No. 1— 2 72 ft. by 18 ft. boilers.

Specification Section No. 2—1 187½ h.p. engine.

Specification Section No. 3—1 150 K. V. A. generator exciter and switchboard.

Specification may be obtained by applying to W. E. Skinner, Limited, Consulting Engineers, 204 Sterling Bank Building, Winnipeg, or to the undersigned, or may be seen at the offices of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg; 62 Church Street, Toronto, or 628 Transportation Building, Montreal.

J. W. BRADLEY,
Secretary-Treasurer, Neepawa, Man.

TENDERS.

RURAL MUNICIPALITY OF KILDONAN.

Sealed tenders addressed to the Reeve and Council will be received at the office of the undersigned up to 12 noon, on Wednesday, the 17th September, 1913, for the construction of 1,150 feet of 24 in. sewer on Ferry Lane, West Kildonan.

Plans, specifications etc., may be seen, and forms of tender obtained from the Engineer, Mr. F. Hill Parr, 215 Chambers of Commerce, Winnipeg.

The Council do not bind themselves to accept the lowest or any tender.

By Order,
H. THOMPSON,
Secretary-treasurer.

215, Chambers of Commerce, Winnipeg,
September 4th, 1913.

CAYUGA, ONT.

Sealed tenders will be received up to noon on the 16th day of September, 1913, by the undersigned at Cayuga, Ontario, for the construction of twenty-six and one-half miles of stone macadam road in the county of Haldimand.

The work will be let in three separate and distinct contracts, not necessarily to the same individual.

Tenderers are required to examine the localities of the work and are requested to be present at the opening of the tenders at 2 p.m., on Wednesday, the 17th day of September, 1913.

Plans and specifications may be seen at the office of the County Engineers, Messrs. Jackson and Kyd, Dunnville, or may be had from them on the payment of $10, which sum will be refunded on return of the documents.

Lowest or any tender not necessarily accepted.

T. A. SNIDER, K.C.,
County Clerk,
County of Haldimand,
Cayuga, Ont.

CITY OF REGINA, SASK.

Sealed tenders, registered and clearly marked on the outside of the envelope "Tender for Power-House Equipment," and addressed to the City Commissioners at Regina, Sask., will be received up till noon of October 1st, 1913, for the supply of:—

Coal bunkers, ash hoppers, coal and ash conveyers and crushers.

Price to be on equipment erected on foundation built by the City of Regina according to contractor's requirements.

A marked cheque for 5 per cent. of the amount of the bid, and made payable to the City Treasurer, City of Regina, must accompany each tender.

Specifications may be obtained from E. W. Bull, Superintendent of Light and Power, Regina, Sask.

The City Commissioners reserve the right to reject any or all tenders.

CITY OF REGINA, SASK.

Sealed tenders, registered and clearly marked on the outside of the envelope "Tender for Power-House Equipment," and addressed to the City Commissioners, Regina, Saskatchewan, will be received up until noon of October 25th, 1913, for the supply of:—

One 3,000 k.w. steam turbine, with condenser.

One 25-ton capacity, hand power crane for 45-foot span.

Specifications may be obtained from E. W. Bull, Superintendent of Light and Power Department, Regina, Saskatchewan.

A marked cheque for 5 per cent. (five per cent.) of the amount of bid must accompany tender.

The City Commissioners reserve the right to reject any or all tenders.

NEW INCORPORATIONS.

Blairmore, Alta.—Blairmore Coal Lands, $500,000.

Orono, Ont.—Pioneer Threshing Company, $10,000. E. N. Armour, E. MacMahon, R. S. Anderson.

Dundas, Ont.—Tocan Manufacturing Company, $250,000. A. C. Caldwell, W. A. Welsh, T. J. Palmer, both of Hamilton.

Ottawa, Ont.—Flexible Railway Supply Company, $1,000,000. C. Forth, D. Blair, G. H. Ferguson, Kemptville. The Grand Central Hotel of Ottawa, $40,000. E. J. Daly, J. P. Ebbs, W. N. Graham.

Montreal, Que.—Southern Canada Power Company, $3,000,000. C. H. Cahan, O. B. MacCallum, M. Lewis. Valley Construction Company, $250,000. A. D. Gall, R. B. Hutchinson, both of Westmount, L. Gosselin.

Toronto, Ont.—Pecol Drilling Company, $500,000, and 30 companies of $75,000 capital each; the provisional directors of all 30 companies are:—A. P. Poussette, A. A. Dickson, both of Toronto, S. Hogarth, of London, England.

Calgary, Alta.—Calgary Flour Mills, $5,000,000. W. C. Robertson, A. deB. Winter, F. A. McAllister. Hawk Eye Crushed Rock and Gravel Company, $20,000. J. B. Anderson, Lumber Company, $25,000. Murray's Limited, $30,000.

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Adelaide Street West, Toronto, Ont., paved with Mexican Eagle Asphalt.

The principal streets in Toronto—both residential and business streets—are paved with sheet asphalt. The city has over 157 miles of this type of pavement, and has also laid some asphaltic concrete. The first sheet asphalt in Toronto was laid in 1887. The total cost of maintenance per square yard for the past 10 years has averaged less than 5½ cents a year. Toronto's experience with asphalt has been that it requires no repairs for the first 5 years and that it requires extensive repairs only after 10 years' wear.

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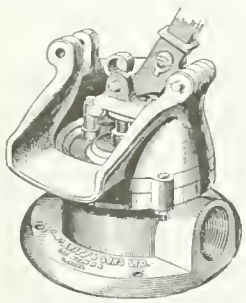

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Especially adapted for use by contractors, pumping out excavations, cellars, trenches or sewers, discharging water containing sand, gravel, mud or any semi-fluid substance.

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20 H.P. GASOLINE or KEROSENE I.H.C. Tractor; nearly new; perfect condition; $1,450. Arnold Forster, Newcastle, Ont.

FOR SALE.—One second-hand Marion steam shovel; model 20; has seen very little service and is in fine repair. Also one second-hand Marion shovel; model 30; revolving; in good repair. Low price for immediate sale. Address, R. B. Stewart, Whitby, Ont.

FOR SALE OR RENT.—10-ton Ruston-Proctor Compound Road Roller, brand new. F. C. Schulte, 8 Merriman Block, St. Catharines, Ont.

CURRENT NEWS.

San Francisco, Cal.—The San Francisco firm that obtained the contract for the two great floating caissons to be used at the entrance to the Panama Canal received orders to begin work on one of the big gates. The cost of constructing the caissons will be $400,000, and it will take 200 men a year to build it. The gate will be 113 feet long, 36 feet in beam, and 65 feet in depth. It will have a draft of 61 feet and will weigh about 10,000 tons. The two entrance gates are designed for use in case it is found necessary to close the canal to make repairs on the ocean sides of the first locks.

Port Arthur, Ont.—In connection with the visit to Port Arthur of M. H. McLeod, general manager, and other Canadian Northern Railway officials from the west, it is stated that the railway company will shortly negotiate with the Western Dry Dock and Shipbuilding Company for the building of two mammoth passenger lake liners, both of which, it is stated, would be larger than the Noronic. It is well known that the Canadian Northern will have to acquire a line of lake passenger steamers in order to compete with the Canadian Pacific and the Grand Trunk Pacific. The through C.N.R. transcontinental will be in operation next year, and all that will be lacking to surround the Canadian Northern with the prestige enjoyed by its competitors will be a steamboat line.

The National Paving Brick Manufacturers' Association's tenth annual meeting in Cleveland, O., on September 17th and 18th, will be marked by a paving conference which will attract city engineers and other officials and paving contractors from all parts of the country. The meeting will be exceedingly important in that it will bring together for the first time engineers from the leading cities of the country and almost the entire body of paving brick manufacturers. It will afford the engineers and paving brick manufacturers an excellent opportunity to discuss their problems on common ground. Both Cleveland and Cuyahoga County are adding largely to their mileage of brick pavements this year, and opportunity will be accorded to witness brick pavement construction in every detail from grading to grouting. The mornings of the 17th and 18th will be devoted to the business sessions of the Association. There will be no formal papers at the banquet to be held on the evening of September 17th, but full opportunity will be given to the visiting engineers to discuss what they have seen. At the last annual meeting the decision was reached to hold future conventions of the Association during a season of the year when brick road construction methods could be viewed in actual progress. Many engineers and contractors have written the Association that they are looking forward with much interest and pleasure to a personal inspection of the thousand miles of city streets and country roads of Cleveland and Cuyahoga County of which they have read and heard.

The September meeting of the Canadian Railway Club was held in Montreal on September 9th. A paper, entitled "Railway Efficiency," was read by Mr. A. Crumpton, Assistant Engineer of the Grand Trunk Railway. Election of officers to fill chairs made vacant by the resignation of Messrs. C. Murphy and D. Cromby also took place.

The Canadian Manufacturers' Association is holding its convention this year in Halifax, September 16, 17 and 18. Meetings will be held in the Technical College. The programme includes a number of outing trips of interest. The business of the convention will be dispensed with on Wednesday and Thursday.

Special Wire Goods for Engineers, Contractors and Manufacturers

FOR FURTHER INFORMATION WRITE US; OR SEE OUR LARGE ADVERTISEMENTS IN LAST WEEK'S AND NEXT WEEK'S ISSUE OF THIS PAPER

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But the man who does the best work insists upon getting "Canada" Portland Cement—

And he looks to see that every bag bears this label

To specify Canada Portland Cement, is to introduce an additional safety factor into your calculations. Architects, contractors and engineers know the value of "making assurance doubly sure."

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Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

CEMENT TESTING ASSISTANT—wanted immediately. Dominion Engineering and Inspection Company, 479 Wellington West, Toronto.

DRAFTSMAN; first-class mechanical man wanted with industrial or power plant experience, piping, etc. State age, experience, salary and when at liberty, Box 128, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DO YOU NEED MALE HELP.—Canadian or foreign labor furnished for all classes of work, skilled or unskilled, for office, construction work, waterworks, paving, dams, and wharves. We can put men on the job for you cheaper than you can get them any other way, write or phone for particulars to O'Donnell's Employment Bureau, 116 Wellington Street West, Toronto. Phone Adelaide 3919.

MECHANICAL ENGINEER—Experienced Designer, Cost Estimator and Salesman, Works Supervision, all kinds of steam engines, boilers, hydraulic pumps, air machinery and mining plants, seeks position with Consulting Engineer, Contractor, Manufacturers or agency business. Highest references, some capital. Box 102, *The Canadian Engineer*, Toronto.

SUPERINTENDENT SEEKS re-appointment on heavy work, experienced in big plant, steam shovel work, rock, hardpan, concrete, etc. Highest references. Box 110, *The Canadian Engineer*, Toronto.

YOUNG CANADIAN ENGINEER.—Experience, paper mill, electric substation, hydraulic power plant, field and office, wishes to get in touch with a manufacturing concern requiring the services of a permanent resident engineer or plant chief; superior references. Address Box 112, *The Canadian Engineer*, Toronto.

YOUNG ELECTRICAL ENGINEER desires position either as consulting or plant engineer; first-class character and education; one who will take an interest and make good. Box 114, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

SUPERINTENDING ENGINEER of construction now free to accept appointment. Large experience on public works, with specialty in tunnelling. Unexceptional references. Nine years' U.S.A. experience. Address T. H. D., Bartram & Wadsworth, Bank of Toronto Building, Toronto.

EXPERIENCED MUNICIPAL ENGINEER and Land Surveyor desires position. Ten years' experience in municipal engineering, two years as superintendent of construction; also experience in construction of concrete bridges and buildings, railway and land surveys and drainage works. Toronto graduate; O.L.S. seven years, A.M. Can. Soc. C.E. five years. Engagement of three to six months' duration acceptable; at present in the West. Address Box 122, *The Canadian Engineer*, Toronto.

CIVIL ENGINEER; broad experience in the design of reinforced concrete buildings; can take off quantities for all classes of fireproofing; now employed wishes a change, can start on short notice. Best of references from England, United States and Canada. Knows English and French. Salary moderate. Box 126, *The Canadian Engineer*, Toronto.

CIVIL ENGINEER (40) with 18 years' experience in railway exploration and location, surveys, construction and maintenance, concrete foundations and bridge erection, at present engaged, will be open for employment about October 1st. Please reply Box 130, *The Canadian Engineer*, Toronto.

STRUCTURAL ENGINEER. Experienced in design; field and shop practice in structural steel and reinforced concrete, seeks technical commercial position. Address Box 132 *The Canadian Engineer*, Toronto.

ENGINEER, MECHANICAL and structural, desires responsible position, or would take an appointment as municipal or reinforced concrete engineer. Ten years' experience and very good technical education. Place of appointment no object. Apply to Box 134, *The Canadian Engineer*, Montreal.

SUPERINTENDENT, hustler, who gets results, wants position. Reinforced concrete, bridge or power plant. Just completed big bridge in Ottawa, Canada. Address E. A. F., 8 Clinton Street, Gloversville, N.Y.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

ENGINEERS' AND CONTRACTORS' Reinforced Concrete Screw Piles—important Canadian and American patents for license or sale, enquiries invited. Helical Reinforced Concrete Screw Syndicate, 40 Commercial Road, Portsmouth, England.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 128031, granted on September 6th, 1910, to Konrad Victor von Meyenburg, of Baske, Switzerland, for tiller, may do so upon application to the undersigned, who are prepared to supply all demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Co., 53 Queen Street, Ottawa, Canada, Russel S. Smart, resident.

ELECTRIC FURNACE.—The proprietors of Canadian Letters Patent No. 134,772 of 1911, are prepared to sell, or license Canadian manufacturers to work in Canada, this patent, which relates to a furnace to be used for the refining of steel or for other refining or smelting operations. Address. International Acheson Graphite Co., Niagara Falls, Ont.

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Great Britain.—Bark and Smyth, tellurians.

Norway.—Frank W. Prentice, railway control system.

Canada.—Thos. Rigby, methods and apparatus for gathering and transporting peat; Thos. Rigby and Nils Testrup, processes for the utilization of peat; Sydney E. Tout, locomotive pilots and foot boards; Henry Crookes, production of metal colloids; George J. Ogden, thermostats; E. Servais, methods of generating producer gases; John E. Snider, corsets; Spalteholz and Haring, manufacture of leather, Samuel Aikens, door knobs; Robt. W. Silversides, rug and carpet making machines; Herbert L. Roberts, street indicating devices; John M. Simpson and Joseph E. Wilkinson, knotters for harvesting binders.

THE FOUNDATION COMPANY
LIMITED

MONTREAL VANCOUVER

BRIDGE FOUNDATIONS

NEWCASTLE BRIDGE
OVER THE MIRAMICHI RIVER, N.B.

At a point where the Miramichi River is approximately 1400 feet wide, varying in depth from 35 to 45 feet, it was decided to build this new highway bridge.

Borings showed some 25 feet of soft silt overlying strata of clay mixed with sand and gravel extending to considerable depths.

Five caissons are to be sunk to depths varying from 45 to 55 feet below water level, where firm clay is reached, piles then being driven and cut off at this depth and concrete deposited.

The above shows our forces at work on the construction of the five piers and two abutments.

MARKET CONDITIONS

Montreal, September 6th, 1913.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in., $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No 1 Summerlee, $22.50 per ton, selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths. X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. of for galvanized; 3½-inch, $95; 4-inch, $1 08.

Toronto, September 10th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1¼-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $13 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm

Copper Ingot.—The market is lower at 15¾ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound. 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ¼ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1¼ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 5c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 5c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1¼-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $6; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.25 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.85
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6 50	25.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1¾ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jewett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, September 9th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10½ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ¾, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 24 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

Volume 25. Toronto, Sept. 18, 1913

Contents of this issue on page 469

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

THE WATER LEVEL OF LAKE ERIE

REPORT OF THE INTERNATIONAL WATERWAYS COMMISSION ON THE VALUE OF COMPENSATING WORKS IN THE NIAGARA RIVER —A SEQUEL TO 1910 REPORT AGAINST ATTEMPT AT REGULATION

THE International Waterways Commission, the duties of which, when instituted in 1902, included an investigation into the advisability of locating a dam at the outlet of Lake Erie with a view to determining whether such a dam would benefit navigation, and, if the structure was deemed advisable, a report to the governments of Canada and the United States containing recommendations relative to the construction of of the same, and an estimate of the probable cost, has recently submitted its report.

Upon undertaking the work, the commission first divided it into two parts. It first investigated the advisability of regulating works to reduce the oscillation of the lake, thereby raising the low-water level but not affecting the high-water level. This part of the problem was reported upon in January, 1910, the commission finding that material improvement in regulation could not be accomplished except at the expense and to the injury of the channel below. In the case of Lake Erie it would be possible to raise the extreme low-water stage about 1 ft., and this in turn would raise the low-water stages of Lake St. Clair about 0.61 ft. and of Lake-Huron-Michigan about 0.27 ft., all without appreciable increase in the extreme high stages. But in doing this the low-water stage of Lake Ontario would be lowered about $4\frac{1}{2}$ in., the available depth in the St. Lawrence Canals would be diminished about $7\frac{2}{3}$ in., and the city of Buffalo would suffer by increased damage from floods and by a postponement of the date of opening navigation in the spring. The question of damage to vested rights was thus introduced. While the advantages of regulation might outweigh the disadvantages if the persons who were to benefit from the former were identical with those who were to suffer from the latter, the difference was not great enough to justify the two governments in entering upon the vexatious question of damages. The commission therefore recommended that the regulation of Lake Erie be not undertaken, meaning thereby the most complete practicable regulation such as can be secured by a dam and sluice gates located at or near Buffalo.

The second branch of their work, viz., the advisability of compensating works for raising the level at high as well as at low-water, without complete regulation, is the subject of a report under date of June 20th, 1913.

In July 3rd issue of *The Canadian Engineer* mention was made of the recommendations of the commission in this respect. A copy of the entire report has since been received, and we extract from it herewith.

As was stated in the former report, the Niagara River at its extreme upper end is an important safety valve for the protection of Buffalo from the effect of storms, and should not be obstructed by a dam, but it seemed possible that somewhere in the river, between Lake Erie and the Falls, a submerged dam might be placed which would greatly benefit the navigation of the waters above without injury to those below and with only minor damages, if any, to the adjoining lands. To determine this question it was necessary to make a complete survey of the Niagara River from Lake Erie to the Falls, including the topography of the adjoining lands. The survey was made by the commission. A survey was made also by the Canadian Government of the Welland River, in Canada, which enters the Niagara about a mile above the rapids approaching the Falls. A sketch upon a reduced scale, showing the Niagara River in outline, is shown in Fig. 1.

From a study of the maps it appears that the best site for a submerged dam, or weir, is just above the Welland River, extending from Hog Island, at the mouth of that river, to the mouth of Gill Creek, on the American side. As the Welland is a navigable stream, there would be some advantage in placing the weir below its mouth, but the survey of that river showed that a moderate increase in the height of its surface would submerge a considerable area of valuable land. To provide for the navigation of the Welland it is necessary to construct a lock at the Canadian end of the weir. The object of placing the weir as near as possible to the foot of navigation is to improve all of the navigable portion of the Niagara River above. A study of the topography on both sides of the Niagara River showed that the water surface at mean stage could be raised as much as 3 feet at the site of the weir without inflicting damage upon adjacent lands, except for a distance of about $1\frac{1}{2}$ miles immediately above the weir on the American side. At this place it is proposed to construct a levee of suitable height to protect the land from overflow.

The form to be given the weir has been the subject of careful investigation. In order to disturb as little as practicable the natural distribution of flow through the different parts of the cross-section of the river, the crest of the weir is broken into four sections, as shown in Fig. 2, the height given to each section being such as will raise

the surface of the water in that section 3 feet at mean stage.

A cross-section of the weir is shown in "A" of Fig. 3. This form was adopted after experiment with various types of weir made under as nearly as possible true river conditions. The experiments were made at the hydraulic laboratory of the college of civil engineering at Cornell University, which was generously placed at the disposal of the commission for the purpose.

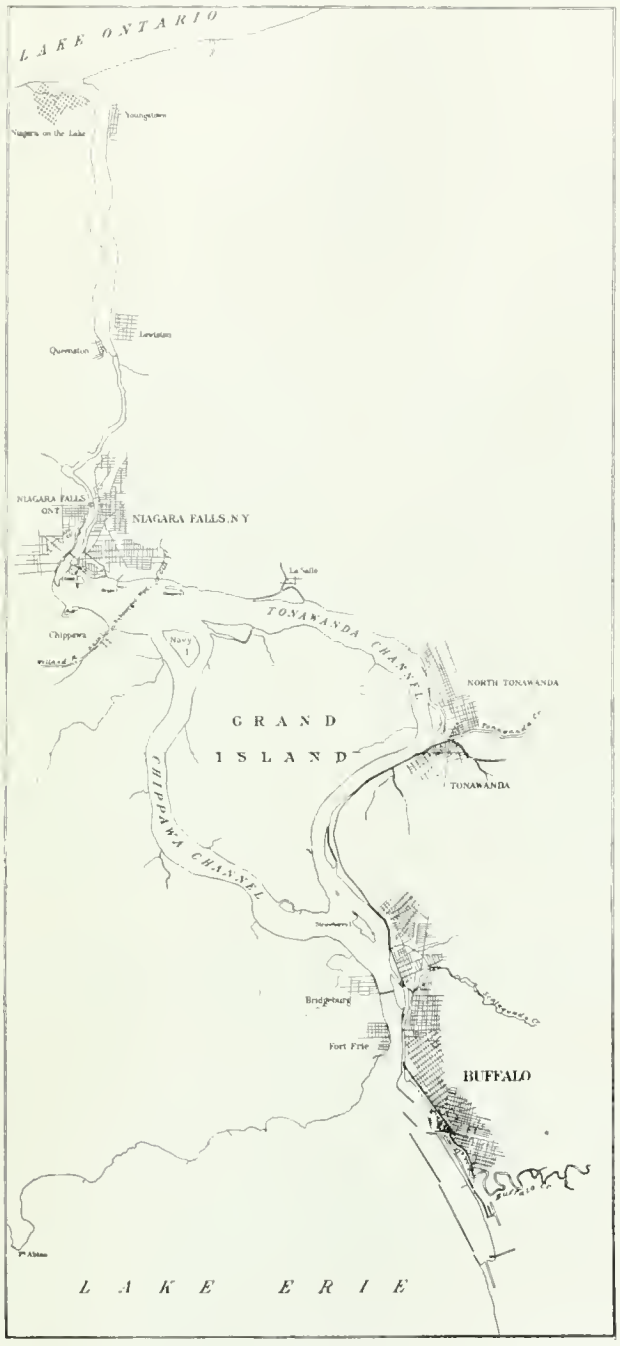

Fig. 1.—Niagara River, Showing Location of Submerged Weir.

The form of weir which was subsequently adopted fills the desired condition of high efficiency at high stages of the river and correspondingly the flow efficiency at low stages. The weir would raise the level of Lake Erie 0.51 ft. at extreme low stage, 0.39 ft. at mean stage, and 0.11 ft. at extreme flood stage. At low-water the surface of the Niagara would be raised 1.08 ft. at the Buffalo waterworks, 1.16 ft. at Strawberry Island, about 5½ miles from the lake, increasing to 3.05 ft. at Schossler's Dock, the foot of navigation. At flood stage these numbers are: For Buffalo waterworks, 0.19 ft.; for Strawberry Island, 0.12 ft.; and for Schossler's Dock, 0.91 ft.

The effect of raising the mean level of Lake Erie 0.39 ft. would be to raise Lake St. Clair's mean level about 0.23 ft., and that of Lake Huron about 0.09 ft.

To change the level of a great inland sea like Lake Erie, upon the shores of which are many populous cities, is a matter to be approached with caution. Any important increase in the height of the high-water level may cause serious damage to the wharves and low-lying lands. Care must be taken to avoid injury to vested rights. In this case, the ordinary high-water level is increased only 0.38 ft., or 4½ inches, and the extreme flood stage at Buffalo is increased only 0.11 ft., or 1⅓ ins.

The construction of the weir recommended in this report will affect to some extent the levels in the first reach of the Barge Canal from Tonawanda to Lockport. The level of the Niagara River at Tonawanda would be raised by 1.71 ft. at mean stage, and by 0.55 ft. at flood stage, so that inasmuch as no provision has been made at the entrance of the canal against the rise which the construction of the weir will cause, it is in our opinion necessary to provide for the construction of a guard lock, the cost of which is included in our general estimate.

The capacity of the lock to enter the Welland River is a domestic question to be decided by the Canadian government. An item of $500,000 in the estimates provides for the construction of that lock, but its dimensions should conform to the capacity which the Canadian government shall determine to give to the connecting waterways, and this estimate can be regarded only as a rough approximation.

The weir is to be constructed of concrete and its cost is estimated as follows:

Rock excavation, 36,300 cubic yards, at $4 per yard	$145,200
Concrete, superstructure, 44,000 cubic yards, at $12 per yard	528,000
Concrete substructure, 48,500 cubic yards, at $10 per yard	485,000
Cofferdam, 105,500 cubic yards, at $3.50 per yard	369,250
Pumping and maintenance, lump sum	210,000
Lock into Welland River	500,000
Guard Lock at Tonawanda	500,000
Excavation for retaining walls along Niagara River, 16,000 cubic yards, at $3 per yard	48,000
Concrete for retaining walls, 12,500 cubic yards, at $10	125,000
	2,910,450
Add for engineering and contingencies about 20 per cent.	589,550
Total	3,500,000

The great value to the navigation interest of an increase of 6 inches in the low-water depth of Lake Erie has already been pointed out. The improvement of Niagara River to be effected by the proposed weir is important. An incidental advantage in its construction is that it would eliminate the possibility of the power companies at the Falls having any injurious effect upon the level of Lake Erie. The Niagara River below the weir and the conditions upon Lake Ontario and the St. Lawrence River would remain without appreciable change. The weir has small regulating effect upon the levels of Lake Erie, the range of the oscillations of the lake being reduced about 4½ per cent. The average natural low stage, 571.3, is raised 0.45 ft., and the average natural high stage is raised 0.38 ft., a difference of 0.07 ft. The storage in Lake Erie is reduced only by that amount, which is not sufficient to affect the level of Lake Ontario seriously.

It is possible that the Canadian government may prefer to assume the damages from overflow in the valley of

the Welland River, which would be caused by placing the Canadian end of the proposed weir below the mouth of the Welland, and thus make the lock unnecessary. If so, provision for this should be made in any treaty.

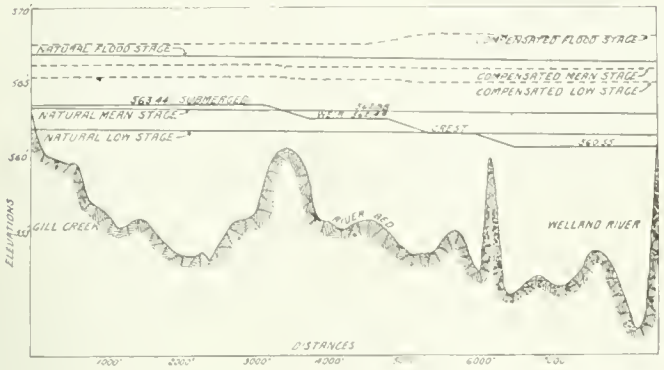

Fig. 2.—Natural and Compensated Stages at Site of Submerged Weir.

The commission believes that the very great advantages to navigation interests will justify and amply repay the necessary expenditure, and recommends that a treaty be entered into between Great Britain and the United States providing for the construction of the weir.

The report has appended to it the findings of Messrs. W. J. Stewart, engineer for the Canadian section, and E. E. Haskell, engineer for the American section, and the following is extracted therefrom:

Niagara River is the outlet of Lake Erie and discharges into Lake Ontario; it is divided into two reaches by the Falls, the "upper" and the "lower." The upper reach is navigable from Lake Erie to Chippewa, Ontario, and to Niagara Falls, N.Y., and is the reach with which we are at present concerned. Strawberry and Grand Islands divide a part of this reach into two channels, known as Tonawanda and Chippewa. The distance from Lake Erie to the head of Strawberry Island is approximately 4 miles and the fall in this distance at mean stage is 5.8 feet. The distance from the head of Strawberry Island to the end of navigation by the Tonowanda Channel is 16½ miles, and between the same points by the Chippewa Channel is 12¾ miles. The fall in these reaches at mean stage is 4.8 feet.

The natural conditions in this upper reach of river are therefore such as to indicate that by placing a submerged weir of proper size at the end of navigation, or below Navy and Connors Islands, it might be possible to create sufficient backwater to restore to Lake Erie a part at least, of what it has lost in stage by diversions, and at the same time greatly improve the navigation of the reach of river under consideration.

It was this project that was in mind when the last report was submitted. Naturally, the question arises: Can the water be raised sufficiently at the location indicated to actually restore to Lake Erie a quantity worth while and at the same time keep within control all flood waters, particularly those that come from heavy southwest windstorms on Lake Erie?

To answer this question it was necessary to have more data than existed at the time of our previous report. A careful topographic survey was required of all lands likely to be affected and a type of weir best suited for the location and conditions had to be determined.

Surveys were started early in 1910 and prosecuted as diligently as the affairs of the commission would permit. The results from these did not become available, however, until about the beginning of the present year. A detailed topographic survey was made of the shores of the Niagara from Lake Erie to within a mile of the Falls; the islands within this reach; and of the Welland River from its mouth to its source, a distance of about 40 miles.

In order to determine the best type of weir, it was deemed necessary to study various types under as nearly as possible true river conditions. These studies were made at the hydraulic laboratory of the college of civil engineering of Cornell University. They covered experiments on seven different types, ranging in height from 3.7 to 6.02 ft. and having in general a 3 to 1 upstream slope and a 1 to 1 downstream, five having a flat crest and the remainder a rounded crest. In two of the flat-top types, the upstream, and in all the downstream corners were rounded on a radius of 9.5 ft. On two of the flat-top and all of the round-top types, the downstream nappe was an ogee curve.

These experiments furnished what was being sought, namely, a type of submerged weir that would be very efficient at high stages and much less so at low stages.

Fortified with these new data, a study was made of the probable effect of submerged weirs placed at right angles to the general direction of the river in the following localities: Willow Island, Port Day, Grass Island, and Gill Island, as well as one on a line between Gill Creek and Hog Island, at the mouth of Welland River. Only the last of these met the conditions desired, and it is not thought necessary to give the results of the studies of the rejected locations because the end to be attained is clearly set forth in the consideration of the site finally chosen.

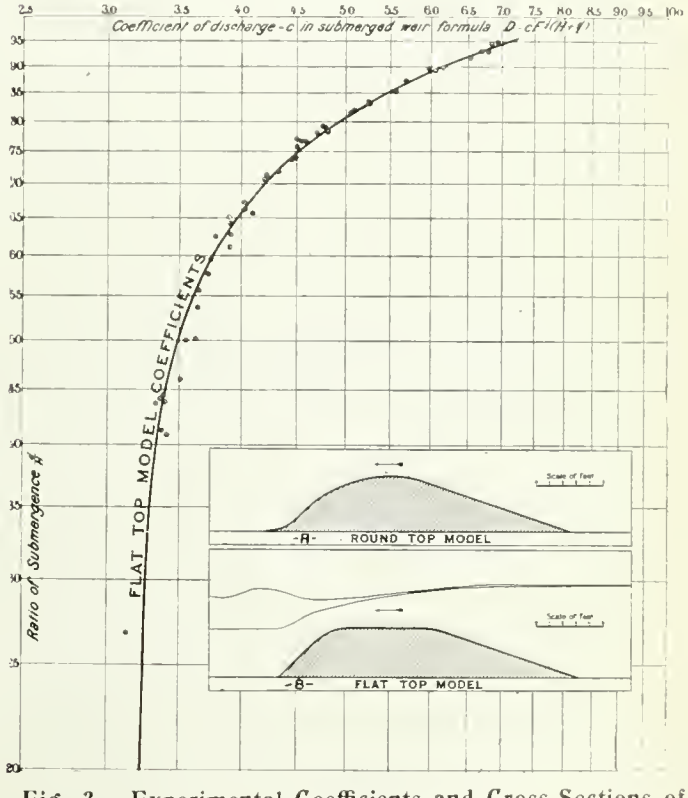
Coefficient of discharge - c in submerged weir formula Q = cF√(H-f)
FLAT TOP MODEL - COEFFICIENTS
Ratio of Submergence f/H
-A- ROUND TOP MODEL
-B- FLAT TOP MODEL

Fig. 3.—Experimental Coefficients and Cross-Sections of Weir Models.

As shown in the previous report, the stage of water in several of the Great Lakes will be materially lowered by artificial diversions of water therefrom. This loss of level on Lake Michigan-Huron, if 10,000 c.f.s. be taken

through the Chicago Drainage Canal, will for mean stage amount to 0.53 ft., while the loss of level to Lake Erie due to this diversion and 1,000 c.f.s. through the Erie Canal and 1,100 c.f.s. through the Welland Canal will at mean stage amount to 0.43 ft. and 0.09 ft., respectively, a total of 0.52 ft. The American power companies have also lowered the level of Lake Erie probably by 0.08 ft.

The project here proposed for restoring the loss caused by these diversions is the construction of a submerged weir of suitable type, on a line between Gill Creek and Welland River, as shown in Fig. 1, of such a height of crest as will create sufficient backwater to offset it.

To determine this, backwater curves have been computed, based upon Bernoulli's theorem for steady flow. The backwater on Lake Erie caused by the submerged weir has also been computed by the supply, storage, and discharge method, and the results by the two methods check very satisfactorily, the latter giving 0.07 ft. greater backwater in the high-water year of 1876 and 0.08 ft. greater in the low-water year of 1895.

Owing to the fact that the weir has an increasing efficiency with increase in stage, it was thought that the flow of the river might vary slightly from present natural conditions and therefore might affect injuriously the stage of water in the St. Lawrence Canals. The computed results show that the effect on Lake Ontario of any variation in the flow from Lake Erie caused by the submerged weir would be negligible.

Submerged-Weir Experiments.—As previously stated, submerged-weir experiments were made upon seven different types of weirs, ranging in height from 3.70 to 6.02 feet. All of the models were approximately 4 feet long. The following table, No. I., gives the dimensions of the several models tested:—

Table No. I.—Dimensions of Submerged-Weir Models.

Model No.	Length	H't	Crest	Width bottom	Upstr'm face	Downstream face	Remarks
	Feet	*Feet*		*Feet*			
1	4.005	6.02	Flat, 6 feet wide	31.76	1-3 slope	1-1 slope	Upstream corner sharp, downstream corner rounded, radius 9.5 feet
2	4.01	4.53	do.	25.79	do.	do.	do.
3	4.01	4.53	do.	27.33	do.	do.	Up and down stream corners rounded, radius 9.5 feet
4	4.02	5.17	Rounded, radius 9.5 feet	27.70	do.	do.	Ogee curve downstream face
5	4.005	4.35	do.	23.50	do.	do.	Ogee curve bottom, downstream face
6	4.005	3.70	Flat, 6 feet wide	23.50	do.	do.	Upstream corner sharp, downstream corner rounded, radius. 9.5 feet. Ogee curve bottom, down stream face.
7	4.005	3.76	do.	25.04	do.	do.	Up and down stream corners rounded, radius 9.5 ft. Ogee curve bottom downstream face.

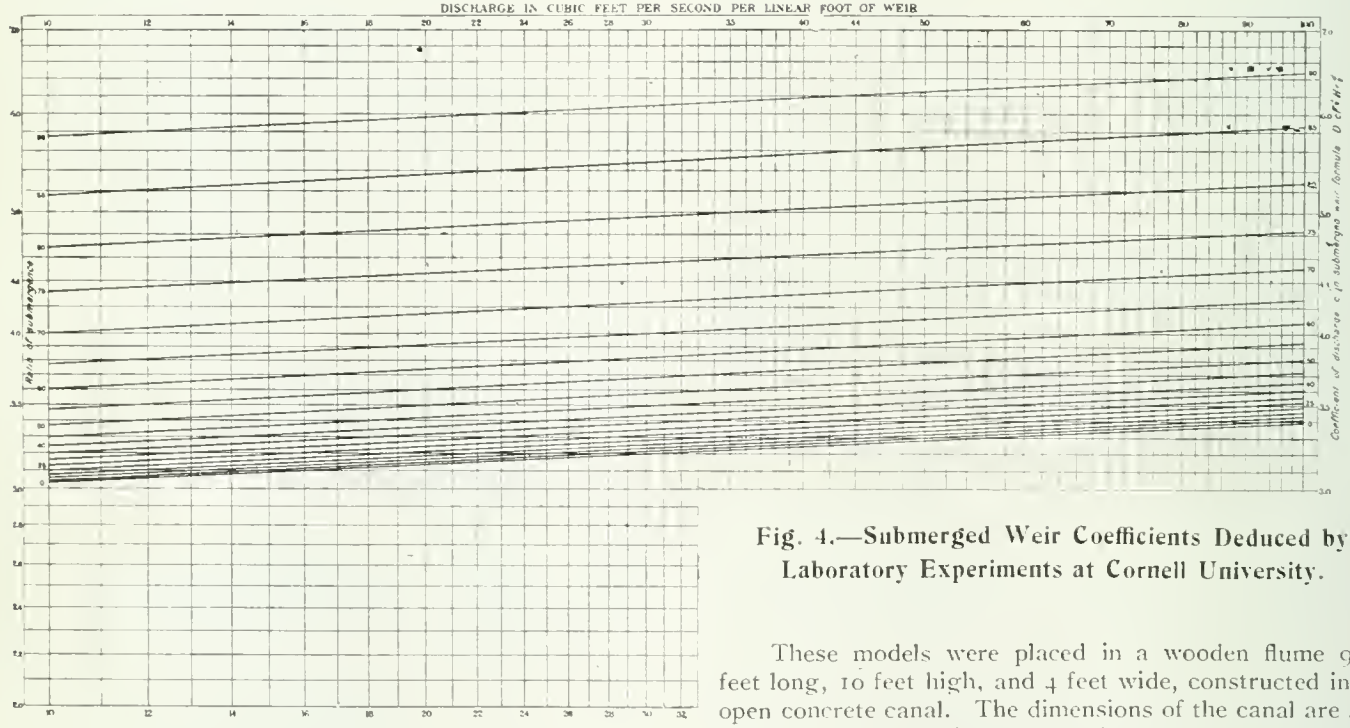

Fig. 4.—Submerged Weir Coefficients Deduced by Laboratory Experiments at Cornell University.

Knowing the elevation of the flood waters of this new compensated flood stage from Lake Erie to the site of the proposed weir, the topographic surveys previously referred to were studied with a view to determining the effect that these new flood waters might have upon adjacent lands. So far as can be seen, but little, if any, damage would result from the proposed weir placed on the Gill Creek-Welland River section. The investigation has also shown that it would not be possible to raise the water at the weir by much more than 3 feet without danger of damage from floods.

These models were placed in a wooden flume 95.5 feet long, 10 feet high, and 4 feet wide, constructed in an open concrete canal. The dimensions of the canal are 418 feet long, 16 feet wide, and 10 feet deep. The grade of bottom of channel is approximately 1 foot in 500. A bulkhead located about 60 feet from upper end of canal divides it into two parts. A standard sharp-crested weir placed on top of this bulkhead measures the quantity of water flowing in canal. The wooden flume mentioned above was built in this canal, the upper end being located about 87 feet below the standard weir. The upper end of flume had a bell-shaped mouth, about 15 feet long, converging from 16 feet, the width of canal, to 4 feet, the width of flume. The crest of weir of tested models was placed about 46 feet below upper entrance to bell mouth. The flow of

water over the standard weir, through the canal, and over the experimental models was regulated by gates at the head and foot of canal. By the manipulation of these gates various discharges, submergences, and heads on the experimental weir models were secured. The upstream head was measured in the flume with a plumb-bob attached to steel tape at a point about 25.5 feet above the upstream edge of crest of flat weir, while the downstream head was measured in the same way in still water behind the flume on both sides and about 16.6 feet downstream from the upstream edge of crest of flat weir. The longitudinal water surface curve over the weir was determined for all models under various conditions of flow. The flow of water over these experimental models varied between 27.6 and 203.2 second-feet, equivalent to 6.87 and 50.75 c.f.s. per linear foot of weir, respectively. The upstream heads on the weir varied between 1.66 and 6.35 feet and the ratio of submergences between 0 and 95. The experimental coefficients as derived are based upon the submerged weir formula $D = cF^{\frac{1}{2}} \left(H + \frac{d}{2} \right)$, where D = discharge per linear foot of crest, H = upstream head, d = downstream head, F = fall or upstream head minus downstream head, c = experimental coefficient. The weir coefficients for the flat-crest models are given in Table II. and are shown in Fig. 3.

Table No. II.—Weir Coefficients, Flat-top Model.

Weir condition	Average minimum river flow per linear foot of weir	Co-efficient	Average mean river flow per linear foot of weir	Co-efficient	Average maximum river flow per linear foot of weir	Co-efficient
	C.f.s.		C.f.s.		C.f.s.	
Free	18 00	3 120	25.00	3 160	45.00	3.260
0.1 submergence	18 00	3.145	25.00	3.190	45.00	3.300
0.2 submergence	18.00	3.195	25.00	3.245	45.00	3.345
0.3 submergence	18.00	3.260	25.00	3.308	45 00	3.419
0.4 submergence	18 00	3.340	25.00	3.397	45.00	3 500
0.5 submergence	18.00	3.480	25.00	3.540	45.00	3.655
0.6 submergence	18.00	3.720	25.00	3.780	45 00	3.900
0.7 submergence	18 00	4.125	25.00	4.190	45 00	4.320
0.8 submergence	18.00	4.850	25.00	4 910	45.00	5.060
0.9 submergence	18.00	5.930	25.00	8.025	45.00	6.210

The weir coefficients of the rounded-crest models were about 5 per cent. greater than those of flat-crest models, but the coefficient increment was about the same for each type within the limits for river conditions. The flat-crest model was therefore adopted on account of the easier construction, inspection, and repair.

The committee does not wish it understood that the type of weir here proposed is the most desirable one for the purpose. The experiments made were by no means sufficient to settle this question. It is very probable that further experiments would reveal a still better type. The one proposed does demonstrate, however, that the project is feasible.

SILICON STEEL FOR ELECTRICAL PURPOSES

The results of extended experiments shows that silicon steel is to be preferred to manganese steel for electrical purposes on account of its superior magnetic properties is the statement made by F. Goltze in a paper read before the German Foundrymen's Association, Berlin. Annealing improves the structure and the mechanical properties, and has considerable effect on the magnetic properties, at 750° C. reducing them slightly and at 1,000° C. establishing a marked improvement, while at 900° C. it has a decidedly adverse influence. Coarseness of grain and good magnetic properties were found to go hand in hand. The addition of aluminum to cast-iron was also found to increase the magnetic properties of the iron.

BASIC OPEN-HEARTH STEEL CASTINGS.*

By H. F. Miller.

FOR some years the prejudice against basic open-hearth steel for castings has been gradually decreasing. Acid steel has been used for this purpose much longer than basic steel; and the melters in acid practice had it well in hand when basic steel was first tried. Then the necessity of learning a new set of laws for the production of satisfactory basic open-hearth steel for castings became evident. The first of these laws has to do with the furnace construction. The charge should be melted down as speedily as possible to prevent excessive oxidation.

Furnace Hearth.—The hearth of the furnace is a decisive factor in the production of solid castings. The manufacturer should know the size of the heats he intends to make constantly, and should have his furnace built for that size of heat. The hearth should differ in dimensions from that of a furnace making ingot steel. That is, the bath should be deeper and should have less surface area. A shallow bath permits the slag to come out soon after the steel commences to flow, and thus prevents the additions from going into the steel, or from becoming uniformly distributed should they be put in hurriedly.

Under this head comes the very poor practice of making small heats in hearths of a much larger capacity. If into a 25- or 30-ton furnace only 12 or 15 tons of metal is charged per heat, the proportion of heats that will be wild or show signs of wildness at some time during the pouring will be comparatively large; whereas, if the hearth is charged to capacity, a heat showing signs of wildness will be a rare occurrence.

Influence of Slag.—The nature and action of the slag is an important factor in the manufacture of quiet steel. Slags are usually roughly classified by the melter according to physical appearance, as follows:—

(1) The dry, heavy slag occurring when there is very little silica present. This is a dangerous slag if not carefully worked. The burning of many furnaces is due to reflection of the heat to the roof by this slag. Another danger is that the melter, deceived by the physical appearance of the slag, may add an excessive amount of fluorspar. This results in the ladle being badly cut and the stopper rod burned off. These disasters can be prevented by a gradual addition of spar until a "wet" slag is created, after which the heat may be worked down as usual. With natural gas the heat will form for some time.

(2) A wet but lumpy slag is a good slag with which to work. The lumps of limestone should be broken up with a rod, so that a rocky bottom may be avoided. Otherwise an unbroken lump will choke the tap-hole, so that the flow of the slag being stopped, the steel is left uncovered until the tap-hole can be freed. A large amount of heat is lost from the steel thereby. A lumpy slag can be avoided by charging small-sized limestone.

(3) A third slag is the very watery variety, usually occurring when heats melt at high temperature, by reason of the presence of an excessive amount of silica. This slag should have burned dolomite or raw limestone added until a thick slag is made. When the slag is too thin, it will mix with the steel in tapping and a wild steel will be the product. The ladle and stopper rod will be badly

*Abstract of a paper presented before the American Institute of Mining Engineers (Iron and Steel Division).

scorified, and usually some tons of steel will go into the pit by reason of a burned-off stopper rod.

The ideal slag is heavy and wet with no large lumps. This slag makes an easy heat to work and gives a steel low in phosphorus and sulphur. It requires but a small amount of fluorspar to put this slag in shape for the ladle A heavy slag of this nature will not mix with the steel, and will generally stay in the furnace until the steel is nearly all in the ladle. It also has the good quality of cutting neither the stopper rod nor the ladle brick. The only objection is that it causes a dirty bottom, and unless a washout is made after each heat the bottom will rise to the sill-plate level after a few heats. This result shows very poor practice. No time is ultimately gained by charging up without the usual washout. If a washout from 20 to 30 min. is made after each heat, the furnace will work fast for a much longer time. Moreover, the holes that occur in a high bottom will be largely avoided, if the bottom is kept low and clean.

Tap-Hole.—The tap-hole should be kept large and low. The quicker steel gets into the ladle, the more heat is retained. The shorter a spout the better, for the same reason. Moreover, a large tap-hole will not clog up easily if rabbling has to be done; and few hard taps will occur. For shutting up the tap-hole magnesite is best, because it does not burn together and make a hard tap, nor does magnesite boil out, as may happen when a tap-hole is closed with green dolomite. Burned dolomite, however, may be safely used, the only drawback being an occasional hard tap, due to the burning together of the material.

The foregoing facts are probably known to most smelters; but unless vigilance is constant, one factor is apt to be overlooked. The bottom may be low and the tap-hole all right; but the spout if not smooth at the end may cause the stream to spray over the ladle, thus losing much heat and causing a skull and, perhaps, some misrun castings, all of which could be avoided with a carefully made up spout.

Alloys.—The addition of alloys may be made in the bath or in the ladle. By putting them into the bath, much heat is saved. This is a valuable method where a furnace is working cold or a heat has melted low and there is difficulty in getting it hot. The advantage is that the additions are made while the flame is still on the bath, and the loss of the heat in the bath caused by dissolving the alloys can be regained. The objections are:—(1) That a large amount of each alloy must be added, since in this method from 15 to 30 per cent. goes into the slag; (2) that the silicon, reacting, will throw back the phosphorus into the steel. Putting the additions into the steel as it goes into the ladle is the better method. A uniform distribution of alloys is obtained by shovelling the alloys in gradually. If the alloys are added to the ladle, the steel will be helped greatly by first raising them to red heat, especially in winter.

After the heat has melted down and the limestone has boiled up, the charge will be benefited by allowing it to "soak" from 15 to 30 min. This will allow any contained slag to rise and also much of the gases. Ore may then be fed if necessary or, if the heat has come ready, it remains only to get the steel hot. Sometimes heats will melt low, and if only small ladles are available or there are no heavy castings to pour, it is best to get the heat ready by using manganese. This will not add much metal to the bath, and it is a good substitute for pig-iron.

With large ladles, working the heats with both pig-iron and manganese is recommended. Very little, if any, ferro-silicon should be used instead of manganese, since the silicon mixes with the slag and cuts the stopper rod off while the heat is being poured. Hot metal is preferable to cold additions, as the bath is not then chilled by the additions.

If the slag comes too quickly and all the additions have to be made to the first part of the heat, an even distribution can be obtained by rabbling the heat. If some of the additions are lost in the slag, or if insufficient has been put in, the heat showing signs of wildness, a simple remedy is to take a number of sticks of aluminium, bend a tapping rod around them, thrust them to the bottom of the ladle, stir the bath with them and rabble it afterwards if necessary. There is hardly a heat that cannot be made absolutely quiet by this means. But it is curative treatment, and a good preventive is always better.

The time consumed in pouring is a factor in determining the size of the heat. Good practice demands that a heat of steel should be poured in less than 60 minutes; the faster the better. The high temperature required to pour steel from 1 to 2 hours causes a great increase in occluded gases and necessitates an increase of about 30 per cent. of ferro-silicon to make it as quiet as when poured at a lower temperature.

The use of fluorspar seems also to make the steel less responsive to the quieting action of silicon, since the fluorine appears to be absorbed by the steel. I have noticed when pouring a test that after much spar has been used the steel gives off a smoky gas of the same appearance as when fluorspar is added to the bath. If this is true, the action of fluorspar cannot be beneficial to steel when added in large quantities. Good basic steel is harder to make than good acid steel; but if the practice outlined is followed, the steel produced will be as quiet while molten and as solid afterwards as acid open-hearth steel —and tougher.

FORCE EXERTED BY EXPANSION OF WOOD.

The great pressure exerted by the expansion of wood when soaked with water has been illustrated during the flood at Dayton, Ohio. A quantity of oak dashes veneered with maple was stacked to within one inch of a reinforced concrete girder in the basement of a factory. This girder had a cross-section of 12 by 19 inches and supported a 6-inch reinforced concrete floor. The basement was flooded, and after the water receded it was found that the girder, together with the concrete floor which it supported, had been lifted 3 inches. Ten weeks after the flood the girder still rested on the dashes, but it had settled about ¾ inch. Large cracks developed in this girder, starting at the edge of the pile of dashes and extending upward and outward. These cracks extended from the bottom to the top of the section at an angle of about 30 degrees with the horizontal. It was necessary to replace this girder and a section of the floor.

In these days, when hydro-electric power is becoming so important a factor in industry, it is of interest to note that in the Western Provinces there are vast possibilities in this regard. In Manitoba there is water power which would produce 7,000,000 horse-power, and only 78,000 horse-power is being utilized. This is at Winnipeg, which has a municipally-owned hydro-electric plant, supplying light and power to consumers at cost.

THE EXPRESSION OF PIVOT ERRORS BY A FORMULA.*

By R. Meldrum Stewart,
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EVEN the best measurements of pivot errors of a meridian circle or transit instrument are, of course, affected by accidental errors, and in the case of fairly good pivots these are no doubt larger than the actual deviations of the pivots from a smooth curve. It then becomes a question what pivot corrections should be adopted, both for the zenith distances at which the errors have been observed, and for intermediate zenith distances. The practice ordinarily followed is to plot the observed values and draw a smooth curve representing them as closely as possible. The objection to this proceeding is that it is not a definite one, and, what is perhaps more serious, that the amount of smoothing does not, as it should, depend on the accuracy of the original observations (for it is manifest that accurate observations should be smoothed less than inaccurate ones). It has seemed, therefore, that it would be advantageous, if possible, to obtain from the observations a definite formula which might be used in place of the smoothed curve, and from this formula to construct tables showing the zenith distances at which the pivot corrections change from unit to unit. In a recent series of measurements at the Dominion Observatory it was found that a good representation could be obtained by the use of a few terms of a Fourier series, and it seems probable that the values so adopted are more accurate than the actual observed values.

It is evident that a Fourier series can be made to represent the observed values to any required degree of accuracy; for example, in the case where the pivot errors are observed at intervals of 6°, the use of 72 terms would reproduce the observed values exactly. Since, however, these observed values contain errors of measurement, it is probable that a more exact representation of the actual pivot errors will be obtained by omitting the terms with small co-efficients; it then becomes a question simply of the number of terms to be retained.

It is evident that, the more accurate the original observations, the more closely the adopted curve should be made to represent them. Also, the accuracy of the observations is represented by the probable error of a single observation, computed in the usual way; since several complete sets of observations are always made, this is readily obtained. Hence the deviations of the adopted curve from the observed values should be a function of the observed probable error. But by treating these deviations as residuals they themselves may be utilized to form another probable error, which represents the accuracy with which the adopted curve reproduces the observed values. The most obvious assumption is that these two probable errors should be made equal that is, that sufficient terms should be included in the Fourier series (choosing always the largest terms) to make its representation of the observed values equally accurate with the representation of the true values by the observations themselves.

Freed from technicalities, the above process simply amounts to drawing a smoothed curve in a particular way, with the adoption of a criterion for the amount of smoothing. The tentative adoption of a particular number of terms amounts to drawing a trial curve; if upon examination it is found that it is an even chance that the discrepancies between the curve and the observed values are due to errors of observation, the curve is adopted; if not, another trial curve is formed, and the process repeated until the desired result is attained.

The statement has been made that the criterion adopted (that of equality between the two probable errors) is incorrect, and a different one has been suggested, viz., that sufficient terms of the Fourier series should be included to make the probable error deduced therefrom a minimum. It seems to the writer, however, that a perusal of the preceding paragraph will establish the fact that his criterion is essentially logical and reasonable. The suggested criterion, not to mention the fact that it takes no account of the known accuracy of the observations (which can be measured independently), and that the whole principle involved in its application (that of "minimum probable error") is at least very seriously open to question, is manifestly entirely inapplicable in the present case. For it may be shown that in the attempt to represent any such observed series of quantities by a Fourier expansion, the computed probable error diminishes continually as the number of terms included increases; the proof of this theorem is elementary. Thus the adoption of this criterion would necessarily be synonymous with the use of a curve totally unsmoothed, that is, of the actual observed values.

It has been mentioned above that the use of the Fourier series amounts to drawing a smoothed curve in a particular way. It may be conceivable (though it does not appear in any way certain) that in some special case this particular way might not be suitable, i.e., that a limited Fourier series might not be applicable at all. This could probably occur only in the case of very irregular pivots, where the majority of the co-efficients in the complete Fourier series would be comparatively large. Even in this case the only fact that seems clear is that the number of terms necessary to give a satisfactory representation would be so large that the labor of computation would be prohibitive. In any case an examination of the residuals from the adopted curve will readily show whether any marked runs occur; if not the formula may be safely adopted. In the writer's judgment the occurrence of marked runs in the residuals would simply indicate that the pivots were decidedly irregular, and stood in need of re-grinding.

The actual determination of the pivot errors of the meridian circle at this observatory, referred to at the outset, was made by the microscopic method. Eight complete measurements of pivot errors were made; the probable error of a pair of microscope pointings (treated as a single observation) was found to be .0015 sec.; five cosine terms and five sine terms of the Fourier expansion (which may be combined into five cosine terms) were found to be sufficient to reduce the computed probable error to the same value. When the results are put in the form of a correction to the observed collimation it may be shown that terms involving the sine and cosine of the zenith distance have no effect; consequently these were omitted.

The resulting formula is:

$$\Delta c = {}^{s}.0010 \cos(2\theta - 188^\circ 29') + {}^{s}.0117 \cos(3\theta - 3^\circ 17') + {}^{s}.0021 \cos(4\theta - 59^\circ 45') + {}^{s}.0008 \cos(5\theta - 121^\circ 58')$$

* Appearing in the bi-monthly journal of the Royal Astronomical Society of Canada.

θ being the zenith distance. The residuals from the formula were satisfactorily small (in no case exceeding .002 sec.), and appeared to be purely accidental.

Values of the formula were computed for different zenith distances, and from these a table was prepared giving the zenith distances at which the value of Δc changed from one unit (in terms of .001 sec.) to the next; it is this table which is used in the reduction of transits.

It may be remarked that the strictly logical method of procedure would be to treat the sine and cosine terms independently. Thus, if the complete representation is given by

$$\Delta c = a_0 + a_1 \cos\theta + a_2 \cos 2\theta + a_3 \cos 3\theta + \ldots\ldots\ldots + b_1 \sin\theta + b_2 \sin 2\theta + b_3 \sin 3\theta + \ldots\ldots\ldots$$

the terms with largest coefficients should be chosen without combining the sine and cosine terms in pairs. This mode of procedure would in the actual case considered have changed the adopted formula slightly, in that the term involving sin 2θ (coefficient $-.0002$) would have been omitted, and that involving sin 12θ (coefficient $-.0005$) would probably have been included. Had the tables not been completed originally with the formula as given above, this change would have been made. As, however, the change in adopted pivot errors would have been extremely minute, it has not, up to the present at least, been thought worth while to make the change.

THE NEW DOCK AT SINGAPORE.

The completion of the King's Dock at Singapore marks an important stage in the scheme of extension and reconstruction works undertaken by the Singapore Harbor Board. The new dock is the largest dry dock in the far east. Its length from the outer stop to the head is 892 ft. 6 in., and from the inner stop to the head 876 ft.; the width at the entrance 100 ft., and inside the dock between the copings 128 ft.; and the depth on the outer sill 34 ft. at high water, and 24 ft. at extreme low water. By means of a central caisson the dock can be divided into an inner and an outer portion, 502 ft. and 346 ft. long, respectively.

With the exception of the entrances, which are of Cornish granite ashlar, the dock is constructed entirely of concrete. The altars consist of moulded concrete blocks, and the remainder of the face is of fine concrete masswork. Three rows of granite keel block courses run the length of the dock under a corresponding number of heavy timber keel blocks, the remainder of the floor being of mass concrete.

For filling the dock two culverts 7 ft. high by 4 ft. 6 in. wide are provided, and for emptying it there are two culverts measuring 10 ft. by 6 ft. The pumping station contains two Gwynnes' 60 in. centrifugal pumps; each has two suctions 36 in. in diameter, and they are together capable of emptying the dock, which contains 22 million gallons of water, in less than two hours against a maximum lift of 30 ft. Each of the pumps is direct coupled to a compound condensing engine of about 1,100 horse-power, having cylinders 24 in. and 46 in. in diameter with a stroke of 24 in. Steam is furnished at 160 lbs. pressure by three boilers, each able to evaporate 12,300 lbs. of water an hour.

Two ship caissons are provided, each weighing 826 tons, including ballast, and as they are identical in size they are interchangeable. Included in the equipment are four ten-ton and eight five-ton capstans, a five-ton crane, a fifteen ton crane and penstocks, all the appliances being worked electrically by power generated at the Board's own power station. The cost has been over $2,000,000.

SHELLFISH CONSERVATION AND SEWAGE DISPOSAL.

THE American Public Health Association has a committee on sewage collection and disposal which will submit a majority and minority report at the convention in Colorado Springs this week. The question of conservation of the shellfish industry is one reason for the lack of unanimous opinion on the part of the committee. In connection with this question Mr. George A. Johnson, consulting engineer, New York City, and a member of the committee, has favored us with a copy of his comments upon the present situation.

He outlines the reversal of conditions since the day when the aborigines made free use of shellfish as food. Since that time huge sewer outfalls in the neighborhood of shellfish grounds have greatly altered public opinion on the advisability of their use as a fish. The shellfish industry has grown until the value of the total annual output of nearly 40,000,000 bushels amounts to approximately $20,000,000. Where shellfish formerly grew in a naturally pure state the grounds are more or less subjected to currents of contaminated water.

Another point touched upon is the certainty of epidemics of typhoid fever and other disorders as a result of the use of polluted oysters for foods.

It is a problem how shellfish grounds may be protected from contamination from this source. The best grounds are found in the mouths of rivers and bays near the ocean, which is unfortunate, as such waters are usually subjected to pollution by the sewage of cities and towns located directly on or tributary to them. The report goes on to state that although shellfish in constantly changing, unpolluted water will become purified in from one to two weeks, this department of oyster purification has not been receiving adequate attention, although deserving of exhaustive study.

Another point is that shellfish will continue to be used as food, and that, "except in special well adapted cases it is impossible, on financial and other grounds, to conserve absolutely the purity of shellfish by sewage treatment. Complete treatment of the sewage entering waters which flow over shellfish layings will improve existing conditions, and in special cases almost, if indeed not entirely, remove the existing danger; but to be thoroughly effective a condition is required which is seldom, if ever, found at sewage treatment works to-day. There would be required not only extreme conscientiousness in the operation of the sewage treatment works, paralleling the vigilance with which good water filtration works are watched, but also interstate co-operation, the whole order of affairs being supervised by a supreme authority vested by law with power to approve or condemn.

"The conservation of the shellfish industry is a difficult problem, made so by the fact that common law rights of sewage disposal into the sea and its estuaries have been and are being extensively utilized. To set these conditions back a century solely for the sake of conserving the oyster industry, where no other offence is created, is a matter which, if pressed, will engage active sanitary, financial and legal minds for many years to come."

The new Canadian Northern road from Toronto to Ottawa will be opened about October 15th. The line is one of the main connecting links of the Canadian Northern Ontario lines, and will open a straight connection from Northern Ontario and Toronto to Montreal and Quebec.

THE EFFECT OF SATURATION ON THE STRENGTH OF CONCRETE.*

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THE paucity of recorded information concerning the treatment of concrete specimens, with regard to moisture conditions during their storage while awaiting the test for strength, seems to indicate a general supposition that this feature has no considerable effect on results. Apparently corroborating this attitude is the statement in the recent report of the Special Committee on Concrete and Reinforced Concrete, in which, while specifying the exact dimensions, mixing, consistency, age, etc., of test specimens, the only requirement designed to control moisture treatment during their curing seems to be that they shall be "stored under laboratory conditions." It is the purpose of this paper to invite attention, not only to the great importance of specifying and standardizing the moisture treatment of specimens intended for testing, but also to the further fact that similar conditions, as they act on the finished structures, will affect their strength considerably, and therefore should be considered in specifying the proper unit stresses. It is evident that this factor should not be ignored when great variations in strength, to an amount of perhaps 50% above or below a mean value, result from differences in moisture conditions.

During the last six years this question, at times, has been the subject of investigation in the Washington University Testing Laboratory. Different features have been explored experimentally since 1907. Although these tests leave the greater part of the field still untouched, the results thus far obtained are so definite in their showing of a decided influence of moisture conditions on strength, and so significant in their general indications, as to authorize a summarized statement of experimental results to the engineering profession for its consideration.

The most important part of the investigation is that of the effect, on the compressive strength of concrete, produced by varying systematically the relative length of time of exposure in air and in water.

The test specimens were cylindrical, 8 in. in diameter and 16 in. high. The materials were: a standard brand of Portland cement which fulfilled thoroughly all the requirements of the standard specifications; a clean sand of good quality, weighing about 110 lb. per cu. ft. when dry, and having 36% voids; and a washed river gravel of the same weight, varying in diameter from quite small up to 1½ in., and having 33% voids. The proportions were the usual 1:2:4, by volume; the mixing was done thoroughly by hand; and the quantity of water used was such as to give a moderately wet consistency, which allowed a thorough compacting by stirring with an iron rod and a slight tamping. All details of fabrication, curing, and testing were planned so as to secure such complete uniformity as is practicable to obtain in all regards except the one for which the controlled variation formed the particular purpose of the experimental study.

The cylinders were removed from the moulds when two days old, and were tested at an age of six weeks. The intervening 40 days constituted the period in which the duration of their immersion in water was varied systematically from nothing to the full time. The average results of the 240 tests thus made are plotted on the diagram, Fig. 1, on which the abscissas represent that number of days (after the two days in the moulds and the time of exposure to air) during which each set of specimens was placed in water before crushing them; and the ordinates give the percentage of strength which each set of immersed cylinders (standing in water for the indicated number of days) was found to have, taking the compressive strength of the dry specimens from the same mix as 100 per cent. Thus, at the extreme left is represented the basis of comparison, or those which were not immersed at all; those specimens which were cured in air of ordinary humidity for 32 days and then immersed for 8 days are shown by the black circle to be 86% as strong as the air-cured concrete; those in air for 12 days and therefore finally cured in water for 28 days have gained 9% in strength; and those submerged for the entire 40 days exhibited an average compressive strength fully 50% greater than that of the air-cured specimens.

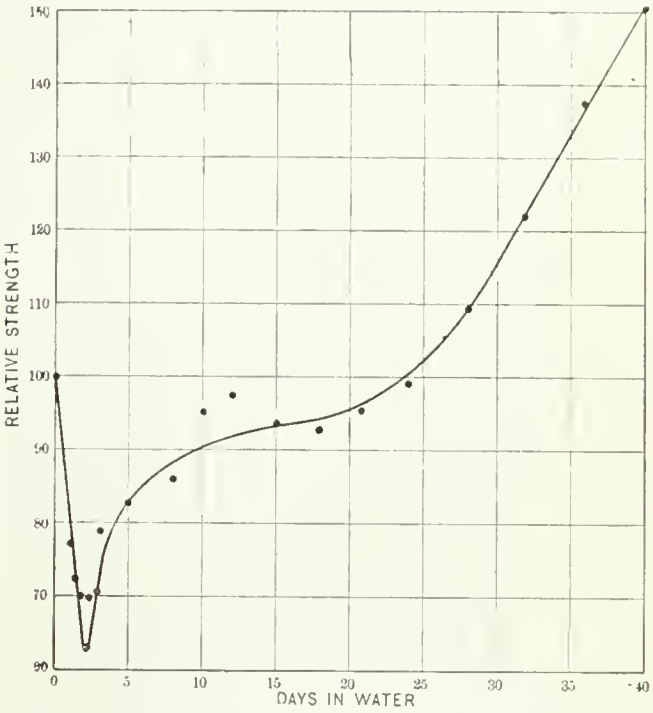

Fig. 1.

An average curve for the plotted points has been drawn as a full line, showing the systematic increase in strength as the time of submergence is lengthened beyond 2 days; but there exists the significant fact that specimens, of the dimensions used, decrease rapidly in strength when stored in air for 38 (or more) days and then placed in water for the remaining 2 days (or less). This particular feature of the rapid loss of strength on first exposure to water, and the active but slower recovery of strength as soaking continued, required a multiplication of tests to determine satisfactorily the locus of the curve in this region; and consequently more than half of the experiments were concentrated in this descending and the adjacent rising portion of the plot.

It thus appears that the compressive strength of concrete exposed only to air may be reduced nearly 40% when saturated with water, but that this loss is actively regained as the treatment is continued. The word saturation is used advisedly, because the minimum strength was found to coincide practically with the length of time required

*To be presented at the November 5th meeting of the American Society of Civil Engineers.

for water to penetrate to the middle of the specimens. Very plainly, this loss of strength has no relation to the percentage of contained moisture, as it is not only regained but much exceeded if the saturation is continued long enough. Perhaps the reduction in strength is purely a temporary physical phenomenon which is gradually counteracted and finally dominated by continued saturation permitting the imperfectly developed chemical processes of hardening to proceed actively. If this be true, concrete would regain something more than its original strength if dried out as soon as completely saturated, but this value would be less than that attainable by a continuance of the water treatment; also a repetition of soaking after such an experience would again temporarily reduce the strength, but less than before. These questions, as well as others, such as the duration of saturation necessary to prevent the temporary relapse of strength described, the corresponding effects of other periods of treatment similar to that discussed, of alternating the exposure to air and water, the result of different dimensions, proportions, materials, etc., all offer a large, interesting, and fruitful field for investigation.

In a series of experiments on the factors affecting the strength of bond between concrete and embedded steel, 74 tests were made to determine whether there existed the same tendency of rapid weakening at first and a following recovery of strength when the dry specimens were immersed in water. The concrete was of the same character as already described, and the test specimens were partly of the notched beam type transversely loaded, and partly of cylindrical form in which the rod was pulled from the embedding concrete. All care was used to make the methods of testing such as to minimize all variables except the particular one the effect of which was sought. The results indicate clearly, for both plain and deformed bars, that the bond strength values, similarly, decline rapidly and then increase after saturation is complete, as is the case with the compressive strength; although the average minimum observed was only about 75% of that of the specimens cured entirely in air. Whether or not this percentage really marks the greatest weakening of bond produced by immersion at an age of 6 weeks is somewhat uncertain; perhaps additional tests for intermediate periods of soaking would have developed a further reduction in strength. At any rate, a similar behavior characterizes the bond values obtained during the first few days of saturation.

Thirty-two beams were made of such dimensions and amount of longitudinal reinforcement (without any web reinforcement whatever) that failure would always occur through the effect of the excessive web tension in the concrete. The materials were of the same quality as those already described, and equal precautions were taken to secure reliable results. These beams were also tested at an age of 6 weeks, but the small number restricted the investigation to lengths of immersion designed to detect only the early loss of web tensile strength and its subsequent increasing value, without tracing it throughout successively lengthening periods of exposure to water to the limit of 40 days. The characteristic effect is again the same, the lowest average found being again practically three-fourths of the strength of the air-cured specimens. It may be that, in this case also, the minimum value was not detected.

A series of experiments on concrete prisms when 7 years old, to determine any change due to age in elastic properties, has been discussed previously by the writer. It may be stated, in reference thereto, that the modulus of elasticity of these old prisms exhibited a practically constant value throughout the repeated loadings equal to the maximum before found, which was about 80% greater than the final constant value as then reported for prisms of ordinary age; or a value of 4,000,000 in compression for that 1:3:5 limestone concrete. In these experiments two specimens were immersed in water until saturated and then carefully tested; the resulting compressive modulus of elasticity for wet concrete was 60% of that observed on the same specimens when dry. This lowering in value refers, again, only to the effect produced as soon as the saturation is complete and has no reference to a continuance of the exposure to water, such as is reported on certain other tests, where the figures given for the compressive modulus of elasticity of concrete specimens cured entirely in water for 26 days are about one-fourth greater than for those cured only in air.

As the various strength values of dry concrete are temporarily reduced from 25 to 40% by saturation, it would seem that this fact should be given definite consideration in fixing the working stresses used in the design of structures which may be thus exposed, or else conditions should be controlled in such a way as to prevent the weakening thus produced. No such effect occurs in concrete constantly under water or in moist earth from the time of its fabrication; but construction above ground, and therefore exposed to dry air for a time and then to a heavy rain or other source of rapid wetting, presents conditions under which this reduction in strength exists temporarily. Fortunately, the remedy is simple and inexpensive. It is to keep the exposed material thoroughly wet until its enclosure by exterior walls and roof renders its saturation by rain impossible. The case of parts not thus protected, or those for which enclosure is delayed, is not so simple; because the length of time of saturation which will make the concrete safe against serious reduction of strength is uncertain. The systematic wetting of concrete is a well-known principle of good construction; but the writer's observation and experience suggest a very considerable tendency to regard that procedure as abstractly correct, but practically rather specious or trivial. One purpose of this paper is to present the facts in such a way that the frequent, thorough, and faithful wetting of all parts of such concrete structures shall henceforth be no more ignored than is now the protection from freezing or disturbance while setting. Probably this treatment should be continued for a length of time substantially greater than that heretofore indicated—perhaps for a period expressed in weeks instead of days.

Undoubtedly, carelessness in a thorough control of this kind is a frequent contributing cause of weakness which is sometimes sufficient to result in failure. Very evidently, this temporary weakening of concrete by saturation is amply covered by the factor of safety required by good practice, if it be the only fault; but the materials may be considerably below standard, or the workmanship may be defective, or the design may encroach on the reserve of safety, or the occasional overload may be imposed; and if the material man, the construction superintendent, the designer, and the user of the structure should each rely on the others to meet fully the requirements, in the expectation that his own delinquency will be safely covered by the factor of safety, it would not require an impossible coincidence of such conditions to cause disaster; especially in view of the fact that considerable variations from the average strength values, which form the basis of design, necessarily exist in different parts of the structure. In fact, the failures which have occurred are

generally a result of several such contributing causes. The writer believes that the considerable weakening produced by the saturation of dry concrete has invariably been a contributing factor in all those instances in which there was an active wetting of dry or partly dry concrete when subjected to essential stresses.

This general proposition furnishes one more evidence of the remarkable responsiveness of concrete to variations in its treatment. The fact that differences in control (which to the average artisan are seemingly unimportant) actually do exert a positive influence on its essential characteristics, constitute a definite warning against entrusting it to the uncertainties of irresponsible or skeptical supervision, and assures ample reward for a competent control which is correctly adapted to develop its capabilities. The susceptibility of steel to the influence of phosphorus and sulphur, of details of its heat treatment, and of other conditions occurring in the process of its manufacture, have resulted in restricting its production to the scrutiny of expert superintendence. Equal reason exists for, and commensurate advantages will follow, a thoroughly discriminating control of both the initial fabrication of concrete, and the details of treatment during its hardening, in order to realize the great possibilities inherent in this newer material.

The treatment of steel is not always complete as it comes from the rolls, as is shown by such effects as the changes in strength produced by the cold-twisting of steel rods; much more important in relation to the resulting quality of concrete is the nature of its treatment after fabrication, both because its attainment of strength is a relatively slow process and for the reason that the nature of the prevailing conditions provided during this period affects so greatly the development of its essential properties.

The notable responsiveness of concrete to the character of its treatment is a direct appeal for thoroughly trustworthy and expert control.

WATERPROOF CONCRETE.

In connection with preparations for the construction of a new lighthouse in Germany, some interesting experiments were carried out in the direction of waterproofing concrete. Various mixtures of cement and fine sand, in ratios of from 1 to 1 to 1 to 6, and mixtures of 1 to 3, with the addition of various materials, as soft soap, were moulded into pot-shaped vessels about 15 in. high with 2½ in. walls. When these pots had set, some of them were filled with water and others, empty, were placed in water, and the density of the walls was judged by noting the time required to empty or fill, the water acting under a maximum head of about 10 in. It is curious to note that a satisfactory degree of imperviousness was not reached, since in every test the vessels emptied or filled within one hour. The relative success of the richest mixtures then induced tests of rich-rubbed surfacing. To this end the surfaces were first wetted, then thickly coated with cement paste, and with a soft brush the cement was rubbed well into the surface of the concrete. This procedure was repeated a number of times, until the pores were closed, and a satisfactory degree of imperviousness was then reached, as the pressure tests, continued for three days, showed that no water penetrated through the walls of the pot. It was the success of this method that decided the authorities upon building the lighthouse of concrete made impervious in the manner outlined above.

A RATIONAL FORMULA FOR ASPHALT STREET SURFACES.*

By J. Alden Griffin, Assoc. M. Am. Soc. C.E.

EVERY now and then the question is raised: "What is the proper crown to give an asphalt street?" and there is a discussion as to which of the many formulas of to-day gives the best results.

Having been asked this question many times in the past few years, and especially while connected with municipal improvements in Los Angeles, Cal., the writer has given the matter careful investigation, and, by a comparison of the surfaces proposed by the various formulas, has arrived at the conclusion that the crown rise should vary with the cross-fall as well as the grade of the roadway, and that a crown considerably lower than that proposed by the well-known formula of the late Andrew Rosewater, M.Am.Soc.C.E., should be used on streets having a cross-fall between the gutter grades. The writer even favors one which is slightly lower, where there is no cross-fall in the roadway; and, having reached these conclusions, he proceeded to determine the proper amount of reduction to make in the crown for varying cross-falls. After a great many experiments he adopted the following modification of Mr. Rosewater's formula. This gives the best results, using one-eighth of the cross-fall plus ¾ in. as the reduction factor, but some may wish to change $0.12H$ in the formula to $0.10H$, or even $0.08H$, in order not to reduce the crown quite so much; however, the following is recommended:

$$C = \frac{W\,(100 - 4\,p)}{5{,}000} - (0.12H + 0.06)$$

in which W = the width of the roadway between curbs, in feet; p = the percentage of grade longitudinally on the street; H = the cross-fall of the street, or the difference of elevation between the high and low gutters, in feet,

TABLE 1.

Width of roadway, in feet	Percentage of grade on street	Crown, with no cross-fall	Crown Rise, for Variable Cross-Falls, in Feet.											
			0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
28	1	0.48	0.45	0.42	0.39	0.36	0.33	0.30	....	....	....	....	....	....
28	2	0.45	0.42	0.39	0.36	0.33	0.30	0.27	....	....	....	....	....	....
28	3	0.43	0.40	0.37	0.34	0.31	0.28	0.25	....	....	....	....	....	....
28	4	0.41	0.38	0.35	0.32	0.29	0.26	0.23	....	....	....	....	....	....
28	5	0.39	0.36	0.33	0.30	0.27	0.24	0.21	....	....	....	....	....	....
34	1	0.59	0.56	0.53	0.50	0.47	0.44	0.41	0.38	....	....	....	....	....
34	2	0.57	0.54	0.51	0.48	0.45	0.42	0.39	0.36	....	....	....	....	....
34	3	0.54	0.51	0.48	0.45	0.42	0.39	0.36	0.33	....	....	....	....	....
34	4	0.51	0.48	0.45	0.42	0.39	0.36	0.33	0.30	....	....	....	....	....
34	5	0.48	0.45	0.42	0.39	0.36	0.33	0.30	0.27	....	....	....	....	....
40	1	0.71	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	....	....	....	....
40	2	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	0.44	....	....	....	....
40	3	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.40	....	....	....	....
40	4	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.40	0.37	....	....	....	....
40	5	0.58	0.55	0.52	0.49	0.46	0.43	0.40	0.37	0.34	....	....	....	....
46	1	0.82	0.79	0.76	0.73	0.70	0.67	0.64	0.61	0.58	0.55	....	....	....
46	2	0.79	0.76	0.73	0.70	0.67	0.64	0.61	0.58	0.55	0.52	....	....	....
46	3	0.75	0.72	0.69	0.66	0.63	0.60	0.57	0.54	0.51	0.48	....	....	....
46	4	0.71	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	0.44	....	....	....
46	5	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	0.44	0.41	....	....	....
56	1	1.01	0.98	0.95	0.92	0.89	0.86	0.83	0.80	0.77	0.74	0.71	....	....
56	2	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.70	0.67	....	....
56	3	0.93	0.90	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.63	....	....
56	4	0.88	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.64	0.61	0.58	....	....
56	5	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.63	0.60	0.57	0.54	....	....
62	1	1.13	1.10	1.07	1.04	1.01	0.98	0.95	0.92	0.89	0.86	0.83	0.80	....
62	2	1.08	1.05	1.02	0.99	0.96	0.93	0.90	0.87	0.84	0.81	0.78	0.75	....
62	3	1.03	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.70	....
62	4	0.98	0.95	0.92	0.89	0.86	0.83	0.80	0.77	0.74	0.71	0.68	0.65	....
62	5	0.93	0.90	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.63	0.60	....
72	1	1.32	1.29	1.26	1.23	1.20	1.17	1.14	1.11	1.08	1.05	1.02	0.99	0.96
72	2	1.27	1.24	1.21	1.18	1.15	1.12	1.09	1.06	1.03	1.00	0.97	0.94	0.91
72	3	1.21	1.18	1.15	1.12	1.09	1.06	1.03	1.00	0.97	0.94	0.91	0.88	0.85
72	4	1.15	1.12	1.09	1.06	1.03	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79
72	5	1.09	1.06	1.03	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73

*From Proceedings Am. Soc. C.E., for August, 1913.

and C = the height of the crown above the mean gutter grade, in feet.

It will be noticed that on a roadway having a very steep cross-fall the upper gutter will not hold water, which, in the majority of such extreme cases, will do no harm, and will very often save a cross-gutter at the intersection; however, it may be desired at some time to hold the water in the upper gutter, and this may be accomplished, without increasing the side slope of the surface, by shifting the crown to the upper side of the centre of the roadway as shown in Fig. 4, which indicates a special cross-section at that point.

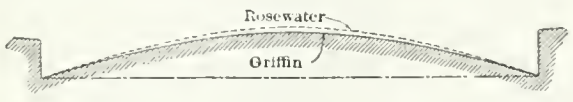

FIG.1

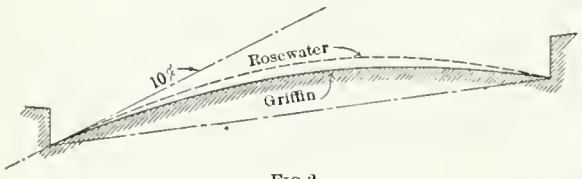

FIG.2.

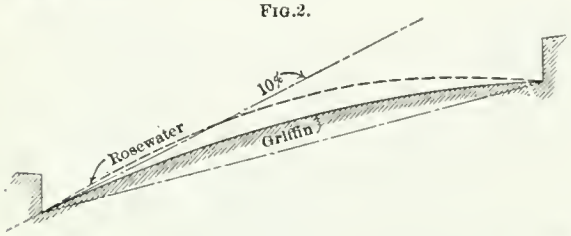

FIG.3.

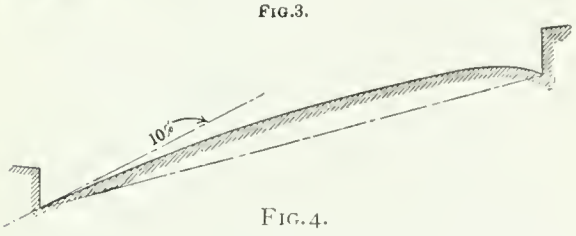

FIG.4.

Table 1 is compiled from the formula for the more common roadway widths in Los Angeles.

Figs. 1 to 4 illustrate the comparison between Mr. Rosewater's formula and the modification herein proposed on a 40-ft. roadway having a 1% grade. Fig. 1 is for no cross-fall; Fig. 2 for a cross-fall of 1 ft. between the mean gutters, and Fig. 3 is an extreme case with a cross-fall of 2 ft. between the mean gutters. Fig. 4 illustrates a section in which the lower half meets the formula and the upper half is modified to hold the water in the upper gutter.

A new building material, known as "Tekton," which is being introduced in Glasgow, is stated to be of the nature of artificial wood and to possess the strength and durability of concrete. The ingredients of which the material is formed are magnesite, granulated slag, chloride of magnesium, and "wood flour," and its principal properties are that it is porous, has a low heat conductivity, and is sound-proof, fire-resisting, odorless, and not liable to develop dry-rot. It is made in boards and planks, or it may be modelled in any required shape. It is claimed to be particularly suitable for use in the construction of portable buildings which have to be erected rapidly and cheaply.

RAILWAY EFFICIENCY.*

By Mr. A. Crumpton,
Assistant Engineer, Grand Trunk Railway, Montreal.

THE product of a railway is transportation, and the measure of its efficiency is the quality and cost of producing the same. In transportation upon land the railway has proven itself pre-eminently superior to any other way. It is a far cry from a rate of $1 per ton per mile for "packing" upon men's backs, or even 25c. per ton mile by team, to ¾c. per ton mile, which is the average cost to the public by railways in America. Passengers in America pay an average charge of a little less than 2c. per mile, and a trip of 500 miles in 12 hours is common. Only the man on the inside realizes what this means, both as regards perfection and economy of construction and operation.

In Europe the average freight charge per ton mile is 1½c.—double what it is in America—while passenger rates run from 1¾c. to 2c. for third-class to 3c. to 4c. for first-class accommodation. This is only of interest as showing where we stand, but does not prove anything as regards relative efficiency, the conditions of construction and operation being different on the two continents.

In 1870, the average freight rate per ton mile was 2c. as against ¾c. in 1909, a reduction in 40 years of 62%.

Mr. W. M. Acworth, an international authority on railway economics, who from time to time inspects American railways in the interests of English investors, says: "It has been my opinion that in actual economy of operation the railways of the United States are first in the world."

A railway to continue and increase its efficiency must not only keep up its lines and equipment for current traffic, but must have means in advance to provide for increasing requirements. This country is rapidly growing in population and wealth, and there is an insistent demand for a better and more improved passenger service, faster freight service, and greater safety. Since these things, speaking generally, do not increase revenue they are a proper charge against operating expenses, and should be met by increased rates for transportation, where necessary. The peculiar fact is that while the public appreciates the situation in ordinary matters and expects to pay more for better pavements or better clothes, yet, in matters of transportation it demands better service but refuses to pay more for it.

When, in 1910, a large section of the railways of the United States made application to the Interstate Commerce Commission for authority to increase rates, they were met by statements alleging lack of scientific management—that a million dollars a day could be saved by increased efficiency—and their request was refused.

Detailed records of cost of building and maintaining railways and of conducting transportation have now to be kept by the railways, at the instance of the commission, and the appraisal of all the railways in the United States has just been ordered, so that, no doubt, any future question of rates will be dealt with in the light of the efficiency shown by the railways.

Briefly, it is claimed that the railways fail in efficiency as follows:

*Read before the Canadian Railway Club, September 9th, 1913.

(1) Maintenance of equipment, which consumes about 20% of total operating expenses.

"Railroad repair shops throughout the country do not show 50% efficiency on an average as regards either materials or labor."—Emerson.

(2) Maintenance of way, consuming about 20% of total operating expenses.

"Standards of maintenance of way vary, but innumerable assays of actual work show a maintenance-of-way labor efficiency of scarcely more than 30%."—Emerson.

(3) Transportation, consuming about 50% of total operating expenses.

"Fuel.—On the Santa Fe average fuel used per 1,000 freight train ton miles was reduced from 261 lbs. to 239 lbs. On the Chicago, Milwaukee & St. Paul, 175 lbs. Dynamometer Car, 80 lbs."—Emerson.

"It has been demonstrated that by proper instruction, fuel consumption could be reduced at least one-half."—Brandeis.

Terminal expense, particularly the handling of less than car load lots, should be improved by the use of mechanical conveyers.

Maintenance of Equipment.—A fair comparison cannot be made between industrial shops with uniform output and railway repair shops with little uniform work, particularly as such repair work is incidental to the main purpose of producing transportation, and while low cost is desired, expedition is primarily which is required.

Maintenance of Way.—The fact that maintenance-of-way forces may be scattered over thousands of miles of line makes adequate supervision difficult, and that the labor requirements vary with the season makes it impossible to always have the force as efficient as could be desired. The force required to man a thousand miles of line could be concentrated on one acre in a textile mill, so that comparisons of efficiency made under such conditions would be unsatisfactory.

Transportation.—Transportation forces are strongly organized and militant, largely increasing the difficulty of reducing labor charges, but by betterment of roadway and the use of heavier power the railways are effecting such economies as are possible. In this connection Mr. Emerson said: "The efficiency of the traffic by my standards is very high; that is, the efficiency of expense in the traffic departments."

As regards economy in fuel and in its use, this has ever been a subject of investigation on the part of the railways, as also that of mechanical conveyance.

It may also be said that railway development has been proceeding along logical lines. First, the period of railway building, then one of traffic organization and consolidation, followed by one of betterments, embracing perfecting of machinery, strengthening roadbed and bridges, cutting down grades and increasing the motive power and weight of trains. Now the human factor is coming in for increased attention and systems of organization are being studied to the end that the machine as a whole may be brought to the highest efficiency.

In this connection it will be interesting to examine the fundamental principles of scientific management as given by Mr. Frederick W. Taylor, its originator:

"1st.—Each man in the establishment, high or low, should daily have a clearly defined task laid out before him. This task should not in the least degree be vague or indefinite, but should be circumscribed carefully and completely, and should not be easy to accomplish.

"2nd.—Each man's task should call for a full day's work, and, at the same time, the workman should be given such conditions and such appliances as will enable him to accomplish his task with certainty.

"3rd.—He should be sure of large pay when he accomplishes his task.

"4th.—When he fails he should be sure that sooner or later he will be the loser by it.

"When an establishment has reached an advanced state of organization, in many cases a fifth element should be added, namely, the task should be made so difficult that it can only be accomplished by a first-class man."

The railway as a proposition is characterized by its great extent requiring unusual specialization in every branch and this has in the earlier days led to undue centralization and the creation of departments whose heads endeavored to perform both "staff" and "line" duties. A departmental organization of this kind, projected over large areas with distant headquarters, has proved cumbersome in operation, a breeder of departmental jealousies, and unsatisfactory to both the public and employees. This type of organization is now being superseded by one in which the "staff" and "line" functions are being separated. "Staff" functions, consisting largely of the theoretical side of the work, studying the underlying principles, whether physical or psychological, which make for efficiency in construction and operation; systematizing and standardizing every operation; providing instruction as to application and formulating means by inspection and otherwise for unerringly recording attainment, is necessarily the work of specialists.

Line functions, consisting of the more practical side of the active conducting and directing of the work is none the less the work of specialists and experts, but of execution rather than design.

Line officers are in charge of stated districts, representing the railway in general and not any particular department. Under this arrangement the different departmental activities are co-ordinated and all the advantages of the public and employees being brought into close touch with a responsible representative of the railway gained.

In line with this, the accounting for each district is done on that district, to the end that greater accuracy may be attained by first-hand knowledge and the officer in charge of the district be in possession of all the figures pertaining to the work for which he is responsible, thus enabling him to supervise more intelligently.

A further development follows—that is a common office and file. While merely a detail, this has proved of great value in reducing the volume of correspondence and locating upon one file everything that pertains to any given subject. The use of this system on the railways recently known as the Harriman lines saved half a million letters a year.

Since material as well as labor enters into the work of a district, it is logical that this, both as regards purchase and supply, should be as far as possible in the hands of the local man, in order that he may be informed on every point. In the larger matters, blanket contracts would be let and districts would simply order under these, while in minor matters, standard prices would be fixed and when goods could be purchased locally as cheaply, preference would be given to the district, thus decreasing handling and increasing the good-will of the local public.

The distribution of the prime functions of railway building and operation would be:

Headquarters.—Building of railway; construction of equipment; creating standards for conducting transportation, and for maintenance of roadway and equipment, as well as for the necessary instruction and inspection.

District.—Conducting transportation; maintenance of roadway; maintenance of equipment.

A superintendent with a staff expert in the above-mentioned lines, and first-hand knowledge through his accountant of actual costs to compare with standard costs, both of labor and material, would at all times know the relative efficiency of his district.

The strong feature of this type of organization is that with reasonable standards of work to be performed, everybody concerned from start to finish has something by which to measure his work. A New York contractor, as an experiment, arranged for each man to have a bucket to shovel into. Result—almost at once the number of buckets that came out of the hole was doubled.

The creation of standard practice, both as regards methods and cost, is merely an elaboration and extension to every operation of practice now in vogue on all railways. For example: it is decided to bring a line up to a certain standard. Careful account is taken of what exists, then the method of producing the desired result is determined, written instructions are given and the cost calculated. Or a new train service is to be put on. Its requirements are determined, time tables prepared and its cost calculated.

Working to standards throws into prominence any over-running of standard costs, and this acts automatically, and those in immediate charge of work look into the cause and remove it if possible, and if unavoidable keep proper records of its nature, for the creation of a new standard, if necessary.

Increasing Efficiency.—Efficiency experts have placed railway efficiency at 70% as against 60% in industrial concerns generally. While the total elimination of waste is impossible, certain classes of work have on many roads reached a much greater efficiency than the above average.

The first step should be to ascertain, tabulate and analyze present practice with particular reference to unit cost of performance. In most cases this could be done with little or no additional expense, simply the introduction of forms designed to this end in place of those now in use. The knowledge so obtained would be a basis from which to work, in fact, could be used as a standard of measurement pending the introduction of proper efficiency standards. Concurrently, present standard practice, as ascertained on one road should be compared with standard practice on other roads or elsewhere, and when a superior method is found it should be adopted. Plans should be made, written instructions prepared of every step of the operation, not only what is to be done but how, and a standard of cost provided.

The following is an example from shop practice: Mr. Emerson went to the Santa Fe and found the annual cost of maintaining belting was 100% of its first cost. From previous experience he knew that this figure should be about 14%. Having this to work on, the best belting obtainable was purchased, 5% above the market price being paid for the privilege of rejecting unsatisfactory belting. A man was put in charge of the belting with instructions that belts were to be kept in condition and replaced before and not after failure. Results—failures reduced from 300 a month to 50 and cost dropped from 100% to 14%. Incidentally machines were not delayed.

In the creation of standards details down to the tool or machine to be used for a given service are specified. For example, in section work the relative economy of hand cars and motor cars is ascertained. Cars are then studied, improved and standardized, and under given conditions, which is to be used is specified.

The following are a number of instances of increased efficiency given before the Interstate Commission:

1. When applied to the simple operation of loading by hand a railroad car with pig iron, the performance of the individual worker increased from 12½ to 47 tons per day.

2. When applied to shovelling coal, it doubled or trebled the performance of the shoveller.

3. When applied to machine work, it developed in certain operations, increases in production, ranging from 400 to 1,800 per cent.

4. When applied to bricklaying, the day's accomplishment rose from 1,000 to 2,700 bricks.

It should be borne in mind that in dealing with this side of the question that a representative of railway labor appeared before the commission and stated that the methods referred to could not and should not be introduced into railway work. In like manner the introduction of the Mallet Compound locomotive was strongly resisted by the Brotherhood of Locomotive Engineers, and organized efforts were made by conductors and trainmen to have double-heading prohibited. The fact is that labor organizations, notwithstanding the good which they have accomplished, are, as at present constituted, by their very nature, detrimental to efficiency. Employees in their respective classes are allied with like classes on other railways, for the furtherance of their particular class interest, and where this interest demands it, the interests and rights of fellow-employees, the public and the owners are made subordinate to their own. With the railway the tendency is to make the standard the pace of the fastest while with the union it is towards that of the slowest. The reasonable standard is somewhere between these extremes and should be scientifically determined, both as regards performance and remuneration, and the present system of highly organized labor holding a pistol at the head of the railways, to the detriment of classes less highly organized should be abolished. It would not be easy and would take much time, but it is conceivable that with a scientifically arranged and, therefore, equitable schedule of wages covering every branch of railway service, the settlement of schedules would become a matter peculiar to each railway and not determined by conditions on other railways having no bearing on the case. Such an arrangement would at least be an effort to give a "square deal" to all classes of employees.

As showing the way how not to create standards I quote the following from "Scientific Management of Railways," by W. J. Cunningham:

"The year 1910 saw the successful culmination of an ambitious plan to 'standardize' the wages of conductors, trainmen, and yardmen in the Eastern States; that is, to set a uniform rate per day, per hour, or per mile for each class of service, regardless of local conditions. The road with the highest wage scale (the Baltimore & Ohio) was selected as the battle ground, and the entire forces of the train-service brotherhoods focused upon it in a demand for new and unreasonably high rates. To prevent a strike the railroad invoked the aid of the Board of Mediation under the Erdman Act, and the award, while not granting the rates demanded, carried with it substantial increases over rates already considerably higher than those of other

roads in the East with distinctly different operating characteristics. The new basis was then in turn forced upon practically every road in eastern territory. The increases in New England averaged between 20 and 30 per cent., and in some cases exceeded 50 per cent. At the same time long standing differentials between different grades of employees were seriously disturbed. Throughout, the new wage basis and working rules (prescribed partly by governmental mediation) are far from scientific or equitable."

Cost keeping must be systematized with the same care as other operations and be beyond criticism to be effective. The old saying that there are "lies, d—— lies and statistics" had its origin, no doubt, in poor cost-keeping. There is a story told of a locomotive standing in the shop waiting for small repairs where costs were carefully (?) kept and everything had to be charged. The old locomotive came in for all doubtful and odd charges until, at the end of three months, it had $5,000 charged against it.

If time is wasted it should be known as surely as if material is wasted and should be considered a reflection upon the system rather than upon the individual. The trouble is that where standards are lax there is an uncertainty as to where such waste is taking place, and advantage is taken of this to let the matter go.

Cost-keeping as above is becoming necessary to comply with the requirements of the Interstate Commission.

The phase of the situation which is the peculiar problem of to-day—that is, the bringing of the human factor in the machine up to standard—is first and last a matter of men, the production of highly trained men, for however efficient in design an organization may be, its real efficiency is measured largely by the human element. Unfortunately, under present conditions, a man enters railway life at the point of least resistance and gets where he can by force of circumstances and native wit. The result is that thousands of men are struggling to hold positions for which by nature they are largely unfitttd. For certain railway positions men are specially selected, the unfitted being rejected. Why should this not be the case for all? For practically every class of material used specifications have to be complied with, and a certain standard attained to be accepted. Why should this not be the case with men? Psychology has made such strides that it is conceivable that a bureau for the purpose could, after some experience, pass upon all applicants, and after deciding upon their general fitness or unfitness for railway work, guide as to the particular class of work for which they are best adapted. Inefficiency under present conditions is often as much a matter of circumstances as any fault of the individual.

When once accepted for railway service a boy or man should have definitely placed before him the necessity for qualifying for the position ahead, and failure to respond should be taken as an indication of unfitness for his particular work or lack of ambition, and the case should be dealt with accordingly. Vocational training has many enthusiastic advocates among railway officers, and is more or less the practice on some of our large systems, so that the material is not wanting for the elaboration of this idea.

The intelligent application of the principles briefly outlined above was the means by which the German army became well nigh invincible, and the nation has in a generation by scientific administration and rational educational training of its people, notwithstanding the poverty of its natural resources, passed from inefficiency to the front rank among the nations of the world.

The nucleus of the foregoing exists on the railways as operated to-day and all that is needed is that present practice should be brought up to date to meet expanding needs, and more thoroughly understood by all concerned. Speaking generally, what we need is a better understanding between head and hand, the proper blending of theory and practice; the creation of a feeling down to the last man that the railway interests are his and that in furthering its interests he is furthering his own.

THE WATER SUPPLY OF PARIS.

THE city of Paris is supplied with water from many different sources, and the distribution of the supply is under the control of several separate companies, and in part only by a committee of the municipality. Samples of the water from each of the supplies are taken each week and examined chemically and bacteriologically at the municipal laboratory at Montsouris, by Mr. F. Diénert, the official chemist and bacteriologist to the city of Paris. The results are published from time to time in the official municipal bulletin of the city. The bacteriological results, for a period of six months, from September, 1912, to March, 1913, as recently published in Engineering, London, are set forth in Table I. from which a comparison of the results obtained by the various systems of water purification may be made.

In the case of the four large service reservoirs at Paris, supplied respectively by aqueducts from the rivers Marne, Loing, Dhuis, and Avre, it will be noted that the bacteriological results are extremely variable, depending to a large extent on the rainfall and consequent state of each river. With regard to the filtered water supplies, the following is a brief summary of the systems employed at the various works.

At Choisy-le-Roi the raw water of the Seine is first passed through Anderson revolving purifiers, by means of which a certain quantity of ferrous oxide of iron is taken out by the water as it flows through. This iron is precipitated as ferric oxide in labyrinth settling-tanks—that is to say, decanting basins—through which the water is made to flow in a continuous stream by means of baffle-walls from inlet to outlet. Recently, however, this system has been partly abandoned, and one-half of the labyrinth settling-tanks have been transformed into roughing-filters, after which the water passes to ordinary sand filters. The roughing filters are scraped by means of the Boistel automatic machine.

At Neuilly the water of the Marne is treated by the ordinary system of decanting-basins and sand filters. At Nogent-sur-Marne decanting-basins, roughing-filters, and slow sand filters are employed. At Ivry Puech "degrossisseurs" were installed some 14 years ago, but the water passes direct from these on to slow filters, instead of being passed through coarse-sand pre-filters in series between the degrossisseurs and sand filters, as in the case of more modern installations on the Puech-Chabal system. At St. Maur, roughing-filters of the ordinary type are employed previous to slow sand filtration, after which the water of the Marne is passed through ozone sterilizers.

Week Ended	UNFILTERED WATER SUPPLIES.				FILTERED WATER SUPPLIES.											
	Montsouris Reservoir.		Menil-montant Reservoir.	Montretout Reservoir.	Choisy le-Roi		Neuilly.		Nogent-sur-Marne		Ivry.		St. Maur.				Suresnes.	
	River Vanne Water.	River Loing Water.	River Dhuis Water.	River Avre Water.	Raw Water (Seine).	Filtered Water.	Raw Water (Marne).	Filtered Water.	Raw Water (Marne).	Filtered Water.	Raw Water (Seine).	Filtered Water.	Raw Water (Marne).	Filtered Water.	Water after Sterilisation by Ozone.	Water from delivery Mains.	Raw Water (Seine).	Filtered Water.
1912.																		
Sept. 29	60	150	300	40	4,400	80	900	50	1,600	10	6,200	28	8,100	420	1	—	116,000	29
Oct. 6	286	132	310	242	—	—	400	308	300	36	148,350	41	2,400	36	2	—	144,300	13
Oct. 13	90	90	310	400	12,770	145	2,000	50	—	—	11,760	42	700	14	0	—	56,000	63
Oct. 20	135	120	110	250	54,785	271	34,390	70	—	—	41,730	91	5,500	14	0	—	81,320	66
Oct. 27	250	230	260	870	40,985	659	5,500	214	—	—	61,270	64	19,450	40	249	—	88,200	32
Nov. 2	787	733	4012	305	5,670	27	15,360	130	—	—	10,920	50	12,720	10	113	—	58,500	35
Nov. 9	610	260	453	874	52,115	535	50,180	576	—	—	25,270	42	18,120	24	—	—	49,000	28
Nov. 16	523	329	370	245	12,600	237	21,200	220	—	—	14,200	51	29,200	230	—	80	21,700	41
Nov. 23	129	172	473	868	34,800	260	3,600	28	—	—	580	44	7,900	60	—	199	32,300	71
Nov. 30	87	122	2446	562	14,600	112	34,060	160	—	—	12,400	220	20,800	160	—	219	22,000	20
Dec. 7	740	210	2496	350	44,710	375	45,000	364	—	—	64,370	270	14,900	20	—	152	42,000	32
Dec. 14	210	205	540	689	37,740	880	19,700	470	—	—	30,400	215	13,000	110	—	278	117,120	18
Dec. 21	540	420	911	1662	32,400	120	15,100	170	—	—	84,200	181	12,500	165	—	1170	55,620	17
Dec. 28	462	420	911	1408	69,440	840	24,200	218	—	—	82,080	104	15,600	235	—	158	21,450	19
1913.																		
Jan. 4	260	363	291	803	33,400	660	—	—	—	—	22,600	60	34,000	510	—	156	30,800	16
Jan. 11	297	143	253	286	21,350	665	30,250	88	—	—	35,480	26	28,800	215	—	190	20,900	6
Jan. 18	200	195	1254	310	21,400	540	120,250	412	—	—	29,200	63	46,600	115	—	133	4,500	19
Jan. 25	440	722	816	570	126,600	1930	96,200	547	—	—	102,370	58	44,800	390	—	203	43,450	33
Feb. 1	968	401	816	1331	97,300	2015	120,250	412	—	—	44,770	70	25,600	455	—	410	85,250	14
Feb. 8	975	358	606	406	51,000	570	30,450	445	—	—	23,520	59	47,200	650	—	920	74,400	19
Feb. 15	92	82	312	356	10,200	330	11,570	33	24,360	375	24,000	54	34,000	1620	—	690	24,680	14
Feb. 22	126	154	341	210	9,600	490	5,500	25	6,000	427	21,200	116	13,600	559	—	190	12,100	15
Mar. 1	749	209	962	713	12,600	530	20,600	1084	36,720	4115	21,400	—	14,600	295	—	806	75,820	59
Mar. 8	125	195	962	442	12,400	580	17,080	840	1,059	30	35,420	187	15,400	155	1	144	46,360	53
Mar. 15	89	52	203	160	20,800	304	2,250	17	6,250	90	22,200	67	25,200	175	1	420	10,550	24
Mar. 21	125	81	748	934	—	—	—	—	—	—	39,933	158	46,600	560	4	168	56,500	29

TABLE II.—SUMMARY OF RESULTS AT FILTERING STATIONS.

Total Bacteria per Cubic Centimetre after an Incubation of Fifteen Days.

—	Average.	Highest.	Lowest.
Choisy-le-Roi, (Seine)—			
Raw water	34,711	126,600	5,070
Filtered water	544	2,015	27
Neuilly, (Marne)—			
Raw water	30,249	120,250	400
Filtered water	288	1,084	17
Nogent-sur-Marne, (Marne)—			
Raw water	11,041	36,720	300
Filtered water	726	4,115	10
Ivry, (Seine)—			
Raw water	39,070	148,350	580
Filtered water	96	270	28
St. Maur, (Maine)—			
Raw water	21,434	47,200	700
Filtered water	278	1,620	10
Ozone sterilizers	42	249	0
Supply mains	352	1,190	80
Suresnes, (Seine)—			
Raw water	53,533	144,300	4,500
Filtered water, (mains) .	33	82	6

All of the above filtering stations draw their supplies from the Marne or Seine above Paris. At Suresnes the raw water of the Seine is drawn from the river after it has received the refuse from the city. It is pumped to the filtering station on Mont Valerien, where it is treated by a complete modern plant of multiple filters on the Puech-Chabal system., consisting of four series of degrossisseurs, coarse-sand pre-filters, and final slow sand filters. The pre-filters and sand filters are all fitted with automatic regulators.

The summary of the results, given in Table II., clearly shows that the more elaborate the filtration plant the more regular are the bacteriological results; and although at Suresnes the raw water contains a far higher number of bacteria per cubic centimetre than at any other filtration station, the results are extremely regular, the highest figure recorded in the final filtrate being 82 per C.C.; the average 33 per C.C., and the lowest 6 per C.C.

The samples at Suresnes are drawn from the supply mains after the water has been stored for about two days in the service reservoirs. At St. Maur it is curious to note that while the sterilizers occasionally eliminate all the bacteria, these appear again in the supply mains, after the operation of sterilizing, in apparently higher numbers than those found in the filtered water before sterilizing.

At Ivry a sterilizing installation on the ultra-violet-ray system has recently been installed; and it will be interesting to note in a future summary of the bacteriological results, whether the bacteria are augmented in this case also after sterilization. Unless filtration is carried out with a due regard to the time necessary for nitrification, the effluent is frequently too highly charged with organic matters in solution, and a possible explanation is that the bacteria afterwards found in this water are nitrifying bacteria, which would naturally multiply rapidly until they had fulfilled their function of mineralizing the organic matters in solution. It should be stated that the whole of the figures in the table are obtained by the French system of counting the colonies after an interval of 15 days.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

The Road Congress in Detroit 469
Edmonton's Water Problem 469
A New Train Control 470
Cost of Wood Block Pavements 470

Leading Articles:

The Water Level of Lake Erie 453
Basic Open-hearth Steel Castings 457
The Expression of Pivot Errors by a Formula 459
Shellfish Conservation and Sewage Disposal.. 460
The Effect of Saturation on the Strength of Concrete 461
A Rational Formula for Asphalt Street Surfaces 463
Railway Efficiency 464
The Water Supply of Paris 467
The Water Supply of Edmonton, Alta. 471
The Harrisburg Filter Patent Decision 474
Approximate Calculations of Transmission Lines With Distributed Capacity 475
Belt Conveyers 477

Coast to Coast 480
Coming Meetings 482
Personals 482
Railway Orders 483
Construction News 75
Market Conditions 92
Technical and Municipal Societies 94

THE ROAD CONGRESS IN DETROIT.

Now that Canada has fully entered upon a new era of road development whereby the introduction of heavier, faster and more numerous traffic will be met by the adoption of more scientific methods in road engineering, Canadian municipal and highway engineers should come forward with keener desires for closer relations with those in the van of highway engineering throughout the world. It was not the good fortune of many to have been able to attend the London Congress in June. Doubtless the substantial gain therefrom in acquiring a fund of information of utmost practical value to them in their work would have vindicated the sacrifice of time and duties, had not such factors so strongly asserted themselves at that stage of the summer. From those who did attend Canada hopes to acquire many improved ideas, of practical value.

The Canadian Engineer has several times, of late, called the attention of its readers to the Third American Road Congress, Sept. 29th to Oct. 4th, in Detroit. The official programme appeared in Sept. 4th issue. No phase of highway work seems to have escaped the designs of the committee responsible for the programme, and the coterie of speakers is a substantial inducement in itself.

The educational advantages of the Congress should be grasped by Canadian municipal authorities. Many municipalities are not content with traffic conditions, and, while on the lookout for the essentials of better construction, their officials should not overlook the Detroit meeting, where papers and discussions will provide them with the brand of information which they find to be indispensible. Considering the enthusiasm which is being put into the movement for better Canadian roads, and the value that the Third American Road Congress will prove itself to be in this respect, a good representation of Canadian highway and municipal engineers should be in evidence.

EDMONTON'S WATERWORKS PROBLEM.

Like many another city, Edmonton has before it an acute problem in the acquiring of a better and a greater water supply. The question has been under heavy fire during the past year. Like many a western city, also, geographical and other conditions forbid placing material reliance, toward a solution, upon the designs carried out in the older and slower-growing cities of the East. The application of engineering skill must be direct. A thorough conception of principles underlying water service, blended by an exhaustive knowledge of all contingent conditions of the past and present, and a judicious forecast for the future, makes it a problem that only highly qualified engineers may be relied upon to handle. A water problem for a city differs from city planning, street paving, transportation, and others prominent in the category of municipal affairs, in that it has such a direct bearing upon life and health. It thereby maintains a degree of importance calling for the best, whether or not the attached expenditure is away and beyond comparison with that for other municipal works. Water supply is the chief contender for the most expert attention and advice in any municipality.

Edmonton is certainly not exempt from difficulties in the way of a pure supply, and the civic authorities are fully awake to the acuteness of the situation. The Saskatchewan River, the only feasible source, flows directly through the city, and its water is subject to dangers of

pollution from various causes. Again, the growth of the city has been phenomenal. From a town of about 2,600 in 1901, it has grown into a city with a population approximating 67,000, practically doubling its number of citizens every four years. Indications point to continued development, wherein lies a weighty and perplexing problem for the engineer who sets about to design systems for the requirements of future years. The average life-time which considerable portions of such a system may attain is 30 or 40 years. It need hardly be wondered at, that there are radical differences, at times, in the opinions of highly competent engineers, in their endeavors to find the best solution to problems such as Edmonton's. One point is clear: an adequate and consistently pure supply of water in the service mains commands superiority over antagonistic factors of speedy installation, low first cost, low operating costs, etc. In the consideration of the reports now in its possession, the city of Edmonton should keep constantly in the foreground the desirability of establishing a system that will provide such a supply; that may be extended as the city grows without unnecessary scrapping of plant before its day of usefulness has expired; and that will not be lacking in efficiency throughout its life-time, as a result of curtailment of initial expenditure with an aim at economy. For it must be acknowledged that, owing to the indefiniteness of the city's needs twenty or even ten years hence, the most careful aim at true economy in the construction and operation of the system may fall very widely off the mark. It remains, therefore, to make now the safest selection of source; then choice of the best site, and economic factors may enter the problem. Indefiniteness of future requirements makes the latter subsidiary to the former.

A NEW TRAIN CONTROL.

Mr. F. W. Prentiss, of Toronto, recently conducted a very successful demonstration of the Prentiss system of automatic "wireless" train control, of which he is the inventor, at the Hampton Court Station of the London and South Western Railway (England). In this system the track is divided into a number of insulated sections, in each of which a low-voltage track circuit is arranged, with, in addition, a high-tension wave wire running between the rails. At the end of each section is a box containing the high-frequency plant for the supply of current at 20,000 volts to the wave wire. This plant is controlled by a relay in connection with the track circuit of the section ahead, with the result that if that track circuit be short circuited the controlling relay is de-energized, and the supply of high-tension current to the wave wire ceases. The locomotive is fitted underneath with an arrangement of wires equivalent to the antennæ of the ordinary wireless apparatus. These receive the energy transmitted from the wave wire, and by means of a system of coherers and relays in the cab a green "line-clear" signal is provided for the driver if the section ahead is unoccupied. If, however, the section ahead be short circuited the wave discharge ceases, and a red light is shown and a buzzer simultaneously sounded, while the brake is at the same time applied, these operations being effected by power obtained from a battery in the cab. Provision is made to enable the driver to release his brake, but the red light and the buzzer continue until the section ahead is cleared, when the high frequency supply is re-established and normal working is resumed. The system, therefore, provides for a continuous danger signal on the locomotive so long as the line is not clear, the automatic application of the brake and a prompt intimation of the restoration of line clear conditions. In the event of failure of the high-tension, or the track circuit danger indications would be given. The operation of the cab apparatus naturally depends on uninterrupted battery supply. The demonstration was quite successful, the train being brought up on every trial by the automatically applied brake, although the regulator was untouched. The system requires electrical supply to all the section-boxes, and transformer plant in each section-box, in addition to the boxed-in high-tension wire between the rails and the apparatus on the engine. The expense question is therefore one which will have to be seriously considered before the system is likely to be largely adopted. In addition to initial cost the working cost must also be taken into account, the power taken by a half-mile section being about 1 horse-power.

COST OF WOOD BLOCK PAVEMENT.

In an article on street and pavement construction, which was published in our issue of September 4th, 1913, the following paragraph appeared on page 410:—

"In Hamilton this pavement (creosoted wood block) has become so popular that some residential streets have petitioned for it on account of its quietness; although it is a costly pavement, running from $2.25 to $2.65 per square yard, according to the kind of block, whether plain or grooved for heavy grades. All of these pavements have assumed a concrete base 6 in. thick at least on business streets, with a mixture not less than 1:3:6, which will cost from 50 cents to 60 cents per square yard."

Some readers are evidently under the impression that the city engineer of Hamilton, who was the author of the above article, meant that the cost of the foundation was included in the "$2.25 to $2.65." This is not the intended meaning. The cost of the foundation is extra, and the wood block is estimated by Mr. Macallum to cost from $2.25 to $2.65 per square yard, assuming that it is to be laid on a good concrete foundation.

In this article also the second paragraph of the second column of page 409 refers to "a temperature not less than 28%," where "28° F." was intended.

For the equipment of the two new battleships now being built at the Government dockyards of Lorient a crane of the Goliath type has been put in service, able to deal with a load of 150 tons, divided between two parallel travelling crabs of 75 tons, which can work separately or simultaneously. The crane consists of an inner framework or tower, surmounted by a platform which supports a cast-steel roller path, and of an outer slewing framework carried on the supporting tower. The lower part of the outer framework is fitted with rollers running on the roller path, which is of 14m. outside diameter. The jib has a total length of 70m., and is composed of lattice girders spaced 6.40m. from centre to centre. The crane has a maximum radius of 23m. with 150 tons and 30m. with 75 tons; a lifting speed of 1.50m. a minute with 150 tons, or unloaded of 4m. a minute; and a speed of horizontal motion of 8m. a minute with 150 tons. The upper part of the jib is fitted with a runway on which travels an auxiliary crane of 20 tons, designed with a lifting height of 60m. and a lifting speed of 10m. per minute (loaded). The crane has been successfully tested with a load of 180 tons at 23m. radius and with 90 tons at 30m. radius.

THE WATER SUPPLY OF EDMONTON, ALTA.

A DESCRIPTION OF THE PRESENT SYSTEM—SOURCE OF SUPPLY UNDER DISCUSSION — IMMEDIATE EXTENSIONS NECESSARY—RECOMMENDATIONS AND ESTIMATED COSTS*

THE water supply for the north side of Edmonton is drawn from the Saskatchewan River through intake pipes, and pumped by low-lift pumps to a sedimentation basin, in which the bulk of the solids are deposited. Hypochlorite of lime is applied to raw water before its entry into the basin. The water then flows by gravity to a battery of filters, thence to a clear water basin. By high-lift pumps the purified water is forced directly into the distributing mains, the normal pressure of 100 pounds being raised to 120 pounds, or thereabouts, for fire service.

The south side is supplied with water by an independent pumping station, without sedimentation or filtration. A submerged force main was partially laid during last winter. When the low stage of the river arrives this main will be completed and the south side will be supplied by filtered water from the main system. The mains and service pipes on the south side are now being filled with liquid mud that flushing cannot completely remove. Treatment by hypochlorite of lime is relied upon solely to reduce the bacteria.

Three intake pipes have been laid to date, not including the original intake of 1902, which was abandoned some years ago. One of these three is available during the winter months only; a second was blocked during the high water in 1912 and has not yet been cleared; the third, completed in 1913, is now furnishing the supply. This last is a 36-inch steel pipe provided with an intake crib located about 200 feet from the shore.

The low-lift machinery comprises three units, all steam-driven turbine pumps, and with a daily capacity of 12 million gallons. There is also an electrically operated turbine pump of three million gallons capacity which is used during winter months only. The high-lift machinery comprises two pumps of two and a half million gallons total capacity, steam-driven, now held in reserve in the original pumping station, a vertical Inglis plunger pump with a normal capacity of six million gallons, seldom operated, and two turbine pumps of the same capacity that are now relied upon for the normal supply. Two electrically operated turbine pumps, each with a capacity of 10 million gallons, are in the course of erection, and an additional low-lift, steam-driven unit of 18 million gallons capacity is on order.

In the original system an open sedimentation basin of less than one million gallons capacity was constructed, which gave satisfactory results. This basin is not now in use as part of the waterworks system. Another open basin has been constructed, with a capacity of about one and a half million gallons, into which the low-lift pumps discharge. By a central longitudinal baffle partition, the water entering at one corner is forced to flow from end to end, returning through the other half of the basin, the greater part of the silt being deposited near the inlet. This basin effects the removal of about 95 per cent. of the solids in suspension during the periods of maximum turbidity.

In 1910 the Roberts Filtration Company installed a temporary filtration plant comprising eight units, which, for various reasons, was not entirely satisfactory. In 1911 the company added four additional units of steel, the former units being of wood. Last season the results were more satisfactory, but not entirely so. This filtration plant is in the open, unhoused, and cannot be operated during the winter. In the autumn the filters are emptied, the filtering materials being replaced in the spring. The drying out of the wooden tubs caused them to leak and the cost of emptying and refilling them was no small item. This year the plant was overhauled, different sand used, and the results during July have been most satisfactory. The plant can now easily filter six million gallons daily, the effluent being perfectly clear, and the turbidity zero. Filtration alone materially reduces the bacteria present, but sufficient examinations and analyses have not as yet been made to warrant a statement being presented of the actual reduction made.

The city has under consideration an additional filtration plant of five million gallons daily capacity, comprising coagulating basins, filters, clear water reservoir, laboratory and chemical room, the entire plant to be enclosed in a suitable building.

The distribution system includes the following lengths of mains and sizes, laid to June 30th, 1913:

20-in.,	8,112 feet	14-in.,	5,923 feet	8-in.,	88,696 feet
18-in.,	2,889 feet	12-in.,	20,969 feet	6-in.,	343,419 feet
16-in.,	2,145 feet	10-in.,	40,517 feet	4-in.,	69,306 feet

This makes a total of 110.22 miles of pipe. Of the total distribution system over 70 per cent. is 6 in. and 4 in. in diameter, which is claimed to be too high a proportion for a waterworks system.

Necessity of Extension and Investigation of Supply.—The present unsatisfactory condition of the existing waterworks system in Edmonton is largely due to the unsettled question: Shall the supply continue to be drawn from the river at the present pumping station site, or shall the supply be taken from a source less liable to future pollution?

The demand for water is rapidly increasing, and additions to the present pumping plant are urgently needed. Further, improvements are required in the filtration plant and larger force mains are necessary to give proper fire protection.

Source of Supply.—There is no doubt that the city of Edmonton must rely upon the Saskatchewan River for its present and future water supply. The distance from the Rocky Mountains precludes mountain streams, and the elevations of the streams to the northwest, west and southwest of the city are insufficient to give a great supply. Pigeon Lake, distant about 42 miles southwest of the city, has been suggested as a source, but the conditions, when carefully studied, lead to the conclusion that it would not yield the requisite supply, neither would the quality of the water at all times be satisfactory, even after

*From a report dated August 9th, 1913, by Willis Chipman, C.E., to the City of Edmonton.

filtration. The capital cost of the project would be excessive. Further, it would only be a waste of time and money to investigate the possibility of securing a water supply from small streams and lakes or from deep wells. The city requires an unlimited supply of water, suitable for domestic and industrial purposes, delivered at a reasonable cost. This can only be supplied by the Saskatchewan River which flows through the city.

Quality.—Above the city the river water is free from sewage pollution, and there is no immediate prospect of cities or towns springing up upon the main stream or any of its tributaries between the city and the Rockies. The most serious objection to the river water is its turbidity, in which respect it resembles the Missouri at St. Louis, the Ohio at Cincinnati, and the Red River at Winnipeg.

During the months of May, June and July, 1911, the turbidity ranged from 5 to 850, and the solids in suspension from 167 to 2,260. During the same months in 1913, the turbidity ranged from 40 to 950, the average being 215.

The melting snow in the mountains during hot days or heavy rains produces great fluctuation in the river, from ten to twenty feet being the difference between low-water and high-water. In 1899 a level of 35 feet above low-water was attained, the highest observed since a traditional flood about sixty years ago.

High water is invariably accompanied by high turbidity, due to the caving in of cut banks. But during the late autumn and winter months, when the river is ice-bound, the water is clear, and for a month or more after the ice leaves the turbidity is low.

By the simple process of sedimentation, 95% of the solids may be removed, and the remaining 5% by filtration, the effluent being clear and sparkling. With a turbidity approaching 1,000 in July, 1913, the effluent from the filters was perfectly clear.

The hardness varies from 50 to 100 in the summer months, and the alkalinity from 100 to 200.

Recently bacteriological examinations of the river water have been made at the Provincial Laboratory, and show a high bacterial count. Sedimentation and filtration remove a large percentage of these bacteria, but treatment by hypochlorite of lime is relied upon to destroy those remaining.

The typhoid outbreak which occurred in September, 1912, was not attributed to the public water supply by the health authorities. The cause, however, has not been determined, and there is a likelihood that the water supply may have been contaminated, as the filtration plant was not working satisfactorily at all times. This season, however, the treatment of the supply is receiving more careful attention and the typhoid rate is below the normal.

Quantity.—The average quantity of water required for all purposes in cities of 100,000 population is about one hundred gallons per capita, where the services are unmetered. In metered cities the consumption varies from fifty to seventy-five gallons, the average being about sixty-six gallons; that is, by metering the capacity of the entire plant is increased by fifty per cent. As Edmonton is now an unmetered city, the consumption may be taken at one hundred gallons per capita.

At the present time about 40,000 people are supplied from the waterworks system, which is approximately sixty per cent. of the population. The maximum daily consumption frequently exceeds the average by fifty per cent., and the maximum rate of consumption may be double that of the average for the year.

The approximate quantities of water necessary for a city supply is presented below in tabular form, for different populations, where the supply is by the direct pumping:

Population	70,000	100,000	150,000	200,000
Gallons, daily average ...	4,000,000	6,000,000	9,000,000	12,000,000
Gallons, maximum average.	8,500,000	12,000,000	18,000,000	24,000,000
Fire streams required	21	25	31	35
Rate for fire supply	6,000,000	7,000,000	9,000,000	10,000,000
Total rate ...	14,000,000	10,000,000	27,000,000	34,000,000
Underwriters' requirements ..	14,000,000	17,500,000	24,500,000	30,000,000

River Pollution.—The Saskatchewan, like all rivers in an agricultural country, is polluted to a certain degree by surface drainage, and in the growing district surrounding Edmonton, this pollution will increase until the country is fully settled. This surface pollution cannot be prevented. Further, the April break-up of ice in the river, which has served as a highway during the winter months, produces a serious pollution for some weeks. This cannot be prevented, either. Both of these sources of pollution are more intense at the present waterworks intake than at points farther up the river, outside the city limits.

The greatest danger from pollution, however, is from storm water discharging directly into the river, conveying into it street washings, catch basin contents, etc. Likewise, domestic sewage may find its way into the river. Such dangers will increase annually. Disease germs therefrom cannot be entirely eliminated by sedimentation and filtration, although those remaining after such process may be destroyed by hypochlorite treatment. Not being in accord with the theory advanced recently that because it is possible to sterilize an impure water, it is therefore perfectly safe to adopt a cheap polluted water supply and trust to filtration and chemical treatment to insure safety, Mr. Chipman recommends that the future water supply for Edmonton be taken from the river at some point above the city limits. This conclusion is based upon a preference to secure the purest water obtainable, whereby less trust need be placed upon the efficiency of purifying apparatus, and chemicals, and the skill of employees.

New Works.—If new works be decided upon they will be of such magnitude that it may require three years for their completion after construction has commenced, while fully one year may be necessary in making surveys, in locating on and securing the land and right-of-way. Preliminary engineering work of this character is frequently so hurried that the best results are not obtained. It will also take time to provide transportation for building materials, plant, machinery, supplies, etc., and the fuel problem must also be satisfactorily solved before proceeding with construction.

To meet the demand for water during the period the new works are under construction, and until they are completed the existing pumping plant must be maintained and extended. The report deals fully with these extensions, a cost summary of which appears in a later paragraph.

Criticism of the Rabbit Hill Project.—Considerable space is given to the consideration of the Rabbit Hill scheme, as described in the previous report of a board of engineers. This hill is situated on Sec. 36, Twp. 52, R. 25, distant about six and one-fourth miles in a straight line from the Parliament Buildings and two and one-half miles east of the river. The elevation of the extreme top

of the hill is 152 feet above the general elevation of the city. This pinnacle, however, is limited in area, and slopes rapidly in every direction. The hill is of sand, and reservoirs and other works erected upon it would demand careful construction.

In this project it was proposed to locate the pumping station on the Prison Farm (Sec. 33) or in that vicinity, pump the raw water to Rabbit Hill, where sedimentation basins and filtration works were to be constructed, also a clear water reservoir, the clear water to flow by gravity to the city. In his criticism, Mr. Chipman refers to several weak points in this proposition. In the first place, turbid water should not be pumped through a long pipe line. The sedimentation basins and filtration plant should be located as near the pumping station as possible, and such works will occupy a considerable area of ground, when the city attains 200,000 population. The elevation of the ground at the Prison Farm does not furnish an ideal pumping site, the flats below the escarpment being below flood level. The pumping station might be constructed near the river at a point above flood level, the water pumped to basins on the plateau above, treated there and returned to the pump-house below.

From the pump-house the water would then be pumped to a clear water basin on Rabbit Hill, with not less than five millions of gallons capacity. The topography of the hill is such that it would be practically impossible to construct a reservoir of more than ten millions of gallons capacity. From the reservoir, the water would flow to the city by gravity. The static pressure on the north side of the city from the reservoir would be 130 feet or 56 pounds, but with ten million gallons flowing through one 36-inch main, the friction loss would be 16 pounds at the centre of the city. In the outlying sections the loss would be from 20 pounds upwards, depending upon the consumption and the size of the mains. With twenty millions discharging through one pipe, the friction loss would exceed the head from gravity. Three conduits would be then required—two for constant service, one for reserve—in order that 30 pounds to 40 pounds might be available for average domestic supply, as pointed out previously. The maximum rate may double the average and the fire supply must also be provided; that is, with a population of slightly over 100,000 the capacity of the conduits should approximate twenty million gallons.

The elevation of Rabbit Hill would not be sufficient to give a proper pressure or supply when the population exceeds 100,000, without additional conduits to the city, each of which would cost about half a million dollars. Better service can be given with much less expenditure by direct pumping, the pressure on the pumps being increased or decreased in proportion to the demands for water.

In the Rabbit Hill scheme, also, about two and one-half miles of conduits would be required between the pumping station and the river, the friction loss in which would increase the operating expenses. Assuming this system in operation, with three conduits leading from the reservoir, the pressure might be increased by one or more booster pumping stations located within the city, but this would be an expensive and complicated arrangement.

Criticism of the Beaver Hills Project.—The Beaver Hills are situated to the southeast of the city, distant approximately eight miles from the Parliament Buildings. These hills extend for some miles from northeast to southwest and on Section 16, Twp. 52, R. 23, the elevation of ponds near the summit of the enclosing ridges is about 200 feet above the city. A previous report suggested this location as a suitable reservoir site.

In this proposition raw water was to be pumped to large open reservoirs to be constructed among the hills, the natural ponds to be excavated, cleaned out and embanked where necessary. The first reservoir would act as a sedimentation basin from which the water would flow by gravity to filters thence to large open clear water reservoirs. Hundreds of millions of gallons of pure water stored at an elevation of 200 feet above the city appeals to the average citizen as an admirable waterworks scheme, eliminating for the present the matter of cost. There are, however, many points to be taken cognizance of that are not apparent to the layman. First, as stated under the Rabbit Hill scheme, turbid water cannot be pumped through long mains without causing trouble, sooner or later. Secondly, in open storage reservoirs, vegetable growths will cause offensive odors and tastes at certain seasons. Thirdly, the static pressure of 86 pounds would be reduced materially by friction loss, and the head required for filtration; and fourthly, the cost would exceed that of the Rabbit Hill scheme.

If this project were carried out, the raw water should be sedimented and filtered at the pumping station, then pumped to clear water reservoirs in the hills. The distance from a suitable pumping station site above the city to the proposed reservoir would not be less than eleven miles, and in addition conduits would be required leading from this conduit line or from the reservoirs to the city. The cost of the pumping station, filtration work, etc., would be practically the same as in the Rabbit Hill scheme, also the cost of the reservoirs, but the conduit lines would be about double the length and, therefore, double the cost.

Cost of Extensions to Existing System.—An estimate of the cost of the improvement proposed in the report is as follows:

First outlay at pumping station (new works necessary to guarantee a continuous service for a population of 100,000 people)	$ 330,000
Large distributing mains (also necessary for present requirements)	550,000
Second outlay at pumping station (additional works to provide for a population of 150,000)	460,000
Third outlay at pumping station (further additions to provide for 200,000 population)	390,000
Total	$1,730,000

Cost of New Works.—On the assumption that the city decide to locate a new pumping station at some point southwest of the city limits, the capital expenditure is estimated to be as follows:

Outlay at existing station (immediately required, as in alternate case)	$ 330,000
Large distributing mains (also required forthwith)	550,000
Outlay at new station, and one conduit pipe to city	980,000
Second outlay for 150,000 population	800,000
Third outlay for 200,000 population	250,000
Total	$2,910,000

The proposed new station, with its equipment, and the additions necessary to the present system, would

therefore exceed, by $1,180,000, the expenditure required if the present site be retained.

The following is a summary of the definite conclusions arrived at:

(1) That the existing pump house site in the central part of the city is an ideal one from an operative standpoint, as there is ample space for extensions to serve a population of half a million people or more.

(2) That the water supply at this point is not now seriously polluted, but the degree of pollution will undoubtedly increase with the population and may become positively dangerous when the population approaches 150,000.

(3) That a less contaminated supply may be obtained at some point above the city limits at a cost that cannot be considered as prohibitive.

(4) That the distribution system requires immediately many large feeder mains.

(5) That the Roberts filters now installed may be depended upon to filter six millions of gallons daily, the year round, if properly housed and additional clear water reservoirs and sedimentation basin be constructed this year.

(6) That the present station be enlarged to meet the city's demand for water until the new system is operative.

(7) That fire service by direct pressure be abandoned and portable fire engines adopted.

(8) That the waterworks department be consolidated and placed under one executive head.

(9) That about $880,000 should be appropriated for expenditures on the existing plant, including the feeder mains, whether the old pumping station site be retained or not.

(10) That neither the Beaver Hills project nor the Rabbit Hill scheme should be adopted.

THE HARRISBURG FILTER PATENT DECISION.

A COPY has just been received of the decision in the negative head patent case between the New York Continental Jewell Filtration Company, and the City of Harrisburg, Pa., as handed down a few weeks ago in the Middle District of Pennsylvania U.S. Circuit Court.

The case, which has been in the course of trial since the middle of 1908, has attracted wide attention, and the outcome is of extreme importance to the water filtration world, made so by the fact that the down-draft feature is now being used in most rapid sand gravity filtration plants.

Infringement of patents, commonly known as the negative head patents, was claimed by the Company on account of the building and use of the filter plant of the City of Harrisburg, which was erected in 1905, the engineer being Mr. James H. Fuertes, of New York City. It was claimed in this case that the Harrisburg plant was copied in design from the Little Falls plant of the East Jersey Water Company, which plant, according to the evidence, was designed by the complainant Company.

A few points which led up to the decision are as follows:—

The effective filtering agency in slow sand filters of the positive head gravity type is the sediment layer which gradually gathers on top of the sand in the form of an unbroken scum. This layer, a vital factor in filtration, is known as the "Schmutz-Decke." In more rapid, or mechanical, filtration plants, coagulants are used which rapidly form a film that corresponds in function to the "Schmutz-Decke."

As this surface sediment thickens it is so compacted by the head of water pressing upon it that there is little percolation, and further, its compact shell tends to create a vacuum beneath, which, by liberating the air in the passing water, also impedes percolation. In plants of the positive head gravity type of slow sand filtration this "Schmutz-Decke" is substantially the sole place where filtration occurs.

It is in this state of the art of filtration—with the slow formation of the surface sediment layer; with that layer constituting virtually the sole potent factor of filtration; with the sand bed being practically confined to forming the surface sediment shell; with vacuum regarded as a retarder of filtration, and tending to lessen plant output—that the involved patents entered. Mr. Ira Jewell in his process disclosed the radical suggestion that this vacuum, if of such relative completeness as to utilize its efficiency, could be made not only to avoid all troubles incident to air-releasing, but to utilize the whole sand bed as an active filtering agency. In other words, he claimed, by the proper use of vacuum, to convert virtually the whole sand bed into a "Schmutz-Decke."

The practical outcome of his process has been to create in sand filtration a differential type of plant known as the down-draft or negative head filter. It is bottomed on a vacuum, created by design, which results from an off-carrying pipe, vertically arranged and of such length that as the filtered water is carried off by it, a partial vacuum is created within the filter bed. The pipe extends downward a sufficient distance to provide the necessary down-draft, usually several feet. Its action is such that the entire body of filtering material is utilized instead of the upper surface only.

This mere insertion of a water-sealed vertical off-take pipe has added to filtration an important improvement, and the continued use thereof by the defending City of Harrisburg occasioned the charge laid by the Company.

From the evidence and discussion brought to bear upon the case, it was shown that the process really does, by the use of the down-draft sealed vertical outlet pipe, create and maintain an operative vacuum which effects a deeper utilization of the sand body for filtration than is found in positive head filters; that the presence of released air incident to the use of this vacuum is helpful and not harmful by reason of the velocity imparted to the passing water by such a vacuum; that the process makes the runs longer, and that both structural and maintenance costs are lessened by its use.

The court dwelt upon the question as to whether this disclosure involved invention. It was conceded to be an original conception. Further, it was not the mere suggestion of the use of the down-draft tube to create a vacuum. The originality and substance of the disclosure was pronounced to be in the utilization of the vacuum and the apparatus was the concrete means suggested to utilize the process. The disclosure was a marked departure from the previous ideas and practice; it gave to the whole of the large sand body a compacted functional working capacity that it did not previously have; it created a new type of filter in the art, and the process has gone into widespread and extensive use.

On these grounds the disclosure involved invention, according to the decision, and the claim of patent infringement was sustained.

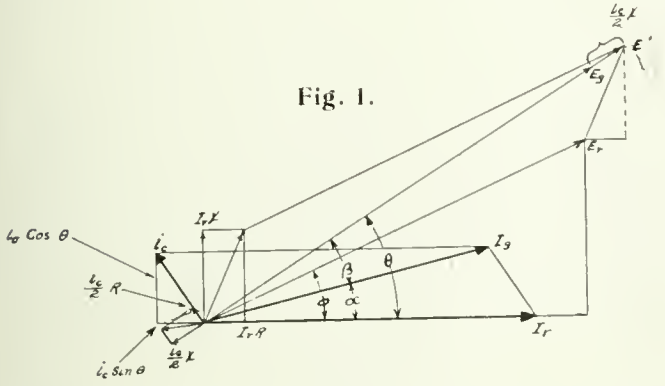
APPROXIMATE CALCULATIONS OF TRANSMISSION LINES WITH DISTRIBUTED CAPACITY.

By Bradley T. McCormick, M.E.

THE recent adoption of voltages of 110,000 and higher for power transmission, somewhat complicates the computations of transmission lines, due to the effect of capacity which can no longer be neglected at such high voltages. During recent years several articles have been published, giving the exact mathematical treatment of transmission lines with distributed capacity, but these usually involve the use of hyperbolic functions, and the formulas are too complex to be of any practical value.

Dr. Steinmetz, in his discussion of Percy H. Thomas' paper on "Output and Regulation of Long Distance Transmission Lines," (A.I.E.E., 1909, Volume 1, page 712), gives the exact formulas on transmission lines with distributed capacity, in a very much simplified form; while in the June issue of the General Electrical Review is an article by Mr. F. W. Peek, Jr., in which the exact formulas of Steinmetz are still further simplified. However, in using Peek's method it is necessary to perform several multiplications of complex variables. Anyone who does not use complex variables frequently is liable to be out of practice and make mistakes in signs.

Fig. 1.



Mr. Peek, in his article, works out some examples on a 120,000-volt transmission line 130 miles long, and in his calculations he adds the resistance and reactance of the step-up and stepdown transformers to the resistance and reactance of the line. Since in the transmission line the resistance and reactance are distributed while in the transformers they are concentrated, the formulas, when used in this manner, are therefore not exact, after all. It is also worthy of note that the charging current does not flow through the impedance of the step-down transformers, as assumed by Mr. Peek. In view of the above, there is nothing gained by the use of the exact formulas, if approximate formulas can be found that will give fairly close results. Approximate formulas based on the assumption that the capacity of the transmission line is concentrated at the centre will give results agreeing very closely with Peek's, more exact formulas, though it may sometimes be necessary to calculate some of the values twice, the first calculation being approximate, and the second more accurate.

Below are given some formulas which the writer has found to agree very closely with the exact formulas. Several calculations have been made on Mr. Peek's transmission line so that the values obtained can be compared with those obtained in his article.

Symbols.

Let E_r = receiver voltage between lines,
Let E_g = generator voltage between lines,
Let I_r = current at receiver end of line,
Let I_g = current at generator end of line,
Let i_c = charging current at generator end of line,
x and R = three phase reactance and resistance = $\sqrt{3}$ times the value per log,
Let ϕ = power factor angle of receiver circuit,
Let β = power factor angle at generator,
Let θ = angle between generator voltage, E_g, and receiver current I_r,
Let α = angle between generator current, I_g, and receiver current I_r,
Let c = capacity of line to neutral,
Let l = distance in miles that power is transmitted,
Let d = distance apart of wires, centre to centre in inches,
Let r = radius of wire, in inches,
Let cm = area of conductor in circular miles,
Let $\sim$ = frequency in cycles per second.

Formulas.

(1.) $R = 56{,}000 \frac{l}{\text{cm}}$ for copper and $89{,}000 \frac{l}{\text{cm}}$ for 63% conductivity aluminium.

(2.) $X = \sqrt{3}\, 2\pi \sim l\, (.00074 \log_{10} \frac{d}{r} + .00008)$.

(3.) $C = \frac{.0194}{\log_{10} \frac{d}{r}} l$.

(4.) $i_c = \frac{2\pi \sim C}{\sqrt{3}\, 10^6} \times \frac{E_g + E_r}{2}$.

(5.) $E_g^1 = \sqrt{(E_r \cos\phi + I_r R)^2 + (E_r \sin\phi + I_r x)^2}$.

(6.) $E_g = \sqrt{(E_r \cos\phi + I_r R)^2 + (E_r \sin\phi + I_r x)^2} - \frac{i_c}{2} x$

$= E_g^1 - \frac{i_c}{2} x$.

(7.) $\sin\theta = \frac{E_r \sin\phi + I_r x}{E_g^1}$.

(8.) $\cos\theta = \frac{E_r \cos\phi + I_r R}{E_g^1}$.

(9.) $I_g = \sqrt{(I_r - i_c \sin\theta)^2 + (i_c \cos\theta)^2}$.

(10.) $\sin\alpha = \frac{i_c \cos\theta}{I_g}$.

(11.) $\beta = \theta - \alpha$

(12a.) Loss in line $= [I_r^2 + I_r (I_g - I_r) + \frac{1}{3} (I_g - I_r)^2] \sqrt{3} R$, when I_g is greater than I_r;

(12b.) or $[I_g^2 + I_g (I_r - I_g) + \frac{1}{3} (I_r - I_g)^2] \sqrt{3} R$ when I_g is less than I_r.

Line Constants of Mr. Peek's Line.

$R = \sqrt{3} \times 39.5 = 68.2$ ohms.
$X = \sqrt{3} \times 182.4 = 316.$ ohms.
$\cos\phi = .85$, $\sin\phi = .53$.
$E_r = 120{,}000$ volts.
$C = 1.735$ M.F.

Check on 5,500 kw. Load at Receiver at 85% Power Factor, $I_r = 31.1$ Amperes.

From (5) $E_g^1 = \sqrt{(120000 \times .85 + 31.1 \times 68.2)^2 + (120000 \times .53 + 31.1 \times 316)^2}$, $= \sqrt{104125^2 + 73300^2} = 127000$ volts.

As a first approximation assume $E_g = E_r$, and from (4)

$i_c = \frac{2\pi 60 \times 1.735}{\sqrt{3}\, 10^6} \times 120000 = 45.3$ amperes,

From (6) $E_g = 127000 - \frac{45.3}{2} 316 = 127000 - 7150 = 119{,}850$ volts,

The voltage at the generator is, therefore, approximately the same as at the receiver when operating at 55,000 kw. load at 85% power factor. Our assumption that $E_g = E_r$ is therefore very close and it will be unnecessary to recalculate the charging current i_c.

From (7) and (8) $.577 \text{ Cos } \theta = \frac{104125}{127000} = .82$ $\theta = 35°$ Sin $\theta = \frac{73300}{127000}$.

From (9) $I_g = \sqrt{(31.1 - 45.3 \times .577)^2 + (45.3 \times .82)^2} = \sqrt{4.9^2 + 37.1^2} = 37.5$ amperes.

From (10) Sin $\alpha = \frac{45.3 \times .82}{37.5} = .99$, $\alpha = 82°$.

From (11) $\beta = \theta - \alpha = 35° - 82° = -47°$, Cos $\beta = .682$.

The minus sign denotes a negative angle of lag or an angle of load, indicating that with a load of 5,500 kw. at 85% power factor lagging at the receiver end, the charging current is sufficient to give a leading current of 68.2% power factor at the generator.

From (12) Loss in line $= [31.1^2 + 31.1 (37.5 - 31.1) + \frac{1}{3}(37.5 - 31.1)^2] \sqrt{3}\ 68.2 = 138.5$ KW.

Check on 44,000 kw. Load at Receiver at 85% Power Factor. $I_r = 249$ Amperes.

From (5) $E_g^1 = \sqrt{(120{,}000 \times .85 + 249 \times 68.2)^2 + (120{,}000 \times .53 + 249 \times 316)^2} = \sqrt{(119{,}000)^2 + (142{,}300)^2} = 185{,}500$ volts.

As a first approximation assume that $E_g = E_r$ and as before, see (4) then, $I_c = \frac{2\pi \times 60 \times 1.735}{\sqrt{3} \times 10^6} \times 120000 = 45.3$ amperes.

From (6) $E_g = 185{,}500 - \frac{45.3}{2} 316 = 185{,}500 - 7{,}150 = 178{,}350$ volts.

Our assumption that $E_g = E_r$ is therefore incorrect, so we must recalculate i_c from (4) and substitute again in (6) to get E_g.

$$i_c = \frac{2\pi \times 60 \times 1.735}{\sqrt{3} \times 10^6} \quad \frac{178{,}350 + 120{,}000}{2} = 56.2$$

amperes.

Substituting again in (6) $E_g = 185{,}500 - \frac{56.2}{2} 316 = 185{,}500 - 8{,}900 = 176{,}600$.

This compares very closely with $E_g = 177{,}300$ as obtained by Peek from his more accurate formulas.

From (7) and (8) Sin $\theta = \frac{142{,}300}{185{,}500} = .766$ Cos $\theta = \frac{119{,}000}{185{,}500} = .641$ $\theta = 50°$.

From (9) $I_g = \sqrt{(249 - 56.2 \times .766)^2 + (56.2 \times .641)^2} = \sqrt{208.7^2 + 36.1^2} = 212$ amperes.

From (10) Sin $\alpha = \frac{56.2 \times .641}{212} = .17$ $\alpha = 9.78°$.

From (11) $\beta = \theta - \alpha = 50 - 9.78 = 40.22°$ Cos $\beta = 7.65 =$ power factor at generator.

The plus sign for β indicates a lagging current at the generator.

From (12) Loss in line $= [212^2 + 212 (249 - 212) + \frac{1}{3}(249 - 212)^2] \sqrt{3}\ 682 = 6{,}300$ KW.

Check on no Load.

Assume as a first approximation that the voltage at the generator and receiver ends of the line are equal. As a first approximation we have as charging current from (4)

$$i_c = \frac{2\pi 60 \times 1{,}735}{\sqrt{3} \times 10^6} 120{,}000 = 45.4.$$

Since there is no load on the receiver, $I_r = 0$ and (6) becomes,

$$E_g = E_r - \frac{i_c}{2} x = 120{,}000 - \frac{45.4}{2} \times 316 = 120{,}000 - 7{,}180 = 112{,}820 \text{ volts.}$$

Now recalculates i_c from (4),

$$i_c = \frac{2\pi 60 \times 1{,}735}{\sqrt{3} \times 10^6} \times \frac{112{,}820 + 120{,}000}{2} = 44.1 \text{ amperes.}$$

Recalculating the generator voltage from (6),

$$E_g = 120{,}000 - \frac{4.41}{2.} 316 = 120{,}000 - 7{,}000 = 113{,}000.$$

$$\text{Line loss} = \frac{1}{3}(44.1^2 \sqrt{3}\ 68.2) = 76.5 \text{ KW.}$$

The following table gives the comparison of the results obtained by Mr. Peek's formulas and the approximate formulas as worked out on the transmission line treated above. It will be noted that the difference between the results obtained by the two methods is in most cases very small, and in other cases close enough for practical purposes.

	No Load.		5,500 K.W., P. F. .85.		44,000 K.W., P.F. .85.	
	Approx.	Peek.	Approx.	Peek.	Approx.	Peek.
Gen. Kilovolts ..	113	112.9	119.85	120.1	176.6	177.3
Gen. Amperes ..	44.1	44.42	37.5	38.45	212	214.1
Line Loss KW...	76.5	81.36	138.5	?	6,300	6,448
P. F. at Generator	0	0094	68.2	69.9	76.5	76.6

Derivation of the Transmission Formulas.

Formulas (1), (2) and (3) are the usual ones employed for transmission lines, and need no explanation. The capacity is treated as if a condenser were concentrated in the centre of the line, so that the charging current flows through only half of the impedance of the line. It is considered that the voltage across the condenser is equal to the average of the voltage at the generator and receiver ends of the line or $\frac{E_g + E_r}{2}$. The charging current is, therefore, expressed as in formula (4). It is assumed that the phase position of the charging current is 90° ahead of the generator voltage E_g. This is not strictly correct, since for that portion of the line nearest the generator the charging current is 90° ahead of E_g, while for that portion nearest the receiver the charging current is 90° ahead of E_r. The voltages E_g and E_r are not in phase but differ by the angle $\phi - \theta$.

If there were no capacity in the transmission line the voltage at the generator end would be expressed in the usual way by formula (5). However, if capacity cannot be neglected there must be added to E_g the voltage consumed by the charging current flowing through the impedance of the line. This voltage may be split into two components $-\frac{i_c}{2} x$ in phase with E_g^1 and the component $-\frac{i_c}{2} R$ in quadrature with E_g^1. We should therefore write

$$E_g = \left\{ [\sqrt{(E_r \cos + I_r R)^2 + (E_r \sin + I_r x)^2} - \frac{i_c}{2.} x]^2 + [-\frac{i_c}{2} R]^2 \right\} ½$$

The second term $-\frac{i_c}{2} R$ can be neglected so that the equation will take the form shown in formula (6). Neglecting this last term bring E_g and E_g' in phase, as shown in the figure. This is not strictly correct, but the error resulting from this assumption is small. The sine and

cosine of the angle between the receiver current and the generator voltage can be expressed by formulas (7) and (8).

The current at the generator is the vectorial sum of the receiver current and the charging current. The charging current may be split into two components $i_c \sin \theta$ in phase with I_r, and $i_c \cos \theta$ in quadrature with I_r. We may, therefore, express the generator current by formula (9).

For the purpose of calculating the energy loss of the line, we will assume that the difference between the current at the receiver and generator ends follows a straight line law. This is not strictly true, but is close enough for present purposes. In Fig. 2 it is assumed that the receiver current is greater than the current at the generator. The current I at any point distant l from the generator end will be $I = I_g + a$ where a is a constant.

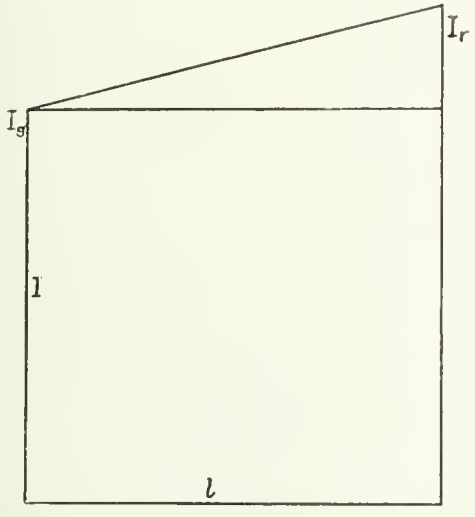


Fig. 2.

The mean square value of current can be obtained as follows:—

$$\frac{1}{l}\int_0^l I_g^2\,dl = \frac{1}{l}\int_0^l (I_g^2 + 2I_g a l + a^2 l^2)\,dl$$

$$= \frac{I_g^2 l + I_g a l^2 + \frac{1}{3} a^2 l^3}{l}$$

$$= I_g^2 + I_g a l + \frac{1}{3} a^2 l^2$$

But $a = I_r - I_g$ so we have

$$I_g^2 + I_g (I_r - I_g) + \frac{1}{3} (I_r - I_g)^2$$

This is the mean square value of the current and when multiplied by $R\sqrt{3}$ is the line loss as in formula 12b. If the current at the generator end is larger than that at the receiver end of the line the expression for energy loss takes the form given in formula 12a.

Twenty-four railway lines radiate from Winnipeg. The Canadian Pacific Railway, Canadian Northern Railway and Grand Trunk Pacific shops are all located there, employing over 5,000 hands; with 130 miles switch siding facilities for manufacturers. Water transportation on Red and Assiniboine Rivers; vessels drawing nine feet of water ply between Winnipeg and Lake Winnipeg, a body of fresh water, in area, 9,414 square miles. The Winnipeg electric railway carried three million people in 1900 and 35 million in 1912, operating over 300 cars on over 72 miles of city tracks and 45 miles of suburban lines.

BELT CONVEYERS.

By Reginald Trautschold, M.E.

OBVIOUSLY, the easiest way—so far as consumption of power is concerned—of transporting material from one place to another is to carry or convey it on a moving body rather than to attempt to drag it along a trough, as in the case of flight conveyers; or to push it, as in the case of screw conveyers. Obviously, also, the simplest kind of conveyer carrying its load on moving parts consists of an endless belt running over end pulleys and supported throughout its length by occasional supporting idlers, or carriers, on the carrying stretch of the belt and by less frequent supporting idlers on the return or lower run of belt. Such apparatus, belt conveyers, have now been brought to such a high state of perfection that they are almost indispensible in the handling of materials in bulk and are also used to great extent in carrying packages, boxes, bales, etc. This latter application of belt conveyers usually requires a flat carrying surface (belt) running between guides to prevent the load from leaving the belt. Material in bulk, such as ores, coal, cement, paper pulp, wood chips, etc., etc., on the other hand, are most frequently carried on troughed belts, belts having their edges turned up and inclined to the plane of the conveyer so as to form a trough in which the material is carried, thus materially increasing the carrying capacity. Troughed belt conveyers being more generally and widely used, they will be chiefly considered in this discussion.

The original troughing idler, or belt carrier, consisted of a spool-shaped pulley or series of individual pulleys mounted so as to form a spool. Following this form came the "dish pan" idler, consisting of one or more centre pulleys of the same diameter between concentrating end pulleys of "dish pan" shape which turned up the edges of the carrying belt. These simple types of carrying idlers had the desired effect of troughing the belt, but they possess one very undesirable feature, the circumferential speed of the pulley or pulleys varying with their diameter while the speed of the belt passing over them is constant from edge to edge; the result being that either the belt was travelling faster than the circumference of a particular pulley, or else the belt lagged behind certain circumferential of the troughing idler, causing much unnecessary wear on the belt due to the scouring action between the contact surfaces of belt and troughing idler. Relatively, the belt is the most expensive part of a belt conveyer and the main improvements have necessarily been in the troughing idler to obviate slippage between it and the belt. Troughing idlers are now almost invariably constructed of several individual pulleys of the same diameter mounted so that the end pulleys are inclined to the horizontal and cause the carrying belt to form a trough conforming more or less to an arc of a circle. These individual pulleys constituting a troughing idler may be mounted all in one plane, the end pulleys in a plane in advance or behind that of the centre pulley, may be mounted on hollow shafts in which grease for lubrication is stored and which is supplied to the bearings through small holes in the hollow shafts, mounted on solid shafts with either grease or oil lubrication, or on ball bearings that require only occasional lubrication, depending upon the construction and patent rights of the manufacturer. The latest construction consists of complete individual units of one pulley each which may be mounted on a board so that the pulleys all lie in one plane and may be

so inclined as to form any desired form of trough. Any of these various types of troughing idlers will give satisfactory results if properly proportioned and, which is even of greater importance, if properly cared for. Particularly, must care be taken not to allow the lubricant to come in contact with the belt, oil or grease having a harmful action on rubber—the material that enters the construction of most belts.

The angle with the horizontal made by the inclined pulleys of the troughing idler varies considerably, being but 10 to 20 degrees in some cases and in others as much as 35 or 40 degrees. Deep troughed conveyers, those in which idlers with steeply inclined end pulleys are employed, have slightly greater carrying capacity than conveyers with more shallow trough, it is true, but such gain is counteracted somewhat by increased power requirements and by increased wear on the belt by the material handled. One of the most successful manufacturers of belt conveyers builds all troughing idlers with end pulleys inclined at about 25 degrees (slightly less in most cases). This angularity would seem to be about the most satisfactory, for with such it is possible to attain within 10 or 15 per cent. of the theoretical capacity of the conveyer, while even with the deepest practical trough the theoretical capacity cannot actually be reached and both depreciation, through abrasive wear of material slipping on the belt, and power requirements are unduly enhanced. A deeper trough may be advisable at loading points, however, as such construction would have the tendency to facilitate the proper arrangement of load on the belt for subsequent conveying. Theoretically, the capacity of a belt conveyer is limited by the amount of material that can be piled on a flat belt of the same width and is, therefore, dependent upon the angle of repose of the material handled. This arbitrary limitation is due to the fact that at some section of every belt conveyer the belt must be flattened. This may be either over the flat pulleys constituting discharging devices, or over the flat bend pulleys where the direction of the conveyer makes a sudden change, or, for conveyers in which there is no interruption to the trough from loading point to point of discharge, over the head pulley of the conveyer. A well proportioned belt conveyer carrying suitable material—i.e., material that is not too bulky for the size of conveyer, that possesses no disadvantages of undue heat or other quality productive of disastrous chemical action on the belt, etc.—has a pretty rigidly fixed carrying capacity at a given speed, however, and Table V. contains such data for conveyers handling material weighing 100 pounds per cubic foot at a conveyer (belt) speed of 100 feet per minute. Conveyers carrying material of other weight have capacities proportionally greater or less according to the weight of the material and, of course, the capacity of any belt conveyer varies directly with the speed at which it is run. Similar data, expressed in the form of a convenient equation, is given as Formula XIII.

Capacity :—

$$W = \frac{1.43\ w^2 V W'}{100{,}000} \qquad \text{Formula XIII.}$$

Where W = Weight of load (capacity) conveyed in tons per hour.
w = Width of conveyer (belt) in inches.
V = Velocity (speed) of conveyer in feet per minute.
W′ = Weight of material handled in pounds per cubic foot.

Table V.—Capacity of Belt Conveyers, Continuously and Uniformly Loaded.

Material weighing 100 pounds per cubic foot.
Conveyer speed, 100 feet per minute.

Width of belt.	Tons per hour.	Width of belt.	Tons per hour.
12″	20.0	26″	96.0
14″	27.0	28″	108.6
16″	35.7	30″	126.8
18″	45.0	32″	143.5
20″	55.6	34″	160.0
22″	67.7	36″	183.0
24″	80.0		

All materials suitable for handling by belt conveyers are not necessarily possible of conveyance at the same speed, however, and this question of advisable speed is one over which there has been considerable controversy

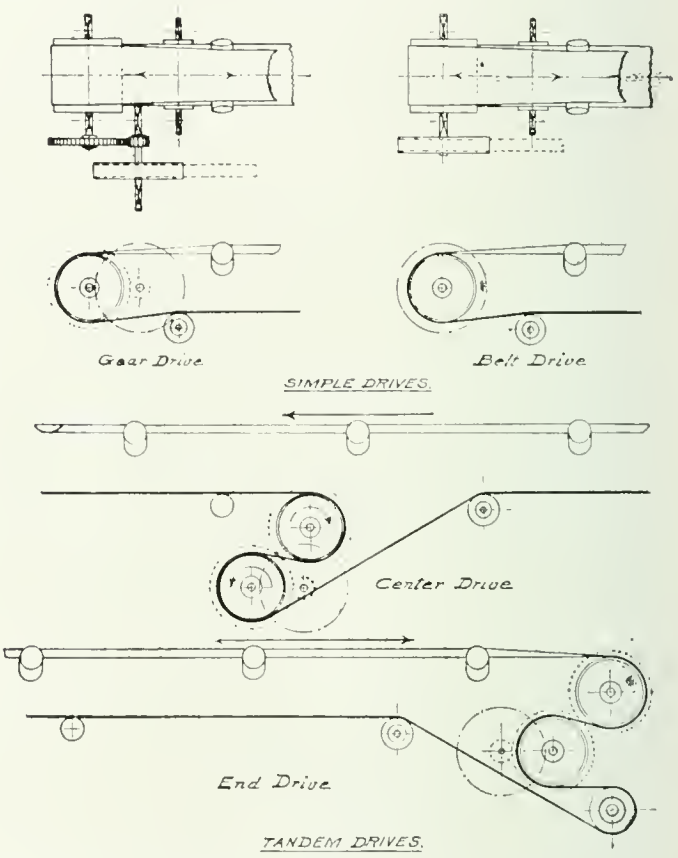


Fig. 1.—Diagrams of Typical Belt Conveyer Drives.

and no fixed rule can be advanced to cover all cases. Ordinarily, heavy materials can be carried at a higher speed than lighter ones, but practice has brought out many exceptions to such a rule. Table VI., compiled from records of a number of successful and efficient installations of belt conveyers, gives suitable speeds for handling a variety of the commoner materials usually conveyed by this class of apparatus, together with the average weight of such materials. The speeds given in the table allow for considerable lee-way, for a variation of as much as 20 to 30 per cent. is allowable and frequently advisable.

Before taking up a consideration of the power requirements and economic value of the belt conveyer, it is advisable to study in some detail the construction of the apparatus, general design of systems, etc. The troughing idlers that have already been considered are usually

spaced from 3 to 6 feet apart, depending upon the width of the belt and to some extent upon the character of the material handled. The return idlers, those carrying the lower run of belt, are invariably of pulleys in the same horizontal plane; that is, a return idler has all its individual pulleys in the same plane; and are spaced about twice as far apart as the troughing idlers. Guide idlers, in a plane tangent to the edges of the conveyer belt, are required for long conveyers to prevent the belt from leaving the troughing idlers and these are usually spaced 40 or 50 feet apart. The driving pulley of the conveyer may be one of the end conveyer pulleys driven through suitable gear-reducing mechanism or simply by a driving pulley fast to the shaft of the conveyer driving pulley if the speed of rotation can be satisfactorily controlled without gears. In installations where such simple drive is not feasible, a centre drive may be installed, consisting of tandem conveyer driving pulleys around which the return run of the conveyer belt passes in the form of an "S." This type

Table VI.—Economic Speeds of Belt Conveyers for Various Materials.

Material.	Weight per cubic foot.	Advisable speed.
Coke	32 to 35 lbs.	250 ft. per min.
Broken stone (coarse)	160 to 170 lbs.	250 to 300 feet
Lump coal, R/M	50 to 60 lbs.	250 to 300 feet
Ashes	About 45 lbs.	300 ft. per min.
Lime and cement	50 to 80 lbs.	300 ft. per min.
Ore	About 125 lbs.	300 to 400 feet
Crushed stone	150 to 170 lbs.	350 to 400 feet
Sand and gravel	100 to 120 lbs.	350 to 400 feet
Fine coal	About 50 lbs.	400 ft. per min.

of drive is also employed at the ends of the conveyer when a conveyer is particularly long or when the service is so severe that the simple end conveyer pulleys do not have sufficient belt grip to drive the conveyer. Excessively severe conditions of drive are also met by covering the conveyer driving pulley or pulleys with a "lagging"—material that increases the grip of the pulley on the belt. Means must also be provided for adjusting the tension in the conveyer belt, and this is usually accomplished by providing take-up bearings for the conveyer pulley at the opposite end of the conveyer from the driving end, though the take-up may be located at any convenient point on the return run of the belt. The driving pulleys should be of the heavy crown type and should be slightly greater in diameter than the width of the conveyer belt; their face should also be about two inches greater than the width of the conveyer belt. The end conveyer pulleys, if not used as conveyer driving pulleys, may be somewhat smaller in diameter and the upper and lower runs of conveyer belt should be about parallel except at the point where the driving conveyer pulley is installed—the greater diameter of such pulley increasing its grip on the belt.

Not only is the belt the most important part of a belt conveyer, as upon it the load is carried, but it is also relatively the most costly. All the abrasive wear caused by material slipping on the belt at time of loading and during a certain unavoidable slippage while in transit is naturally concentrated on the belt itself and the depreciation from such causes constitutes by far the greatest expense of maintenance. Belts of many materials have been experimented with and that found the most generally satisfactory is the rubber belt, a belt that is composed of the necessary plies of heavy duck for strength bound together with a rubber "friction" and protected by a rubber covering that is considerably thicker on the carrying side (top of belt on the upper run). Such a belt is comparatively expensive—a conveyer so equipped costing nearly twice as much as one in which the conveyer belt is of stitched canvas construction without rubber covering—but is by far the most economical and satisfactory in the majority of installations, owing to its excellent properties of resisting abrasive wear. The rubber covering of a conveyer belt should not be highly vulcanized, but should be quite resilient, as the tendency of the material to slip on the hard belt is much greater than when the adhesion of the particles of material in contact with the belt is more tenaceous—the case with the relatively soft resilient belt. Refinements of the standard rubber belt of uniform thickness, with the same thickness of rubber wearing cover from side to side of belt, have been made in attempts to lengthen its life for conveying purposes and, for installations presenting exceptionally trying conditions of service, two of these patented types deserve particular consideration and criticism. One of these belts has sections of the duck plies omitted on its carrying side, the gaps increasing in width as the plies approach the surface of the belt, and replaced with rubber, making a belt with a rubber cover that is thickest at the centre of the belt and becomes thinner towards the edges. This construction, augmented by stiff reinforcement of the edges, makes a very pliable belt that readily conforms to the trough of the conveyer. Another claim that is advanced by the manufacturers of this belt is that it possesses greater wearing qualities, owing to the fact that the rubber cover is thickest at the centre where the wear is claimed to be the greatest. In installations of conveyers in which the load is carried up so steep an incline as to cause a slippage of material (load) on the belt or where the belt is run at such speed that a vibratory oscillation of the belt as it passes over the troughing idlers is great enough to cause readjustment of load on the belt. This claim is substantiated, and even in installations where neither the inclination of the conveyer nor the speed at which it is run is excessive the agitation of load in passing over the troughing idlers may be sufficient to create a slight and continual readjustment of load, causing a certain scouring action on the surface of the belt. In such cases, the wear is naturally greatest at the centre of the belt where the load is the thickest and consequently the heaviest. Whenever the carrying belt passes over a flat pulley, however, rearrangement of load on the belt is necessary and the portion of load that changes position is not at the centre, but toward the edges of the belt. Another change of location or position of load on the belt takes place on retroughing the flattened belt and, as in the case when flattening the belt, the abrasive wear takes place along the edges of the loaded section of belt. In a properly installed system, in which the tension on the conveyer belt is maintained correctly, the main wear of the load, other than that which may be caused at the loading point when charging the conveyer, *is* toward the two edges of the belt. However, as the section of the conveyer belt covered by the load never extends to the edges of the belt, the abrasive wear due to the shifting of load on passing over a flat pulley comes at a point on this patented belt where the rubber is still comparatively thick, so that this construction produces an excellent belt. The second noteworthy special rubber conveying belt is one that has some of the plies of duck omitted at the point where the belt would turn upward if it followed closely the pulley surfaces of a three-pulley troughing idler and the gap thus formed filled with rubber, which construction also makes

a pliable belt that clings to the troughing idler pulleys. This belt has no extra cover at its centre, so possesses no particular wear-resisting qualities where the load is the thickest, but does possess increased resisting properties against abrasive wear at the hinged points just outside the limits of the centre pulley. The peculiar shape to the trough when using the "hinged belt" also increases the carrying capacity of the belt to some extent, but the readjustment of load on passing over a flat pulley is correspondingly greater and necessarily the abrasive action of the load in shifting its position on the belt is augmented. Both these patented belts are of necessity more expensive than belts in which the refinements of varying the thickness of rubber cover are not attempted—straight ply belts —and, without disparagement of the patented belts, it is a question whether greater benefit might not be gained by putting the extra money into a straight ply belt with an extra heavy rubber cover of uniform thickness.

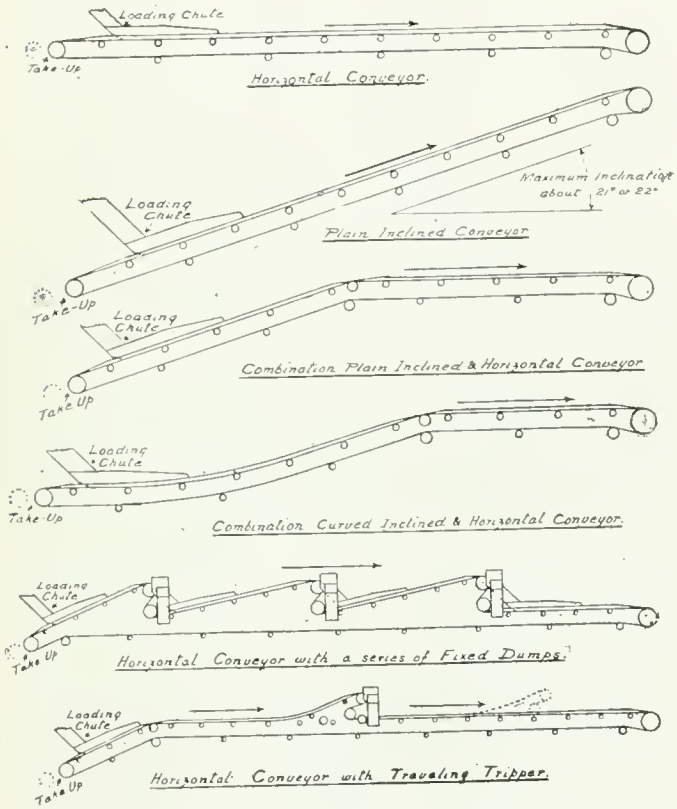

Loading Chute
Take-Up
Horizontal Conveyor.
Maximum inclination about 21° or 22°
Plain Inclined Conveyor
Combination Plain Inclined & Horizontal Conveyor
Combination Curved Inclined & Horizontal Conveyor.
Horizontal Conveyor with a series of Fixed Dumps.
Horizontal Conveyor with Traveling Tripper.

Fig. 2.—Typical Arrangements of Belt Conveyers.

NOTE.—Installations of Belt Conveyers may consist of any combination of the above arrangements and conveyers can frequently be made reversible—i.e., arranged so they be operated in either direction. They also may be loaded at more than one point, can be driven at any point and the Take-Up can be loaded wherever convenient.

Fixed Dumps may be installed on any horizontal stretch of conveyer or inclined stretches may be interrupted for their accommodation.

Traveling Trippers may be installed on any horizontal or slightly inclined stretches of conveyer, may be propelled by hand or be of the automatically traveling and reversing type.

Provision for discharging the load from belt conveyers, other than over the end pulley of the conveyer, necessitates the forming of an "S" in the carrying belt, similar to that required in the return belt for a tandem drive, the load leaving the conveyer as the belt passes over the upper of the two straight pulleys employed to so guide the belt. This discharging arrangement may be mounted on a movable carriage that can be moved from position to position by a hand crank (hand-propelled tripper) or else the motion of the moving conveyer belt may be employed automatically to cause the tripper to travel back and forth over a fixed length of track on which the tripper is supported (automatic tripper). When it is required to discharge load at only a specified point or at several fixed points in the length of the conveyer, the discharging device is usually made permanent, part of the supporting structure of the conveyer system, and is known as a "fixed dump." By arrangements of chutes and gates, either trippers or fixed dumps may be made to discharge the conveyed load on either side of the conveyer in any desired proportion, and may also be arranged to discharge any proportion of the load to the conveyer belt beyond the particular discharging point for subsequent discharge at some further advanced point.

Belt conveyers carrying wet or sticky materials also require brushes for cleaning the belt at each discharge point. These brushes are usually of the rotary type, constructed of stiff bristles, and are gear- or belt-driven from the conveyer pulley over which discharge of load takes place—rotation of brush being in the opposite direction to that of the conveyer pulley.

(To be continued.)

COAST TO COAST.

Ottawa, Ont.—"Until the report of Sir Alexander Binnie, founded on his own investigation and those of his engineers, is submitted, I do not propose to give out any information whatever, and anything which may be published in the meantime must be regarded as only conjecture." This was the statement made by Mayor Ellis recently in regard to the water scheme. "I expect to have complete reports upon every phase of the water question ready to submit to council in October," added Mayor Ellis.

Ottawa, Ont.—The appointment of a commission to consider the practicability of the Georgian Bay Canal project will be taken up shortly by the Minister of Public Works. Heretofore the investigations have had reference wholly to the engineering features of the work and the estimate of its cost. What is now proposed is an inquiry into the economic aspect of the project and its probabilities as a profitable proposition.

Windsor, Ont.—Seeking protection from disease or possible contamination of the city's water supply, the members of the Windsor Water Board and Medical Health Officer Ashbaugh have gathered several samples of Detroit River water near the mouth of the intake pipe and in the current flowing directly into the pipes. The samples will be packed and shipped at once to the Ontario Health Board at Toronto for analysis. The water was obtained from near the bottom of the river by means of an especially devised apparatus, consisting of a metal box containing a sterilized bottle. The equipment was lowered to the required depth and the bottle uncorked. While Windsor's water supply is taken from the channel in the river and not from the lake, former tests have shown it to be as pure as any water in the Dominion. Only two samples out of nearly a dozen taken last summer were found to contain the least trace of contamination.

St. John, N.B.—Mr. H. A. Powell, K.C., member of the International Waterways Commission, has left for Grand Falls and vicinity to conduct an investigation into the boundary waters, which, it is understood, have given rise to much serious consideration through their pollution. The idea of the visit of Mr. Powell, who is acting in the interests of both the United States and Dominion Governments, is to investigate the waters with the intention of reporting as to the extent of the pollution, the interest of each country in the matter, and the remedial measures which are deemed necessary with a view to the protection of the health of the dwellers

in the vicinity. The Board of Health officials will be conferred with and a thorough examination of the waters from a bacteriological standpoint will be undertaken. After the scientific examination has been completed, Mr. Powell will report as to the nature and extent of the contamination and the precautionary measures necessary to protect the residents. The responsibility which rests upon each country in connection with the waters under examination will also be considered. The problem of investigating and inquiring into the condition of waters in different countries believed to be contaminated is now occupying the serious attention of every country where the danger is found, and it is most necessary that remedial measures be considered at the inception of the pollution. In such a connection a commission has for the past ten years been conducting scientific examinations on the waters of the Thames River in England.

Toronto, Ont.—Mr. E. A. James, Highways Engineer, is back in his office again after a tour of inspection of the work being done by the Commission in York County. At Unionville the abutments for the new bridge are finished, and the bridge at Markham Village has been started. In the western part of the county a new concrete bridge is under way at Kleinburg, and a 40-foot concrete retaining wall near Woodbridge to protect the roadway from the spring freshets of the Humber River is being built. The repair gangs are all out and busy at their work of keeping the good roads in proper shape. Spoken to regarding the road on Yonge Street, Mr. James explained that within the city limits, near Hogg's Hollow, it is badly rutted in places. Near the foot of the hill the oil put on by the Commission had not penetrated the earth, but had formed a crust on top. This was now breaking up, but the repair gang would soon have that in first-class shape. "If they are prepared to give us the money," said Mr. James, "we can easily lay asphalt roads in York County. But they would cost $25,000 per mile as against the $5,000 the Yonge Street roadway has cost. There is also the cost of repairing an asphalt roadway to be taken into account, and this would prove almost prohibitive in the county. The plant required is too cumbersome to be easily moved long distances over the county roads, and it would pay to move it only to districts where extensive repairs were necessary. Then a well-built macadam roadway is better fitted to carry the class of traffic that uses the country roads. Commissioner Harris compelled the owners to remove the cleats from the wheels of motor trucks in Toronto, because of the damage they did to the asphalt. What a heavy traction engine, with its cleated wheels, drawing a tank, would do to a country road built of asphalt can be better imagined than described."

Toronto, Ont.—One of the things which it is understood the Ontario Government may lay hold upon when the Legislature convenes early in the new year, is the problem of water purification and sewage disposal. The numerous instances of difficulty which municipalities have encountered during the past year and the general desire for reliable methods of solution were instrumental in the sending of Dr. J. W. S. McCullough, chairman of the Provincial Board of Health, to the Continent this summer to gather information on the subject in general. He returned recently from a nine weeks' tour of investigation and will present an authoritative report within a short time to the Cabinet. In the same manner a report will be made up for the consideration of the Federal House by Dr. C. A. Hodgetts, chairman of the Commission on Conservation, who travelled in company with the Ontario representatives. Dr. McCullough, in company with Dr. Hodgetts, made an especially exhaustive study of sewage and water conditions in Great Britain, and brought home voluminous notes on the different systems in use in the different cities. The aim in every case was to find the extent to which the civic authorities were succeeding in producing water for domestic and public uses of a necessarily high quality and uncontaminated by the sewage, which perforce was disposed of in proximity. Twenty large sewage plants of different natures were visited in Great Britain. The water systems, while varying in smaller details, nearly all came under two general divisions of filtration, viz., mechanical and slow sand. Another feature, however, was observed in the ozone process utilized in Paris.

Windsor, Ont.—Governor Ferris, of Michigan, is personally urging the Governors of each State to name delegates to the Third American Road Congress, which will be in session at Detroit during the week of September 29th. Thirty Governors have named their delegates, and it is expected that a number of the governors will be present in person at the Congress. Governor McCreary, of Kentucky, which State has recently established a State Highway Department, expects to attend the meeting. It now seems assured that the heads of every State Highway Department from Maine to California will personally take part in the big meeting, and as a result of this unusual interest the demand for exhibit space by manufacturers has been unprecedented. All available space has been reserved by nearly one hundred manufacturers, who will display their products, including every kind of road-making machinery, engineering instruments, concrete machinery, bridges, culverts, concrete, wood block, asphalt, tar and oil preparations. Important progress is expected to be made in three great questions affecting the road movement. The Congress will endeavor to agree upon a policy of national aid, which, with the united support of the good roads workers throughout the country, will be submitted to the Congress of the United States. Steps will be taken at the session on State Road legislation, to be held under the auspices of the American Bar Association, to the formation through official action by the several states, of an interstate commission to codify and simplify existing State road laws. At present, most of the States are laboring under a weight of antiquated and contradictory road laws, and it is plain that the Commission will recommend simple, clear-cut and uniform road laws as a substitute for the mass of useless existing road legislation. Maintenance of roads will be discussed from every standpoint during the sessions held by the American Highway Association, the parent organization in the Congress, and the engineers will endeavor to determine among themselves upon the steps which should be taken in the several States to insure adequate maintenance.

Winnipeg, Man.—Considerable discussion has taken place in regard to what can be done by municipalities in the construction of good roads under the Good Roads Act, chapter 73, of the Statutes of Manitoba, 1912. Under this Act a municipality can issue debentures at a rate of interest not exceeding 5 per cent., spread over a period of forty years or less, which have to receive the approval and consent of the electors of the municipality in the usual way of all by-laws, and the interest on which is guaranteed by the Government, in order to insure the better sale of the debentures. The Government provides the municipality with an engineer, upon receiving a proper request by resolution of the council to do the engineering work for the municipality, lays out the roads, makes recommendations as to same, gives estimate of the cost, likewise of all bridges to be made, and generally furnishes the municipality with plans for the development of roads coming under the Act. The Government also co-operates with the municipalities in every way in order to assist them to bring their municipality under the Act, furnishing them free all engineering services, making plans, estimates, and carrying out the work of construction. By taking advantage of this Act taxpayers will find that the actual cost of construction may possibly be lessened, and by the issue of debentures payable in a long term of years the present taxpayer does not have to pay for all work done, but

any additional settlers coming to the district have to bear their fair proportion of the taxes. Thus, the taxpayers only pay a small amount of the principal and a small rate of interest, and have the satisfaction of obtaining good roads through the district almost immediately. The present system of patchwork will be found, upon investigation, to be much more costly than to go right ahead and construct a road system on thoroughly up-to-date and modern lines.

Ottawa, Ont.—The following recommendation of the board of control was passed at a recent meeting: "On the advice of the city engineer the board recommends that in future, to avoid the sinking of permanent roadways over excavations, no permanent pavements be laid until six months after sewers and other underground works have been completed; and, further, that the city clerk notify all public service companies that should they neglect to take advantage of the city engineer's notice from time to time of contemplated pavement works, and proceed with any repairs or new work which may require trenching the streets, permission thereafter will be refused." It was explained by the mayor that the city engineer was of the opinion that much of the faulty pavement of the past was due to not giving the roadway sufficient time to settle after it had been dug up when installing underground services. Some objection was raised to the recommendation, because it will mean a great deal of delay, as, for example, O'Connor Street has been dug up in a number of places recently, and if six months is allowed for the ground to settle again, it will mean that the paving can hardly go on this fall. Ald. McNeill thought that it should not apply to O'Connor Street. Practicaly all the members of the council were agreed, however, that it is better to wait than put down pavements that soon get out of repair because of the ground underneath settling.

Regina, Sask.—The civic construction works are proceeding very rapidly, an effort being made to complete the entire programme mapped out during the early part of the year. The sewer work is now well on toward completion, with the exception that about half a mile or so of trunk sewer still remains to be laid. Practically all of the street car line extensions to be completed this year are completed, while large gangs are employed on paving and laying concrete sidewalks. During the past week or two good progress has also been made on the construction of the federal armories at Regina. The steelwork has practically all been erected with the exception of that required to support the roof, and a large force of bricklayers are working at building the walls.

PERSONAL

J. E. RITCHIE, B.A.Sc., has been appointed permanent secretary of the University of Toronto Engineering Society.

C. W. LEAVITT, of New York, has been engaged by the city of Berlin, Ont., as civic expert to prepare a plan of the city.

F. W. SEIBERT, B.A.Sc., D.L.S., is now connected with the Department of the Interior, topographical survey's branch, at Edmonton, Alta.

RAYMOND UNWIN, a town planning expert of England, has completed preliminary work in connection with a housing scheme for Halifax, N.S., and has returned to London.

J. E. PENNYBACKER, chief statistician of the United States Joint Congressional Committee on Federal Aid, and secretary of the American Highways Association, has received an appointment to organize a Canadian statistical road bureau.

A. T. LAING, B.A.Sc., lecturer in highway engineering, and secretary, Faculty of Applied Science and Engineering, University of Toronto, has returned from a trip to Italy, France, Switzerland and Great Britain, where he has made a study of road conditions.

K. L. AITKEN, formerly general manager of the Toronto Hydro-Electric system, and under whose direction the system was designed, constructed and placed in operation, has returned from Europe and is re-establishing in Toronto his practice as consulting engineer.

R. G. BLACK, consulting engineer, has been appointed a member of the Toronto Hydro-Electric Commission to fill the vacancy caused by the resignation of H. L. Drayton, K.C., who accepted the chairmanship of the Dominion Railway Board last spring. Mr. Black is a University of Toronto man, with a broad, general experience in electrical engineering. The Commission, as now constituted, is P. W. Ellis, chairman, H. C. Hocken and R. G. Black.

OBITUARY.

H. BODE and E. R. ROBERTS, of the Canadian Boundary Survey staff, were killed in a landslide which occurred on September 6th, destroying their camp at Cape Musson, Dale Island, Alaska. The party had been working on the boundary survey up Portland Channel and Dixon Entrance.

GEORGE STREET, of the Dominion Government Survey staff, and his companion, H. V. RADFORD, of Washington, met death last year at the hands of an Eskimo band at Bathurst Inlet. The two men were engaged in coastal survey work, and had been away several years, eventually intending to follow the coast of Canada across the Arctic to the Yukon and thence south to Vancouver. The news of their sad fate did not reach headquarters for fully a year after the occurrence.

COMING MEETINGS.

ILLUMINATING ENGINEERING SOCIETY.—Annual Convention to be held at Pittsburg, Pa., September 22nd to the 26th. Secretary, I. D. Israel, 29 West 39th Street, New York City.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20151—August 25—Authorizing the C.P.R. to construct a diversion of the surveyed trail in Secs. 23 and 14, Tp. 22, Rge. 3, W. 4 M,. and between Secs. 14 and 11, Tp. 22, Rge. 3, W. 4 M.; and to construct its tracks, by means of a grade crossing, across the said diversion in Sec. 14, mileage 102.2 on C.P.R. Bassano Easterly Branch.

20152—August 22—Authorizing the Essex Terminal Railway Company to construct its railway, at rail level, across the Langlois Road, and existing highway, being the boundary line between Twp. of Sandwich West and town of Ojibway.

20153—August 22—Ordering the C.L.O. & W. Railway to provide a cattle pass on the property of J. R. Irwin near Cobourg, Ont., of the same dimensions as that furnished by the C.N.R.

20154—August 22—Authorizing the Montreal Tramways Company to construct its proposed new track across the tracks of the G.T.R. on Notre Dame St., at the intersection of St. Ferdinand St., Montreal, Que.

20155—August 21—Authorizing the Winnipeg North Eastern Railway, to construct its line and tracks across the lines and tracks of the C.P.R. Co.'s Emerson Branch, in Roman Catholic Mission Lot 312, St. Boniface, Man.

20156—August 25—Authorizing the C.N.R. to construct its line of railway across the trail in the S.W. ¼ of Sec. 9, Tp. 7, Rge. 25, W. 4 M., Calgary South Branch, Alta.

20157—August 25—Authorizing the G. T. P. to construct bridge across Cottonwood Creek, at mileage 211.6 Wolf Creek West, District of Fort George, B.C.

20158—August 23—Approving revised location of Dominion Atlantic Railway, North Mountain Branch, between Grafton and Tory Lane, Tp. of Cornwallis, N.S.

20159—August 23—Approving plans showing location and details of D.A. Ry.'s proposed new station at Annapolis Royal, in Annapolis Co., N.S.

20160—August 22—Authorizing the Midland Ry. Co., C.P.R., C.N.R. and G.T.P. to operate their trains over the crossings within the scope of interlocking plant installed at said crossings.

20161—August 22—Authorizing the C.P.R. to construct a road diversion in Lot 10540, Kootenay Dist., B.C.

20162—August 22—Authorizing the C.P.R. to construct, maintain and operate a branch line of railway, or spur, for the British Columbia Sugar Refining Company, Limited, Regina, from a point on the existing spur in lane in Block 137, thence across said lane and across Lots 16 to 20 inclusive, Block 137, Regina, Sask.

20163—August 18—Approving location of C.N.R. Co.'s railway through Tp. 26, Rges. 23-26, west 3 M., Sask., mileage 105.42 to mileage 125.45, Alsask Branch.

20164—August 18—Approving revised location of G.T.P. Ry.'s main line of railway, mileage 138.19 to mileage 149.41, Prince Rupert East, through Squin-Lix-Stat Indian Reserve, Cassiar Dist., B.C.

20165—August 25—Granting leave to the C.P.R. to cancel siding agreement between the C.P.R. and the Nelson-Ford Lumber Company, dated July 17, 1909.

20166—August 23—Amending Order No. 19236 and providing that the Campbellford, Lake Ontario and Western Ry. and the C.N.R. build the bridge and approaches over its own line on the farm of John Pearse, in the S. ½ of Lot 4, Con. 4, Tp. Scarborough, Ont.

20167—August 19—Ordering that paragraph 1 of the operative part of Order No. 19500 be struck out; and that the plan dated Winnipeg, July, 1913, marked "A," showing the proposed layout at Herbert, Sask., be approved.

20168—August 25—Authorizing the G.T.P. to construct proposed bridge across Dome Creek, mileage 273, Wolf Creek West, Cariboo District, B.C.

General Order No. 109—Suspending, until further Order, the mileage rates on less than carload shipments of grain and grain products.

General Order No. 110—Requiring Railway Companies subject to the jurisdiction of the Board to accept and carry by freight, trunks containing wearing apparel and personal effects when securely corded.

20169—August 26—Approving revised location of G.T.P. Co.s main line from the west boundary of Lot 4900, into Fort George Indian Reserve, mileage 459.61 to mileage 466.11, east of Prince Rupert, Dist. of Cariboo, B.C.

20170—August 19—Authorizing G.T.P. Branch Lines Co. to construct, maintain, and operate a spur for the Lyall-Mitchell Company, turning out from its Melville-Regina Branch into Sixteenth Ave., thence easterly across Albert Street and the two tracks of the Regina Municipal Railway, and turning southerly into Wascana Park to the G.T.P. Hotel site in Regina.

20171—August 26—Authorizing the G.T.R. to construct, maintain, and operate branch line of railway, or siding, commencing at a point on the 13th Dist. of its railway on Lot No. 3, Con. 1, Tp. Caledon, Co. Peel, Ont., about one mile north of Inglewood Station, thence extending in a northerly direction to and into the premises of Charles Mould, Lot 3.

20172—August 19—Authorizing the G.T.R. to construct, maintain and operate, branch line of railway or siding and spur therefrom, commencing at a point on the G.T.R. west of Muskoka Wharf, Ont., thence extending in a northwesterly and northerly direction to the premises of the Ontario Granite Crushed Stone Company, Lot 8, Con. 4.

20173—August 26—Authorizing the G.T.R. to construct, maintain and operate branch line of railway or siding, commencing at a point on its railway south of Milton Station, Ont., thence extending in a westerly and northerly direction across Lot 14, 1st con., Tp. of Trafalgar, to and into the premises of Brandon's Pressed Brick and Tile Company, of Milton, Limited, on said Lot 14.

20174—August 26—Authorizing the G.T.R. to construct, maintain and operate branch line of railway, or siding, commencing at a point on its railway on Lot 13, 5th Con. of Tp. of Somerville, Co. Victoria, Ont., thence extending in a northerly direction to and into the premises of S. Suddaby on Lot 13, occupied by Messrs. Britnell and Company.

20175—August 26—Authorizing the Municipal Corporation of the town of Sudbury to construct and maintain, at its own expense, grade crossing over the C.P.R. Co.'s Soo Branch, Sudbury, at the intersection of Regent and Riverside Streets with the Copper Cliff Road.

20176—August 18—Authorizing the Corporation of the County of Richelieu to construct and maintain, at its own expense, a highway under the tracks of the Quebec, Montreal and Southern Railway Company. Parish of St. Joseph, Dist. of Richelieu, Que.

20177—August 26—Authorizing the New Brunswick Coal and Railway Company to construct bridge No. 1.1 on its line of railway.

20178—August 26—Approving location of extension Niagara, St. Catharines and Toronto Ry. Co.'s line to Lake Front, Lot 12, Con. 1, Tp. of Grantham, Co. Lincoln, Ont., mileage 0 to mileage 0.68.

20179—August 26—Approving location of C.N.R. station grounds at Bratton, Sask.

20180—August 21—Approving location of C.N.O.R. station grounds at Cedar Lake, Tp. of Deacon, Dist. of Nipissing, Ont., at mileage 163.06 from Ottawa.

20181—August 26—Approving revised location of C.N.R. Co.'s de Lourdes spur through Sec. 36, Tp. 6, Rge. 9, W. P M., Man., mileage 0 to mileage 2.627.

20182—August 26—Approving plans showing locations and details of Algoma Central and Hudson Bay Railway Co.'s station proposed to be erected at Frater, Dist. of Algoma, Ontario.

20183—August 23—Ordering the G.T.P. to erect fences and install cattle guards at the east end of its station grounds at Ingelow, in Sec. 4, Tp. 12, Rge. 16, W. P M., Man.

20184—August 19—Extending until the 30th October, 1913, the time within which the C.P.R. move and complete stock pens at Shelburne.

20185—August 25—Ordering the T.H. & B. Railway to employ a day and night watchman at the crossing of Bailey Street, Hamilton, Ontario, at its own expense.

20186—August 20—Relieving, for the present, the G.T.R. from providing further protection of the first highway one hundred and fifty feet west of St. Hilaire Station, Quebec.

20187—August 23—Amending Order No. 19957, dated Augnst 2nd, 1913, by adding thereto the following clause, namely:—

"And it is further ordered that the Applicant Company be, and it is hereby, authorized to re-arrange the remaining tracks of the Grand Trunk Railway Company on the property of the Acton Tanning Company, in the manner shown on the said plan, in green,—using for the purpose the rails, ties, and other track material in the existing spur tracks, and supply, at its own expense, such other material and labor as may be required for the purpose."

20188—August 18—Authorizing the Esquimalt and Nanaimo Railway Company to construct, maintain and operate siding for Scott and Peden from a point on its railway, near Victoria Station, B.C., thence crossing Store Street, Victoria, into the premises of Scott and Peden.

20189—August 26—Authorizing the Government of the Province of Saskatchewan to construct and maintain highway over the C.P. & G.T.P. Rys. in Sec. 28, Tp. 32, Rge. 27, W. 2 M., Sask.

20190—August 26—Approving proposed location of C.P.R. Co.'s station on the S.E. ¼ of Sec. 32, Tp. 6, Rge. 15, W. 4 M., at Conrad, Alta., at mileage 24.7 on its Suffield to Blackie Branch.

20191—August 27—Extending until 1st of November, 1913, the time within which the C.P.R. install gates at the crossing of Montcalm St., St. Boniface, Man.

20192—August 26—Authorizing the C.P.R. to construct additional track of its main line, Lake Superior Division, Cartier Subdivision, across certain highways in the Tp. of Balfour, Sudbury, Ontario.

20193—August 27—Approving location of C.P.R. station on land lying to the north of Wellington Street and westerly of Robinson Street, Port Butwell, Tp. Bayham, Co. Elgin, Ontario.

20194—August 19—Authorizing the C.P.R. to construct, maintain and operate branch line of railway or spur from a point on the existing spur in Lot D.G.S. 45, Parish of St. James, to and into the premises of the Pease Foundry Co., Limited, situate in Lot D.G.S. 45, Parish of St. James.

20195—August 18—Authorizing the C.P.R. to construct, maintain and operate branch line of railway or spur, for Peter Verigin, of the Doukhobor Society of Brilliant, B.C., from a point on the westerly limit of the C.P.R. Co.'s Slocan Lake Branch, mileage 19.75 from Slocan Junction, into Lot 3463 G 1, B.C.

20196—August 26—Authorizing the C.P.R. to construct, maintain and operate branch line of railway or spur for the East Kootenay Lumber Company, Jaffray, B.C., from a point on the easterly limit of the C.P.R. right-of-way at Glenlily, Alberta Division, in Lot 7927 Group 1, B.C.

20197—August 19—Authorizing the C.P.R. subject to the terms of city's consent, excepting paragraph 5, to construct, maintain and operate two branch lines of railway or spurs, from a point on C.P.R.'s line, thence across Lachine Canal Lands and St. Patrick Street, to and into the premises of the Canadian Rolling Mills Company, situate in Lot Cadastral No. 3607, Parish of Montreal, Emard Ward, Montreal, Que.

20198—August 26—Authorizing the C.P.R. to construct, maintain and operate branch line of railway or siding from a point on the existing spur in Lamoriciere Street, thence across said street and Cadastral Lots Nos. 209-100 to 209-105, inclusive, in village of Cote St. Louis, to and into the premises of the Canada Produce Company, situate in said lots in St. Denis Ward, Montreal, Que.

20199—August 22—Authorizing the C.P.R. to construct, maintain and operate branch line of railway or spur for Orr Minnis, Markdale, Ontario, from a point on the northeasterly limit of the C.P.R. right-of-way, at mileage 66.12, Owen Sound Subdivision, Ont. Div. to and into premises of Orr Minnis, Lot 100, village of Markdale, Tp. Glenalg, Co. Grey, Ont.

20200—August 26—Authorizing the C.P.R. to construct, maintain and operate extension of existing siding for Messrs. Quinlan and Robertson, in Lot 10, Con. 8, Tp. Huntingdon, Ont., at mileage 85.86, C.P.R.'s Havelock Subdivision, Ont. Division.

20201—August 19—Authorizing the C.P.R. to construct, maintain and operate branch line of railway or spur from a point on the existing spur in the lane in Block 206, thence across and along said lane in Block 206, Lethbridge, Alta., for the International Harvester Company of Canada, Limited.

20202—August 19—Authorizing C.P.R. to construct a diversion of the road allowance in Sec. 4, Tp. 21, Rge. 9, W. 4 M., and to construct its tracks by means of a grade crossing, across the diversion, at mileage 60.78 of the C.P.R. Co.'s Bassano Easterly Branch.

20203—August 27—Authorizing the Corporation of the city of Edmonton, Alta., to extend Peace Avenue across the Edmonton, Yukon and Pacific Railway, at rail level.

20204—August 27—Ordering the G.T.P. Branch Lines Company to construct its Prince Albert Branch across the highway in the S.E. ¼ of Sec. 4, Tp. 33, Rge.. 27, W. 2 M., at mileage 1.5, Sask., on or before September 15th, 1913.

20205—August 27—Authorizing the C.N.R. and G.T.P. Railways to operate their trains over, upon, or through the connection and junction of the C.N.R. with the National Transcontinental Railway at St. Boniface, Man.

20206—August 28—Authorizing G.T.P. Branch Lines Company to carry traffic over portion of its Biggar-Calgary Branch between Dodsland, mileage 48.0, and Loverna, mileage 104.06.

20207—August 27—Authorizing the Government of the Province of Saskatchewan to construct and maintain, at its own expense, road under the C.N.R. right-of-way in the S.W. ¼ of Sec. 21, Tp. 29, Rge. 17, W. 3 M., Sask.

20208—August 27—Ordering the C.N.R. to construct a standard portable passenger and freight shelter and platform and a two car cattle pen at Mulvihill, Man.

20209—August 28—Relieving, for the present, the C.N.O.R. from providing further protection at the crossing of Ontario Street, Cobourg, Ont.

20210—August 28—Authorizing the C.P.R. to construct, maintain and operate branch lines of railway or spurs for the Moose Jaw Flour Mills Limited, Moose Jaw, Sask., from a point on the N.W. limit of the right-of-way of the C.P.R. main line of railway in Block 102, Moose Jaw, thence across said Block 102 and Second Avenue, to and into the premises of the Moose Jaw Flour Mills, Moose Jaw, Sask.

20211—August 27—Authorizing the C.P.R. to construct, maintain and operate a branch line of railway or spur for the Sherwin-Williams Company, Winnipeg, Man., from a point on existing spur in lane in Blocks 65, 66, 68 and 69 and across 6th St. W, 7th Street W, 8th Street W, and 9th Street W, Calgary; and a branch line of railway or spur from a point on above spur in lane in Block 66, thence across said lane and 7th Street W., to and into the premises of the Sherwin-Williams Company, situate in subdivision Lots 39, and 40, Block 67, Calgary, Alta.

20212—August 28—Rescinding Order No. 17282, in so far as it approves the revision of the location between mileages 15.1 and 31.5; providing that if C.P.R. file with the Board a new plan showing a connection at mileage 19, the Board will approve the revision from mileage 15.1 to mileage 19.

20213—August 27—Authorizing the C.P.R. to construct, by means of grade crossings, additional track across certain highways in the District of Sudbury and Province of Ontario.

20214—August 27—Relieving the C.P.R. of speed limitation of fifteen miles an hour on the Lauder Extension of its railway from Tilson, mileage 28.7 to Alida, mileage 54.72.

20215—August 27—Approving revised location of portion of C.P.R. main line, as constructed, Lake Superior Division, Schreiber Subdivision, from mileage 16.01, thence in a westerly direction to mileage 21.79, Dist. of Thunder Bay, Ont.

20216—August 27—Authorizing the C.P.R. to change the present grade crossing in the road allowance between Lots 28 and 29, Con. 2, Tp. Scarboro, and to construct an additional track (double track) by means of a grade crossing, across road allowance between Lots 28 and 29, at mileage 89.0 on C.P.R. main line.

20217—August 27—Authorizing the C.P.R. to change the present grade crossing in the road allowance between Cons. 2 and 3, Tp. Scarboro, and to construct an additional track (double track), by means of a grade crossing, across said road allowance between Cons. 2 and 3, at mileage 88.2 on the C.P.R. main line.

20218—August 27—Authorizing the C.P.R. to change the present grade crossing in the road allowance between Lots 26 and 27, Con, 2, Tp. of Scarboro, and to construct an additional track (double track), by means of a grade crossing, across the said road allowance between Lots 26 and 27, at mileage 88.4, on the C.P.R. main line.

20219—August 28—Approving Express Classification for Canada No. 3, superseding and taking the place of the present Classification No. 2.

20220—August 28—Authorizing the city of Peterboro, Ont., to construct highway, known as De Laval Street, in said city, across the tracks of the Midland Branch of the G.T.R.

20221—August 28—Amending Order No. 19936 to provide that connection be made at the point shown on the C.N.R. Co.'s plan dated August 16, 1913, File No. 21826; provided the C.N.R. extend its transfer track up to the proposed connection with C.P.R.; the C.P.R. to put in crossover west of the new connection and extend its transfer track up to the proposed connection.

20222—August 26—Recommending to the Governor-in-Council for approval, the Rules and Regulations of the Transportation Department of the Montreal and Southern Counties Railway Company.

20223—August 29—Approving and authorizing the clearances at coaling station at G.T.R. new engine terminals, St. Lambert, P.Q.

20224—August 29—Authorizing the Corporation of the city of St. John, N.B., to construct a highway bridge over the Cantilever Branch of the C.P.R. at Alexandria St. Extension.

20225—August 29—Approving proposed location of C.P.R. station at Willows on the C.P.R. Weyburn Westerly Branch, in the South Half L.S. 12, Sec. 35, Tp. 7, Rge. 29, W. 2 M., Sask.

20226—August 29—Authorizing the C.P.R. to construct, maintain and operate branch line or spur for H. J. Heinz Company, Leamington, Ont., from a point on existing spur, thence across Con. St., to and into premises of H. J. Heinz Company, Subdivision Lot 27, Lot 2, Con. 11, Tp. Tillsonburg, Ontario.

20227—August 29—Authorizing the C.P.R. to construct, maintain and operate extensions to trackage for the Western Canada Flour Mills Company, Winnipeg, from points on the westerly limit of the right-of-way of the C.P.R. Manitoba Division, to and into premises of the Western Canada Flour Mills Company, situate in Lot D.G.S. "M" St. Boniface, Man.

20228—August 14—Authorizing the C.L.O. & W. Railway to divert the highway between Lots 8 and 9 of Con. B, Tp. Hamilton, Ont.; and authorizing the C.L.O. & W. Railway to construct its railway across the Cobourg and Grafton Road by means of a subway to be constructed on the line of the highway, carrying the said road under its railway and the two main line tracks of the G.T.R.

20229—August 26—Approving location of C.P.R. station proposed to be erected at Limerick on the C.P.R. Weyburn Westerly Branch, in the N.W. ¼ of Sec. 18, Tp. 8, Rge. 2, W. 3rd Mer., Sask.

20230—August 30—Authorizing the C.L.O. & W. Ry. to divert Fourth Depot River in Lot 12, Con. 8, Tp. Hichinbrooke, Co. Frontenac, Ont., and to construct a bridge across said river as so diverted at mileage 33.54 from Glen Tay.

20231—August 29—Extending the time within which the C.P.R. are required by Order No. 18512 to install gates at the North Vancouver Ferry, Columbia Avenue and the G.T.P. Railway Company's team crossing at Vancouver, B.C., until October 15, 1913.

20232—August 30—Amending Order No. 20102 by striking out the word "Sheffield" wherever the same appears in said Order and inserting in its place and stead the word "Suffield."

20233—September 2—Authorizing the C.P.R. to open for the carriage of traffic portion of the double track of its Swift Current Subdivision from Chaplin, near mileage 54, to Ernfold, mileage 66.5, Sask.

20234—September 2—Authorizing the C.P.R. to construct an additional track (double track) across highways at mileage 82.2 and 81.5, in the Province of B.C.

20235—August 30—Authorizing the Lake Erie and Northern Railway to construct its railway across certain highways in the Tp. of Oakland, Co. Brant, Ont.

20236—August 30—Authorizing the Lake Erie and Northern Railway to construct its railway across the highways in the Tp. of Townsend, Co. Norfolk, Ont.

20237—August 30—Approving location of the Lake Erie and Northern Railway Company from station 240+54 to station 850+54.8, Ont.

20238—September 2—Authorizing the C.N.O.R. to construct the lines and tracks connecting its Montreal-Port Arthur Line with the G.T.R. temporarily, pending the expiration of the lease from John Morrison, across Eganville Road, Tp. of Pembroke, Ont.

20239—August 30—Authorizing the C.N.O.R. to construct its proposed spur for Point Anne Quarries, Limited, across the public road between Lots 20 and 21, Point Anne Con., Tp. Thurlow, Ont.

20240—September 2—Authorizing the Government of Alberta to construct a highway across the C.N.R. in the N.E. ¼ of Sec. 30, Tp. 29, Rge. 20, W. 4 M.

20241—September 2—Authorizing the C.N.O.R. to construct its line of railway across public road between Lots 32 and 33, con. C, Tp. Scarboro, Co. York.

20242—August 30—Authorizing the C.N.O.R. to construct its line of railway across public road between Lots 30 and 31, Con. C., Tp. Scarborough, Co. York, Ont.

20243—September 2—Amending Order No. 20058 by striking out the words, "William Alexander of Silverwood," where the same appear in the recital to the said Order, and substituting therefor the words, "William Alexander Silverwood of Saskatoon."

20244—August 30—Authorizing the C.P.R. to construct, maintain and operate branch line of railway or spur for the Dunmore Development Company, Medicine Hat, Alta., from a point on the southerly limit of the right-of-way of the C.P.R. Alta. Div., thence across Block D. 1st Ave., Block A, and Gov. Trail, Mnn. Dunmore, Alta., to and into the premises of Dunmore Development Company, situate in Block E, S.W. ¼ Sec. 2, Tp. 12, Rge. 5, W. 4 M.

20245—August 30—Ordering that the effective date of the advanced rates in Supplement No. 17 to Tariff C.R.C. No. W-1615, be suspended for a period of Thirty days from the date of this Order.

20246—August 30—Ordering that the effective date of the advanced rate in Supplement No. 24 to Tariff C.R.C. No. W-1713 be suspended for a period of Thirty days from the date of this Order.

20247—September 2—Approving revision in grade of portions of C.P.R. main line from mile 6.35, at Farnham, thence in a north-westerly direction to mile 19.89 at St. Johns, P.Q.

20248—September 2—Relieving, for the present, the G.T.R. from providing further protection at the first public crossing one-quarter of a mile west of Colborne Station, Ont.

20249—September 2—Authorizing the Canadian Northern Alberta Ry. to construct its proposed spur to Jasper Park Collieries, Ltd., across the public road between Sec. 7, Tp. 49, Rge. 27, and Sec. 12, Tp. 49, Rge. 28, W. 5 M., Alta.

20250—August 30—Approving detail plans Nos. B-1174.1 and B-1174.2, showing bridge No. 112.0 over Wyandotte St., Windsor, Ont.

20251—September 2—Authorizing the Edmonton, Dunvegan and British Columbia Ry. to construct its line of railway across certain highways in the Province of Alta.

General Order—No. 111—Refusing application of Harold W. Riley, of Calgary, Alta., for reconsideration of Orders Nos. 17492 and 17384 prescribing express on cream and terms and conditions of service in connection therewith, and substituting certain rules for those included in tariff prescribed by Order No. 17384.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING

in addition to those in this issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Amherst, N.S., extension of a wharf	Sept. 22.	Sept. 4.	80
Fraser River, B.C., jetty and dredging	Sept. 30.	Aug. 21.	80
Laprairie, Que., protection dyke	Sept. 23.	Aug. 28.	80
Meaford, Ont., extension and construction of revetment wall	Sept. 29.	Sept. 4.	80
Newport, B.C., buildings	Sept. 26.	Sept. 11.	84
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Petite Riviere, Est. Quebec, construction of a break-water	Oct. 7.	Sept. 11.	82
Prince Rupert, B.C., drill hall	Sept. 23.	Sept. 4.	80
Regina, Sask., power house equipment	Oct. 1.	Aug. 28.	86
Regina, Sask., power house equipment	Oct. 25.	Sept. 11.	86
Toronto, Ont., supplying fire alarm boxes	Sept. 23.	Sept. 11.	80
Victoria, B.C., public building	Sept. 24.	Sept. 11.	84
Winnipeg, Man., transmission system	Sept. 20.	Aug. 28.	78
Winnipeg, Man., supplying water-pipe and hydrants	Sept. 19.	Sept. 4.	80

RAILWAYS—STEAM AND ELECTRIC.

Calgary, Alta.—The announcement is made that work on the Dominion Western Railroad, which will run from a point on the international boundary line north of Great Falls, Montana, west into the Crow's Nest country, tapping the coal fields north to Calgary and on into the Peace River country, will be commenced immediately. British and American capital are back of the new undertaking.

+—Montreal, Que.—The Canadian Pacific Railway has awarded MESSRS. SOPER AND McDOUGALL the contract for the double tracking of eight miles of road from Levis to Chaudiere Junction and the extension of the yards at Levis to about double their present size.

Montreal, Que.—It is for the C.P.R. legal experts to take the next step in the fight with Maisonneuve over the laying of a spur line through that municipality. At present the laying of the rails is tied up through the Maisonneuve police interfering a short while ago, their action being sustained by the courts. Mr. Holden stated recently that he did not yet know what they would do to put the C.P.R. in the way of proceeding with the construction.

Victoria, B.C.—Steel is now being assembled for the construction of the splendid viaduct which is to span Arbutus Canyon on the route of the Esquimalt and Nanaimo Railway. As has already been announced the concrete piers for the structure have been in position for some weeks, and now that the other material has arrived, it will not be long before the trestle at one of the finest scenic bits between this city and Duncan will be an accomplished fact. The Arbutus Canyon bridge, however, is not the only construction work of that nature which is being undertaken by the Esquimalt and Nanaimo Railway, and their programme for the next year or so includes an extensive campaign of bridge construction along the route of the new east coast extension from McBride Junction to Courtenay. Among the spaces to be bridged on this route are French Creek and the Little Qualicum. Owing to the lateness of the arrival of the steel the Courtenay extension cannot be completed this year, but the work is being pushed through with all possible speed.

Victoria, B.C.—The work of grading the Canadian Pacific extension from Victoria as far as Union Bay will be finished by the end of November, according to Mr. Clarence Hoard, who has returned after a two weeks' trip of inspection. Mr. Hoard, who has a contract for the grading of the section between Courtenay and Union Bay, says that his men are busy on the concrete abutments and piers ready for the steel bridges which will be erected by the railroad company. There are two of these spans on this section, and the contractors will be ready for their erection at the end of the present month. "The twelve-mile section on this side of Courtenay is not quite so far advanced," said Mr. Hoard, "but I anticipate that the whole length of line will be turned over to the railway company before the end of November for the bridge spans and the actual laying of the track."

BRIDGES, ROADS AND PAVEMENTS.

+—Brantford, Ont.—The City Council has awarded the WARREN BITUMINOUS PAVING COMPANY the contract for the refacing of the pavement on Brant Avenue. The contract price is $1.22 per square yard.

+—Brantford, Ont.—The Town Council has awarded the following contracts in connection with pavements:—THE ROYAL ARTIFICIAL STONE PAVING COMPANY, of Guelph, were awarded the contract for the laying of a cement sidewalk on both sides of Aberdeen and Emily Street. Their tender was 11¼ cents per square foot. The work will be started at once. The company was also awarded the contract for the laying of a cement walk on Chester Avenue. The tender was 12½ cents. MR. GEO. THOMPSON was awarded the contract for laying a cement walk on the south side of Grand Street, Grandview. His tender was 13 cents per square foot.

Calgary, Alta.—The Calgary Builders' Exchange went on record as favoring reinforced concrete as the construction material for the proposed bridge across the Bow River to Crescent Heights. City Engineer Craig gave a detailed exposition of the bridge situation, dealing with the good and bad points of reinforced concrete. He discussed the advantage of both the high level and low level bridges, the latter as proposed by T. R. Mawson. The exchange was non-committal, not endorsing or condemning either plan.

+—Montreal, Que.—The contracts for the paving of Sherbrooke Street have been signed and work will be commenced at once, for the agreements call for the finishing of this improvement by October 26th next. It depends upon the weather whether this work can be done by that date. This thoroughfare will be paved in three sections. Two sections will be done by the BITULITHIC PAVING COMPANY, and one by the WARNER, QUINLAN COMPANY, and the total cost will be $214,797.50. While in Toronto the city council was shown some bitulithic pavement, and were pleased with it. The surface is rougher than asphalt, and is designed to enable the horses to get a better grip on it with their feet in frosty weather. The pavement to be laid by the Warner, Quinlan Company is an asphaltic composition, similar to

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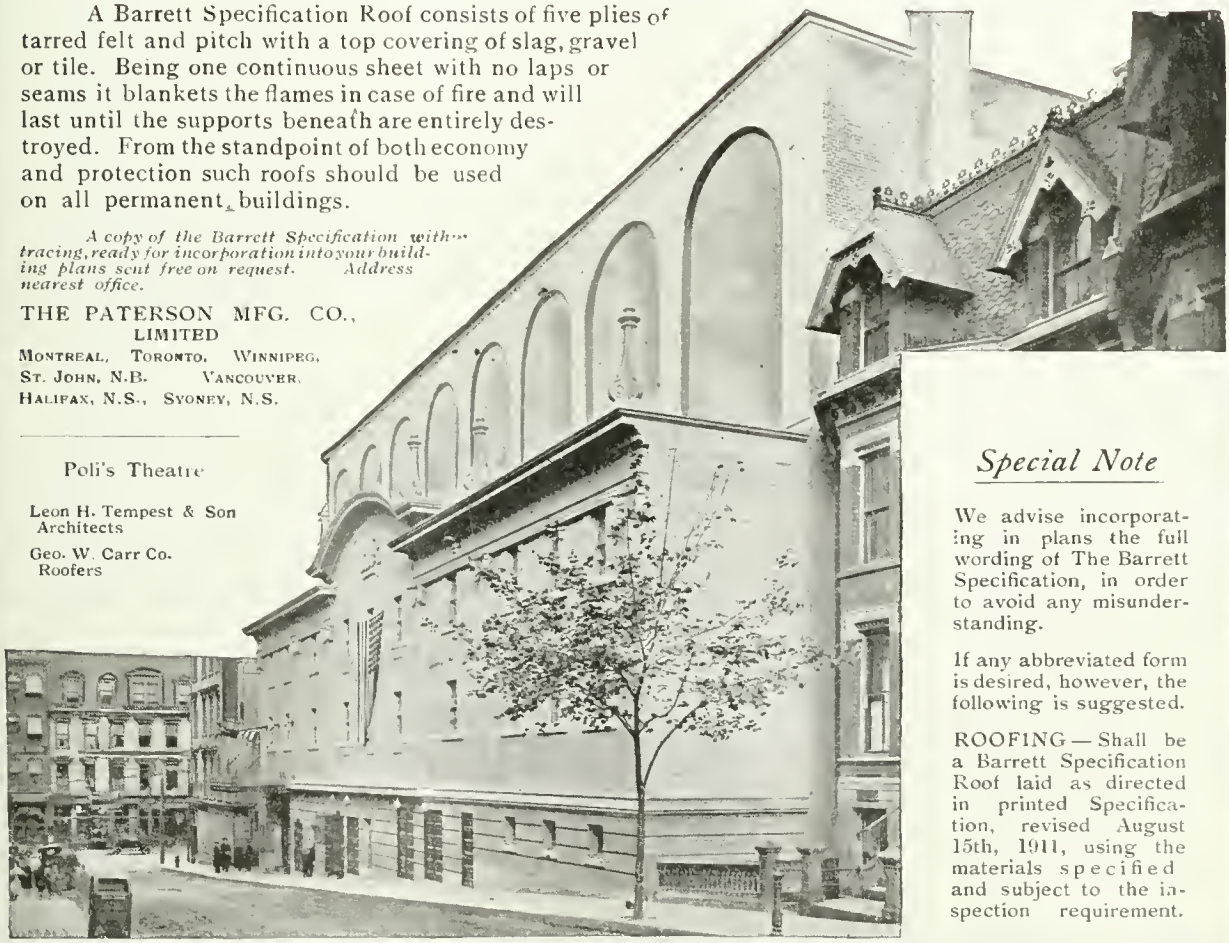

Poli's Theatre

Leon H. Tempest & Son
Architects

Geo. W. Carr Co.
Roofers

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested.

ROOFING — Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified and subject to the inspection requirement.

bitulithic. In addition to Sherbrooke Street, the city will have paved under contract by the end of next month, a number of streets between St. Catherine, Ontario, and Sherbrooke. Among these are McGregor, St. Urbain, City Councillors, Clarke, Beaudry, Demontigny, at a cost of eight to eleven thousand five hundred dollars each.

+—**Ottawa, Ont.**—The Dominion Government has awarded MESSRS. JOHN DONOVAN and H. A. McCARTHY, Belleville, the contract for the construction of a new swing bridge over the Rideau Canal. The contract price is $10,380.

+—**St. Thomas, Ont.**—The Board of Works has awarded Mr. A. E. PONSFORD the contract for the construction of pavements on Elgin Street and Denison Avenue. The tenders were as follows:—Crowley and Macdonald, curb 30 cents, track work $2.75, pavement complete $1.20; A. E. Ponsford, curb 40 cents, track work $2.75, pavement $1.40; George Ponsford, curb 40 cents, track work $2.80, pavement $1.42.

Taghum, B.C.—Tenders will be received up till the 14th of October, 1913, for manufacture and delivery of superstructure, metal, bridge and tender for substructure and erection of superstructure bridge. Plans and specifications may be obtained from the Department of Public Works, Victoria, B.C. J. E. Griffiths, Public Works Engineer.

▲—**Toronto, Ont.**—Tenders will be received up till the 23rd of September, 1913, for the construction of a large number of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

Toronto, Ont.—Tenders will be received up till the 23rd of September, 1913, for the construction of a number of pavements, concrete curbings, and concrete walks. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

+—**Vancouver, B.C.**—The City Council has awarded the following contracts for the construction of pavements:—Fourth Avenue, from Vine to Balsam, T. R. NICKSON AND COMPANY, for creosoted wood block pavement, $13,839.76; track allowance, B. C. GRANITOID COMPANY. Fourth Avenue, Balsam to Alma Road, MESSRS. M. P. COTTON AND CO., for asphaltic mixture pavement, $124,841.76; track allowance, B. C. GRANITOID COMPANY. Burrard Street, Seaton to Pacific, COLUMBIA BITULITHIC, LIMITED, for asphaltic mixture pavement, $94,928.64. Wherever there was any track allowance the competing firms had entered bids both inclusive and exclusive of the track allowance, and the suggested arrangement was stated to be satisfactory to the contractors.

Victoria, B.C.—If the Canadian Mineral Rubber Company does not meet the notification to commence paving work on Gorge Road, and the intersections of Douglas Street and Hillside Avenue and on Government Street and Bay Street, the council will proceed with the work, leaving the surfacing to the Worswick Paving Company.

+—**Welland, Ont.**—The County Council has awarded MR. A. GOEBEL, Port Colborne, the contract for the construction of a bridge over Lyons Creek. The contract price is $1,500.

+—**Woodstock, N.B.**—The Canadian Pacific Railway has awarded MESSRS. McBEAN AND McLAGGAN the contract for the construction of the bridge at Meductic.

LIGHT, HEAT AND POWER.

Calgary, Alta.—Through an arrangement effected by Commissioner Graves the Calgary Power Company will enter into a five-year agreement with the city to supply power at $26 a horse-power per year, instead of at $28.50 as under the former agreement. The company will supply 5,000 horse-power a year, which will cost the city in the neighborhood of $130,000. Soon after the expiration of the old agreement last December, a new agreement was framed by R. A. Ross, the city's power expert, but the company contended that the penalty clause was too stringent and refused to sign it. The penalty clause in the new agreement calls for the company paying $52 per horse-power in case of breakdown, or twice the amount of the ordinary price of power. In case the city wants any more power than the 5,000 agreed to, it will be supplied at a dollar less per thousand than the regular agreement rate. The company will be able to supply as high as 5,000 horse-power when their new plant is in operation and their system of storage reservoirs is completed, but it is not likely that any demand for excess power will be made, as the city plant is capable of supplying 5,000 horse-power.

▲—**Regina, Sask.**—Tenders will be received up till the 1st of October, 1913, for supplying equipment for power-house. Plans and specifications may be obtained from E. W. Bull, Superintendent of Light and Power Commission.

▲—**Regina, Sask.**—Tenders will be received up till the 25th of October, 1913, for supplying equipment for power-house. Specifications may be obtained from E. W. Bull, Superintendent of Light, Heat and Power Department.

St. Catharines, Ont.—The cost of a Hydro-Electric plant in St. Catharines to equal the service now enjoyed is estimated by the Commission at $90,000 and $26,000 for a street lighting system. The council approved the proposition, but the fact that there was no estimate of the annual cost per hour to consumers was regretted by several aldermen. The city now has an offer of five cents per hour from the Cataract Company.

GARBAGE, SEWAGE AND WATER.

Montreal, Que.—The Board of Control and the Harbor Commissioners have met in conference in regard to the completion of the Elgin basin sewer and pumping house. The cost of the work has been estimated at $150,000, and the city and the Harbor Commissioners have consented to pay one-half each, pending the decision of the courts on the responsibility for diverting the sewage. No decision as to a future course of action was decided at the conference. The Board of Control has already recommended to the City Council that the city should purchase the adjoining properties.

+—**Port Edward, B.C.**—The Town Council has awarded the following contracts in connection with the installation of its water supply:—The DOMINION WOOD PIPE COMPANY, of New Westminster, the contract for supplying the pipe; MR. J. G. WATTS the general contract and building of the dam and the trenches. Messrs. Ritchie, Agnew and Company are the engineers in charge and the system will cost $25,000.

+—**Toronto, Ont.**—A contract for two 60″ pressure water filters has been awarded by O'Keefe's Brewery to WILLIAM B. SCAIFE & SONS, Pittsburg, Pa., who were the lowest bidders.

+—**Toronto, Ont.**—The Board of Control has awarded MESSRS. DONNELLY & GRAHAM the contract for the construction of sewers in Shaw and Arthur Streets. The contract price is 63c. per lineal foot for brick, and 62.23c. per lineal foot for concrete. The total cost is $356,000.

+—**Toronto, Ont.**—The city has awarded the MORAN CONSTRUCTION COMPANY, Ottawa, the contract for the midway sewer system outlet. The contract price is $89,416. MR. JOS. O. JEROW, Earlscourt, the contract for a drainage system. The contract price is $45,834.

Toronto, Ont.—Tenders will be received up till the 23rd of September, 1913, for the construction of a number of sewers. Plans and specifications may be obtained from the Board of Control. H. C. Hocken, chairman.

Toronto, Ont.—Tenders will be called for in about a month by the Department of Works, City Hall, Toronto, for the construction of a mechanical filter plant of sixty million gallons' capacity, to be built on the Island. About two months' time will be given to the filter firms to prepare their tenders. General specifications will be issued defining the Department's requirements, bidders to submit their own designs with their tenders. R. C. Harris is Commissioner of Works.

+—**Winnipeg, Man.**—The City Council has awarded the DOMINION CONSTRUCTION COMPANY the contract for the construction of a sewer in Lansdowne Avenue to McGregor Street.

INDUSTRIAL WORKS.

+—**Calgary, Alta.**—The Canadian Pacific Railway has awarded the J. L. McKINNEY Co. the contract for the earthwork on the big dam at Bassano. The contract calls for the sloping of the mile and a half bank at Horseshoe bend to prevent any possibility of a cave in. The bank at this point is steep and it is the intention of the C.P.R. to grade it down

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until it assumes a gradual slope. The work will take from six to twelve months to complete, and several million yards of earth will be moved by the contractors before the job is completed.

Calgary, Alta.—A syndicate of local and Minneapolis capitalists, of which Mr. O. G. Devonish is the head, will shortly commence the erection of what is declared will be the largest flour mill in the British Empire. It will be built in four units, to cost $1,400,000 each, and when all units are completed will have a capacity of six thousand barrels a day.

+—**Fort William, Ont.**—The Barnett-McQueen Company has awarded the SMART TURNER MACHINE CO., LIMITED, Hamilton, the contract for supplying an automatic feed pump and receiver.

▲—**Galt, Ont.**—Tenders will be received up till the 27th of September, 1913, for the construction of river walls. Plans and specifications may be seen at the office of the town clerk, Galt, Ont.

Gull Harbor, Man.—Tenders will be received up till the 7th of October, 1913, for the construction of an extension to the wharf at Gull Lake, Lake Winnipeg, Man. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

▲—**Halifax, N.S.**—Tenders will be received up till the 15th of October, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor, and filling reclaimed areas. Plans and specifications may be obtained from Department of Railways and Canals, Ottawa. L. K. Jones, Assistant Deputy-Minister and Secretary.

Kaslo, B.C.—Tenders will be received up till the 7th of October, 1913, for the construction of a pile bent and timber decking wharf. Plans and specifications may be obtained from J. P. Ford, Esq., District Engineer, Revelstoke and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—**Lindsay, Ont.**—MR. A. E. KENNEDY, Bobcaygeon, has been awarded the contract for the construction of a wharf at Ancona Pt.

Moncton, N.B.—Maritime Oil and Gas Company have struck another big gas well in Albert County, near the scene of its present wells. The last well was several million capacity, and the well reported to-day at a depth of 1,640 feet, has a larger capacity.

+—**Montreal, Que.**—The Canadian Vickers Company, Limited, have placed an order with SIR WILLIAM ARROLS, of Clyde, for the construction of a gigantic shipuilding shed capable of accommodating a ship 880 feet long. A large order has also been placed for shipbuilding machine tools, of which British firms practically hold the monopoly.

+—**Montreal, Que.**—The Dominion Government has awarded MR. K. A. MORRISON, Ottawa, the contract for the concrete foundation and piers in connection with the Lachine Canal at St. Gabriel. The contract price is $14,433.75.

+—**Ottawa, Ont.**—The Department of Marine and Fisheries has awarded the contract to the POLSON IRON WORKS of Toronto for the construction of a steamer to be used on the St. Lawrence River above Montreal, and on Lake Ontario, in the lighthouse service. The contract price is $173,399. This is the first ship let under the new condition, namely, that construction must take place in Canada.

Ottawa, Ont.—Tenders will be received up till the 26th of September, 1913, for the renewal of the head pier, St. Anne's Lock. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, secretary.

Ottawa, Ont.—For construction of the big shops of the Transcontinental Railway at Quebec, tenders will be submitted shortly. The cost will be around a couple of million dollars, and a number of big contractors are here figuring on specifications.

+—**Ottawa, Ont.**—The Dominion Government has awarded MR. J. R. BOULANGER the contract for the extension to Montmagny Wharf. The contract price is $5,000.

Ottawa, Ont.—Tenders are to be called at once for the erection of the two piers for outer harbor works at Victoria. The purchasing agent of the Department of Public Works has been ordered to proceed to Victoria at once in connection with the purchase of a site for the new drydock at Esquimalt.

+—**Port Arthur, Ont.**—The Canadian Pacific Railway has awarded the WESTERN DRYDOCK & SHIPBUILDING CO. the contract for the repairing of the steamers Alberta and Athabasca, which ply between this port and Port McNicol. Both steamers are to be completely fitted out with new boilers and accessories, while numerous other work calls for the overhauling of the engines and other general repairs. The contract price is $65,000.

Prince Albert, Sask.—Great mineral wealth is generally supposed to be embedded in the earth throughout the northwest provinces, and with the view of getting reliable data on this matter the board of trade at a recent meeting decided to ask the government to institute a thorough geological survey of the northern halves of Manitoba, Saskatchewan and Alberta.

+—**Quebec, Que.**—The Harbor Commission has awarded the POLSON'S IRON WORKS, Toronto, the contract for the construction of six scows. The contract price is $125,000. These are to be used in connection with the dredging of the Quebec Harbor, and are to be ready for delivery by the spring. In tendering for this contract the Toronto company were successful in competing with a number of the leading shipbuilding firms of both Canada and the United States.

Sarnia, Ont.—Improvements and additions to the plant of the Imperial Oil Company that will be made within the coming year are said to total upwards of three million dollars.

+—**St. Catharines, Ont.**—The Canadian Carbide Company has awarded the SMART TURNER MACHINE CO., LIMITED, Hamilton, the contract for supplying a centrifugal pump.

+—**St. John, N.B.**—The Dominion Government has awarded the METCALF CONSTRUCTION COMPANY the contract for the construction of grain conveyers. The conveyers will connect both the old and the new Canadian Pacific elevators with berths Nos. 5 and 6. They will be of the most modern design known to engineering science. They will consist of double belt galleries between towers with trippers and machinery for driving the conveyers, including heads, pails and snubbing pulleys and take-ups. There will also be 33 dock spouts. The motors for driving these conveyers will have a capacity of 465 horsepower. The contract price for the conveyers is $133,000, and a further allowance of approximately $5,000 is to be made for electrification. Work is to be begun immediately, and the conveyers are to be ready in time for the coming winter's business.

+—**Toronto, Ont.**—The Dominion Government has awarded the CANADIAN STEWART COMPANY the contract for another large section of the harbor improvement work. The contract price is $5,760,000. The latest contract includes the construction of a breakwater from the eastern channel to Woodbine Avenue, and the excavation of a ship channel 6,800 feet long and 400 feet wide from the eastern end of the harbor through the Ashbridge's Bay industrial district. This comprises the whole of the government works, except the three lift bridges which are to span the eastern and western channels and the ship channel.

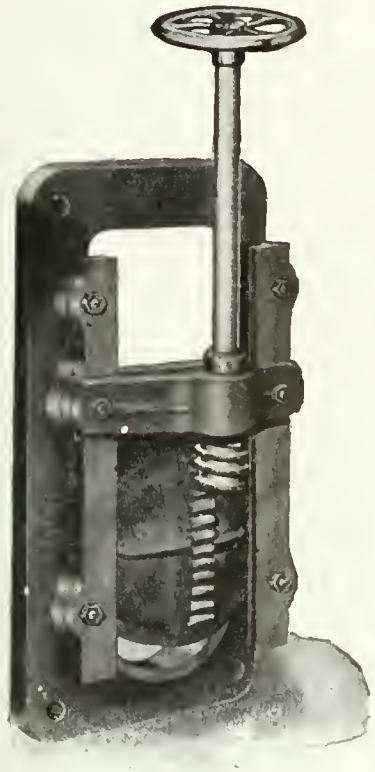
Vancouver, B.C.—The end of the hard strata which the Pacific Coast Dredging Company encountered in their operations in dredging False Creek will not be reached until the machines have worked their way past Connaught bridge, according to Mr. Stuart-Cameron, general manager of the company. In order that no delay may be caused two more dredges will be placed on the job in another month, one of these being a hydraulic and one of the dipper type. No estimate of the amount of material taken from the channel has been made as yet but the figures will soon be ascertained.

+—**Victoria, B.C.**—The CANADIAN NORTHWEST STEEL COMPANY have been awarded the contract for supplying 200 tons of steel to be used in the construction of the new Pantages Theatre.

MISCELLANEOUS.

Alsask, Sask.—The ratepayers of this town have passed a by-law authorizing the expenditure of $6,000 for fire engine, hose and equipment, with a water storage tank and hose tower.

Aurora, Ont.—Tenders will be received up till the 24th of September, 1913, for supplying fire pumps, motors and auxiliaries, etc. Plans and specifications may be obtained from S. H. Lundy, Esq., town clerk.



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Belleville, Ont.—Tenders will be received up till the 29th of September, 1913, for the erection of a new gun shed. Plans and specifications may be obtained from the Department of Militia and Defence. Ottawa. Eugene Fiset, Deputy-Minister.

+—Edmonton, Alta.—The Canadian Consolidated Rubber Company has awarded the CANADIAN STEWART COMPANY the contract for the erection of a warehouse. The contract price is $120,000.

Fort William, Ont.—Tenders will be received up till the 7th of October, 1913, for the construction of an examining warehouse. Plans and specifications may be obtained from Mr. H. E. Mathews, Winnipeg, Man.; Messrs. M. H. Beaden, Seaman and Penneman, Fort William, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Grimsby, Ont.—Tenders will be received up till the 18th of September, 1913, for the erection of a cold storage warehouse. Plans and specifications may be obtained from the Department of Agriculture, Ottawa. A. L. Jarvis, secretary.

+—Halifax, N.S.—The Dominion Government has awarded MR. J. F. COISTON the contract for the erection of a new residence for the bacteriologist of the Department of Agriculture. The contract price is $9,600. MESSRS. D. M. THOMSON and A. C. THEAKSTON were awarded the contract for the erection of a laboratory building for the Halifax quarantine station. The contract price is $6,620.

+—Hamilton, Ont.—The Dominion Steel Castings Company has awarded H. G. CHRISTMAS & CO. the contract for additions to their plant. The contract price is $12,000.

▲—Kingston, Ont.—Tenders will be received up till the 30th of September, 1913, for the construction of extension to stables. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy-Minister.

Medicine Hat, Alta.—The building permits for the month of August amounted to $802,241. In the same month last year they amounted to $243,400. This is an increase of $558,841.

+—Montreal, Que.—The Board of Commissioners has awarded MR. J. L. SIMMONS the contract for the erection of a boiler house. The contract price is $6,225.

+—Montreal, Que.—Messrs. Sir W. G. Armstrong, Whitworth and Company, Limited, has awarded the following contracts in connection with the erection of their crucible steel plant. The contract for buildings, waterworks, and drainage systems, to MR. E. G. M. CAPE, Montreal; for supplying the steel, the DOMINION BRIDGE COMPANY; for supplying five 5-ton and one 15-ton cranes, the WHITNEY FOUNDRY EQUIPMENT COMPANY, Harvey, Ill.

+—Montreal, Que.—The John D. Metcalfe Company, Limited, has awarded E. F. GIHERSON & CO., LIMITED, the contract for supplying the Indiana limestone required for the following railway stations on the Campbellford, Lake Ontario and Western line of the C.P.R.: Whitby, Oshawa, Bowmanville, Port Hope, Brighton, Cobourg, Belleville.

+—Moose Jaw, Sask.—The School Board has awarded MESSRS. COLLUM BROS. the contract for the erection of Wadena School.

North Battleford, Sask.—The by-law to raise an additional $55,000 to finish and furnish the new collegiate institute has been carried here by a large majority over the required two-thirds.

+—Ottawa, Ont.—The Dominion Government has awarded MESSRS. CROCKETT & THARLE, Fort William, the contract for the construction of the addition to the Parliament Buildings. The estimated cost is $1,000,000.

Peterborough, Ont.—That the collapse of a wall carelessly built 50 years ago was the cause of the disaster at the Turnbull Department Store on August 28th last, and the death of five persons, was the opinion expressed by W. W. Langford at the inquest before Coroner Greer.

Peterborough, Ont.—The Canadian Pacific Railway will construct new freight yards and sheds here. The estimated cost is $16,000.

+—Regina, Sask.—The City Council has awarded the PARSONS CONSTRUCTION CO. the contract for the erection of a police station. The contract price is $211,050.

Regina, Sask.—An order-in-council has been passed at Ottawa authorizing the purchase of a site for a new customs building here. The estimated cost of the building is $200,000.

Regina, Sask.—The Gutta Percha Rubber Company will erect a warehouse in this city. The estimated cost is $30,000.

Sussex, N.B.—Tenders will be received up till the 22nd of September, 1913, for the construction of a drill hall. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy-Minister.

+—Toronto, Ont.—The HILL AND STRATHY CONSTRUCTION COMPANY, LIMITED, have been awarded the contract for the construction of a series of buildings. The contract price is $100,000.

+—Vancouver, B.C.—The Japan Trust Company has awarded the J. J. FRANZ CONSTRUCTION CO. the contract for the erection of a bank and office building. The contract price is $22,000.

+—Vancouver, B.C.—MR. S. BEAUMONT has been awarded the contract for the erection of a six-story reinforced concrete apartment building. The contract price is $35,000.

Vancouver, B.C.—The Canadian Pacific Railway have prepared plans for four additional storeys to the central portion of the $2,000,000 hotel. This work will cost in the neighborhood of $1,100,000.

Vancouver, B.C.—Plans have been approved by the city building department for additions to the Canadian Pacific Railway hotel here. These additions will cost $1,100,000.

+—Victoria, B.C.—The city has awarded MESSRS. KNOTT & JONES the contract for building the additions to the Old Men's Home.

+—Victoria, B.C.—The Provincial Government has awarded MESSRS. GILLES & STEPHENS the contract for the erection of South Lillooet school.

+—Victoria, B.C.—The Provincial Government has awarded MESSRS. ROBINSON BROS., New Westminster, the contract for the erection of the school at South Westminster. The contract price is $6,500.

Victoria, B.C.—Tenders will be received up till the 22nd of September, 1913, for addition and alterations to Soke School. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffiths, Public Works Engineer.

+—Welland, Ont.—The town has awarded MESSRS. CLARK BROS. the contract for the rebuilding of the county court house.

+—Winnipeg, Man.—The Metallic Roofing Company has awarded MESSRS. WORSWICK BROTHERS the contract for the erection of a warehouse. The contract price is $19,000.

+—Winnipeg, Man.—The Tribune Publishing Company has awarded MESSRS. HAZELTON & WALIN the contract for the erection of a publishing plant. The contract price is $173,000.

+—Winnipeg, Man.—Mr. E. Prain has awarded the DAYKIN SCOTT CONSTRUCTION COMPANY the contract for the erection of an apartment block. The contract price is $56,000.

+—Winnipeg, Man.—The T. Eaton Company has awarded MESSRS. CARTER, HALLS & ALDINGER the contract for the erection of a garage building. The contract price is $22,000.

+—Winnipeg, Man.—The Dominion Government has awarded MESSRS. CARTER-HALLS-ALDINGER COMPANY, the contract for the construction of a new drill hall. The contract price is $519,000.

CURRENT NEWS.

Edmonton, Alta.—Tenders for the $500,000 tunnel to be constructed for the Southern Alberta Land Company's monster irrigation project in the Lost Lake country, north of Taber, are now being called, and will close about the middle of the present month. This tunnel, which will be the largest for irrigation purposes in Western Canada, commences at a point three miles south of Lake McGregor, and extends along the lower end of the Snake Valley for nearly 10,000 feet. When completed, it is estimated by Divisional Engineer C. E. Bee, that it will carry 1,300 second feet, or 1,300 cubic feet will pass a given point every second. The tunnel will cut off five miles along the main ditch from the lake, which is the source of supply, and besides being the longest in the west for carrying water, it

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You will find it a great convenience to deal with a House that can supply you practically anything you require in the mechanical line all "under one roof." One of the two items mentioned below may interest you

Elwell-Parker Electric Trucks

Wherever used have shown an actual saving of from 25 to 65 per cent., both for railroads and industrial concerns. One large Canadian plant trying electric trucks for the first time claims that each truck, operated by one man, has replaced eight men with eight wheelbarrows.

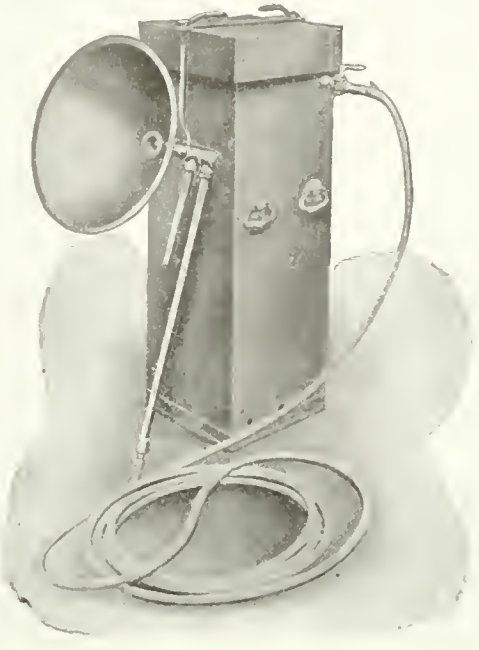
The truck shown above is one of the many types of Elwell-Parker Electric Storage Battery Trucks used by the American Express Co. The Canadian Pacific also use these trucks.

Elwell-Parker Electric Trucks are equipped with Edison Storage Batteries which are now recognized to be about the best on the market. Edison Batteries increase greatly the efficiency of the electric truck. We think so much of them that we would not advise you to purchase any electric truck that was not equipped with Edison Batteries.

Ellwell-Parker Trucks are extremely easy of operation, in no way requiring skilled labor, and by having a spare battery set can be worked continuously without injury.

If you are extending or rebuilding your plant it will pay you to investigate this well known truck.

Ask for Bulletin 107.



The Milburn Light

The No. 3-W Milburn Acetylene Light shown here gives from 5,000 to 12,000 candle power and lights 1,500 feet. The light follows the crane or shovel and throws its rays directly on the work. It lights instantly, requires no attention, and positively defies wind and weather. Has water tight cover and is made to withstand hard usage, the vibration and movement of cranes, steam shovels and dredges. Supplied with 15 inch aluminum reflector and 25 feet of armoured hose with connections. Cost 4 to 6 cents per hour to operate. Over 70,000 Milburn lights have been sold.

Ask for catalogue of Milburn Lights.

The Canadian Fairbanks-Morse Co., Limited

"The Departmental House for Mechanical Goods"

ST. JOHN QUEBEC OTTAWA MONTREAL TORONTO
WINNIPEG SASKATOON CALGARY VANCOUVER

3

will be the largest in diameter, and will show a cross section of 100 square feet. Several engineers have already been out looking the proposition over, and owing to the magnitude of the scheme, bids are expected to be numerous. It will be at least a year before the company's land is opened up for settlement.

Fort William, Ont.—Rapid progress is being made on the various plants under construction here, nearly every man that can find room in which to work is being engaged, and indications are that the men in charge of the different works will complete their contracts on schedule time. The steel skeleton for the big car works is just about completed, and tile is already being laid at one end of the structure. About one-half of the steel frame work for the plant of the Steel Company of Canada, has been completed. A large force of structural iron workers are at work there. The building for the National Tube Works is complete, and the heavy machinery is arriving and being installed. Seven of the group of buildings that comprise the plant of the Fort William Starch Works, Limited, on Island No. 1, are about completed, and in two months' time it is expected manufacturing will have started. In anticipation of the demands that will be made on them for electrical energy by the new factories, the Kaministiquia Power Company is installing poles for power line to several of the new industries.

Naples, Italy.—The exact site of the harbor of Pompeii, for which search has been made for centuries, has been discovered by the sculptor Lorenzo Cozza, who has for years continued the investigations of his late father. The harbor is 1,250 yards inland from the beach as it at present exists, and 700 yards from the gate of Pompeii.

Toronto, Ont.—Ontario's mineral production for the first six months of this year, shows a large increase. From returns made to the bureau of mines, the gain in metalliferous ores amounts to about three and three quarter million dollars, the total being $18,598,804. Gold heads the list with a gain of $1,935,949, while silver shows a falling off of $242,867, and Cobalt and nickel oxides of $5,726. In addition to gold there is an increase of $96,176 in copper; $347,519 in nickel; $108,264 in iron ore, and $1,109,202 in pig-iron. These increases are all derived from comparisons with the production for the same period in 1912.

Winnipeg, Man.—The construction of a hall, to be called the Capitol Approach, 160 feet wide, from Portage Avenue due south to the central entrance to the provincial parliament buildings now under construction, the prolongation of Osborne Street north from Broadway to Portage Avenue, the closing of several streets (particularly that part of Colony between Portage and St. Mary's Avenue), with the opening of two new east and west streets, are features of a by-law which will come up for consideration of the city council. It is planned to organize an independent commission to handle the whole proposition, the bonds of which will be guaranteed by the Provincial Government and possibly by the city.

Washington, D.C.—An English builder has been awarded the contract for turbine drums for the newest American battleship, No. 39, at a little more than one-third the price offered by the lowest American bidder. The accepted bid, $57,436, was submitted by New York agents of the Cyclops Steel and Iron Works, Sheffield, England. It is exceptional for the navy department to send a contract abroad. but Acting Secretary Roosevelt held that the action was justified by the tremendous difference between the English and American prices. The Sheffield bid includes the payment of duty, and by giving the work to the foreign builder the United States save more than $100,000. There were two American bidders, the Bethlehem Steel Company, $169,568, and the Midvale Steel Company, $160,272. The Carnegie Company, the only other domestic concern equipped to build the drums, did not seek the contract.

Washington, D.C.—Canada has called upon the United States for aid in improving its highways, and J. A. Pennybacker, chief statistician of the joint congressional committee on federal aid in the construction of postroads, has been loaned to the roads committee of the Dominion. Mr. Pennybacker, who also is secretary of the American Highways Association, will organize a statistical bureau for the Canadian Commission. The Province of Ontario is said to have already appropriated $10,000,000 for the beginning of work on its highways, and the sum is to run up to five times that figure before the programme of improvement is completed.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received:—907.—A well-known concern of Lyon would like to appoint a representative for the sale of their new patent universal rule for architect or engineers' drawings, answering all purposes. 909.—An Austrian firm of merchants seeks Canadian agents for the sale of hardware, glass and porcelain ware, electric lamps, fine art products, etc. Bankers' references given and required. 920.—A British firm in Yokohama would like to get into communication with exporters of wood sulphite, bleached and easy bleached, in Canada. 922.—A Birmingham firm is open to purchase large quantities of tinplate scrap. 926.—A large foreign firm in Japan would like to get in touch with manufacturers and exporters of sulphate of ammonia. 930.—Correspondence and quotation is requested by a Durban firm on handles of all kinds. The names of the firms making these inquiries, with their addresses, can be obtained upon application to:—"The Inquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary and Chambre de Commerce du District du Montreal.

The following inquiries relating to Canadian trade have been received. 977.—A Hamburg firm of importers and exporters are constant purchasers of the copper, nickel, zinc, etc., ores and residues; they also desire to appoint a reliable representative in Canada for the sale of metals and of chemicals used for metallurgical purposes. 985.—A London firm who import railway ties, would be glad to receive offers from Canadian manufacturers of same. 987.—A Bristol firm desires to import mineral ores from Canada. 988.—A London manufacturing company who are buyers of cobalt oxide and grey arsenic, invites offers from Canadian producers.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.

A Liverpool correspondent is prepared to communicate with Canadian manufacturers desirous of appointing United Kingdom sales agents.

From the branch office, 73 Basinghall Street, E.C.

A German company desire the addresses of Canadian firms who would be interested in purchasing pumps for waste and refuse water.

CANADIAN PATENTS JUST ISSUED.

Below will be found a list of patents recently granted to inventors in Canada, which is furnished by Messrs. Fetherstonhaugh and Company, patent barristers, solicitors, etc., head office, Royal Bank Building, 10 King Street East, Toronto. Offices in Hamilton, Montreal, Ottawa, Winnipeg, Vancouver and Washington, D.C., from whom all information may be readily obtained.

B. Bertram, capped gears; H. E. Reilly, mining boxes or columns; P. A. Barbeau, railway rail supports; W. B. Burton, rifle sights; J. V. B. Lamater, hot blast stump burners; R. B. Dillon, pole track extensions for litter carriers; L. Drapeau, electric signs; F. T. Goodwin, combined friction and positive clutches; R. H. Hill, devices for the transmission of power; C. C. Hockley, bark stripping machines; E. Johnson, stump pullers; A. Lappin, hand grip attachments; E. Maher, gate bars; A. M. Renney, fire guards; A. H. Rumohr, tenon machine gauges; H. E. Simpson, collapsible boxes; J. S. Speers, load binders.

The following are among the patents recently issued in Canada through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Leslie B. Taylor and Frederick Sanders, cartridges and tools to be used in their manufacture; James Dunlop, Quintin Marino, treatment of surfaces of aluminum or its alloys; David K. Morris and Geo. A. Lister, electric switches, circuit breakers, etc.; Alfred H. Darker, electrical installations for lighting, heating and ventilating railway carriages and similar purposes; Horace Mellnish and Alfred Montreuil, axes; Hugh H. Gregory, trailers for motor cars and other road vehicles; William Calway, building of concrete, cement and like walls.

When designing structures do you pay sufficient attention to the various matters that govern insurance rating? Why not use—without charge—the services of a well-known firm of

Insurance Engineers

Specializing in fireproof construction and protective devices

Not only can you add greatly to the fireproofness of buildings by adopting our suggestions, but it is very likely that you can do so without the improvements costing anything ultimately. They will practically be paid for by the lower insurance rates.

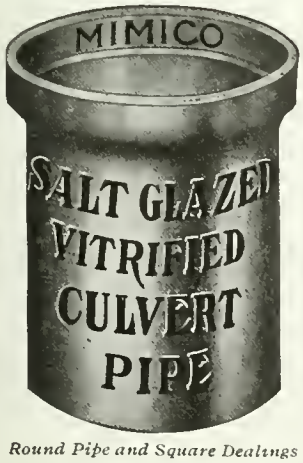
Correspondence solicited.

E. M. SELLON & CO.
LIMITED
INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I E.E., Lawford Grant, M.I.E.E. J. J. Creelman

136 St. James Street Montreal

MIMICO BRAND
Vitrified, Salt-Glazed
SEWER PIPE



Excellent clay, modern machinery, up-to-date kilns and—above all—CARE in every process makes Mimico Brand the best sewer pipe in Canada.

BIG STOCK ON HAND.

Round Pipe and Square Dealings

Write for 1913 catalogue

The Ontario Sewer Pipe Co.
LIMITED
MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

RENOUF PUBLISHING CO.

25 McGill College Ave.
MONTREAL

SECOND EDITION, Revised and Enlarged

River Discharge

By John C. Hoyt, Member, American Society of Civil Engineers, and Nathan C. Grover, Associate Member, American Society of Civil Engineers. 8vo. xii + 173 pages, 38 figures and 8 plates. Cloth, $2.00.

This book is of special use in connection with problems relating to the quantity of available water-supply, which is fundamental in all hydraulic development.

Water-Works Management and Maintenance

By Winfred D. Hubbard, Associate Member, American Society of Civil Engineers, and Wynkoop Kiersted, Member, American Society of Civil Engineers. 8vo, vi + 429 pages, 114 figures, 18 plates. Cloth, $4.00.

Part I. covers the various methods by which a supply is secured. Part II. covers the ordinary routine management of a water-works plant. Part III. is devoted to questions which arise in the dealings of municipalities with private water companies.

THIRD EDITION, Revised and Enlarged

The Filtration of public Water-Supplies

By Allen Hazen, Member, American Society of Civil Engineers. 8vo, xii + 321 pages, fully illustrated with line and half-tone cuts. Cloth, $3.00.

Explains the nature of filtration and the conditions which, in half a century of European practice, have been found essential for successful practice, with a view of stimulating interest in the subject, and of preventing the unfortunate and disappointing results which so easily result from the construction of inferior filters.

Hydraulics of Rivers, Weirs and Sluices

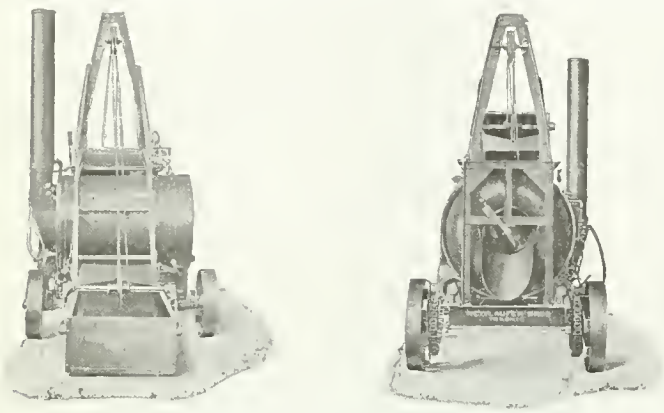
By David A. Molitor, C.E., formerly Professor of Topographic and Geodetic Engineering, Cornell University. 8vo. xii + 135 pages, 72 figures. Cloth, $2.00 net.

Treats on the derivation of new and more accurate formulae for discharge through rivers and canals obstructed by weirs, sluices, etc.

NEW STATIONARY DRUM MIXERS.

On account of the wide difference of opinion as to the respective merits of tilting and stationary drum mixers, Wettlaufer Brothers have announced they are now manufacturing their entire line of mixers with both tilting and stationary drums.

In loading the stationary drum mixer, the material enters the small, conical head of the drum, and on account of the heart shape immediately forces its way to the back. Fans,



New Traction Paving Mixer.—Views Showing Discharging and Loading Ends of Stationary Drum Mixer, made by Wettlaufer Bros.

or mixing blades, increase the mixing operation, so that the material is rapidly thrown from end to end, and the batch is held in the back of the drum ready for delivery.

The Wettlaufer automatic lift, or loading hopper, is attached to both stationary and tilting drum types of mixers. It holds the amount of the batch, with room for an additional foot or two. It loads the material directly into the mouth of the drum. To discharge the stationary drum mixers, all that is necessary is to turn a small handle. The mixers are constructed entirely of channel steel and semi-steel castings, the only wood in their construction being the engine platforms.

NEW INCORPORATIONS.

Victoria, B.C.—Rubidge Mining Company, $10,000.

Ottawa, Ont.—La Mine D'Or Huronia, $1,000,000. C. Lafond, G. Morrisset, F. Giroux.

Westport, Ont.—Westport Rural Telephone Company, $7,000. W. S. Ripley, J. F. McNally, J. Myers.

Victoriaville, Que.—Arthabasca Motor Car Company, $19,900. F. Bastien, J. O. Bastien, A. Quesnel.

Treherne, Man.—Treherne Farmers' Elevator Company, $7,000. J. H. Robertson, J. Howe, W. V. Carroll.

London, Ont.—Ideal Electric Manufacturing Company, $40,000. J. Sussex, H. J. Gracey, W. A. Cooper.

Saint Lambert, Que.—Ideal Concrete Products Company $20,000. E. S. Hicks, J. W. Newman, J. C. Terrill.

Montreal, Que.—Durbin Train Pipe Connector Company, $300,000. R. W. Hart, A. Chenier, C. McNaughton.

Windsor, Ont.—Maxwell Motor Company of Canada, $10,000. E. Flanders, W. M. Antony, E. E. von Rosen.

Sarnia, Ont.—Perfection Stove Company, $1,000,000. R. V. LeSueur, A. I. McKinlay, N. L. LeSueur.

Virden, Man.—B. McCormick, $30,000 (lumber, fuel and live stock dealers). J. Coulter, J. E. McCormick, P. J. Proctor.

Winnipeg, Man.—Schumacher-Gray Company, $40,000 electrical contractors). J. H. Schumacher, J. G. Brown, C. T. Kummen.

Brandon, Man.—Waldron Cigar Company, $25,000. A. B. Evans, Brantford, Ont., J. H. Waldron, Brandon, Mrs. M. A. Evans.

Edmonton, Alta.—Clark Cobb Engineering Company, $50,000. Alberta Chemical Rubber Company, $150,000. J. J Candy Manufacturing Company, $25,000.

Shawinigan Falls, Que.—La Compagnie Manufacturiere de Shawinigan Falls, $49,500. A. Brunelle, Three Rivers, G. Baril, J. Trepanier, both of Shawinigan Falls.

Montreal, Que.—Compagnie Nationale de Construction, $49,000. J. Brosseau, G. E. Lanthier, both of Montreal, J. A. Croteau, of Thetford Mines. Specialties, $200,000. E. R. Bouchard, D. R. Kennedy, J. R. Perreault.

Toronto, Ont.—Koohinoor Gold Mines, $2,000,000. S. King, A. Hayward, F. Watts. Moffat-Irving Steel Works, $100,000. J. W. Moffat, T. C. Irving, junr., T. R. Loudon. Hepburn and Disher, $150,000 (iron and steel manufacturers). J. T. Hepburn, C. T. Disher, C. Inrig.

GIANT ELECTRIC CLAM-SHELL OUTFIT FOR CITY OF NEW WESTMINSTER, B.C.

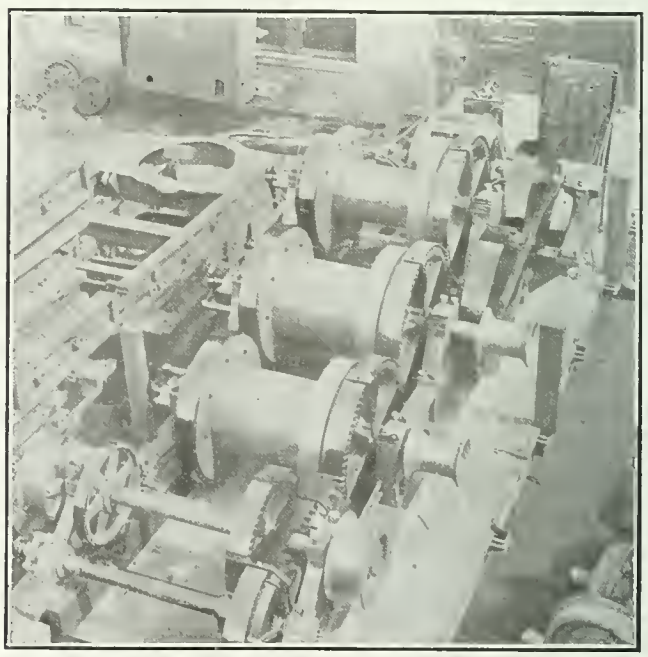
The city of New Westminster, B.C., has purchased an exceptionally large 150 h.p. electric hoist for operating a clam-shell bucket on a derrick. The hoist has three drums arranged according to the "waterfall" type, and is also equipped with a Clyde "Type A" Bull-Wheel Swinger. All drums have 18-inch barrel, the middle drum and the third being lagged to 24-inch. Fig. 1 illustrates the arrangement.

All gearing is of cast-steel, the motor pinion and intermediate gears having cut teeth with special dust-proof casing, and all drum gears are pressed on their shafts.

Specifications call for a pull of fifteen thousand pounds at two hundred and fifty feet a minute on a 24-inch drum. Each drum is equipped with brake band on the end opposite friction, and also with ratchet and pawl.

The length overall, of the hoist, including swinging gear, is 20 feet; width, over bearings of hoist, is 66 inches. The weight of the hoist alone is 35,000 pounds; with operating system this is increased to 38,000 pounds.

The 150 h.p. motor is a 3-phase, 60-cycle, 220-volt induction motor with outboard bearing bolted to bed extension. It develops 720-700 revolutions per minute. The controller has a contractor panel which automatically throws in the resistance, making it impossible to start the motor above a safe speed.



In addition to foot-brakes, the hoist is equipped with the Clyde patent automatic mechanical brake. This brake is mounted on the end of the intermediate shaft; its function is to prevent backward rotation of the gearing in the event of an interruption to the current.

The outfit was made by the Clyde Iron Works of Duluth, for Messrs. Taylor and Young, of 513 Pacific Building, Vancouver, B.C., from whom it was ordered by the city of New Westminster.

MEXICAN EAGLE ASPHALT

TRADE MARK

Mountain Street, Winnipeg, Man., paved with Mexican Eagle Asphalt.

Mexican Eagle Asphalt is the purest asphalt on the market. It is also a favorite among city engineers for its high cementing value and ductility. That means that sheet asphalt pavements constructed with Mexican Eagle Asphalt take first place among permanent pavements. Because there is no doubt but that sheet asphalt is in general the most satisfactory pavement. Read the experiences of a few Canadian cities:

OTTAWA, ONT.

Five-sixths of the thirty miles of permanent pavement in Ottawa is sheet asphalt. The principal business and residential streets are paved with it. The city engineer's department says that, if properly constructed, asphalt has been found to be about the best pavement they can have. Ottawa has a great many streets constructed with Mexican Eagle Asphalt.

WINNIPEG, MAN.

Winnipeg has laid eighty-one miles of sheet asphalt since 1897, for all kinds of traffic. City Engineer Ruttan installed the first municipal asphalt paving plant in Canada. In their experience the asphalt has worn uniformly and has been extremely satisfactory, particularly the pavements constructed with Mexican Eagle Asphalt.

VICTORIA, B.C.

Sheet asphalt is practically the only kind of pavement laid in Victoria, only four out of the forty-eight miles of permanent paving being of any other type. It has been Victoria's experience that no repairs at all are necessary in the first five years, and extensive repairs are necessary only after ten years' wear.

TORONTO, ONT.

As in most cities, asphalt predominates in Toronto, over 157 miles of sheet asphalt pavement having been laid since 1887. The average cost of maintenance per square yard during ten years has been only slightly over five cents a year. For both residential and business streets it is the principal pavement. One of the many Toronto streets that are laid with Mexican Eagle Asphalt was illustrated in last week's issue of The Canadian Engineer.

LONDON, ONT.

The city engineer of London says that asphalt pavements in London that have been down nine years are in good shape and will likely be so for another four or five years. Of less than nine miles of pavement in London, over five miles are sheet asphalt.

HAMILTON, ONT.

Thousands of tons of Mexican Eagle Asphalt have been used in Hamilton during the past five years. Asphalt greatly predominates there, two-thirds of the thirty miles of permanent paving being sheet asphalt. The principal business streets are paved with it. The average cost of maintenance per square yard for the first five years has been two cents a year.

For prices, analyses, samples, etc., please address

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

TENDERS CALLED FOR

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, September 23rd, 1913, for the construction of the following sewers:—

Earlscourt drainage system, No. 3 outlet.

Dufferin Street, 500 feet N. St. Clair Avenue to 90 feet N. Morrison Avenue.

Beaver Avenue, Lightbourne Avenue to 431 feet west.

Brandon Avenue, Primrose Avenue to Dufferin Street.

Lane 1st W. Christie Street, Garnet Avenue to Yarmouth Avenue.

Lane 1st E. Parliament Street, Spruce Street to Carlton Street.

Lane 1st W. Spadina Avenue, Oxford Avenue to N. end.

Lane 2nd N. Bloor Street, Symington Avenue to Perth Avenue.

Lane 1st N. Bloor Street, Bartlett Avenue to Gladstone Avenue.

Elmer Avenue, Queen Street to Norway Place.

Ashdale Avenue, Queen Street to Applegrove Avenue.

Wilton Avenue, storm overflow sewer section No. 3.

Danforth Avenue, storm overflow sewer section No. 1.

Bloor Street, Keele Street to E. limit of former West Toronto.

Morrison Avenue, Dufferin Street to Harvie Avenue.

Lane 1st N. Queen Street, Fuller Street to West end.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the Commissioner of Works, Toronto.

Tenderers shall submit with their tender, the names of two sureties (approved of by the City Treasurer, not members of the City Council, or officers of the Corporation of the City of Toronto) or in lieu of said sureties, the bond of a Guarantee Company approved of as aforesaid.

The usual conditions relating to tendering as prescribed by the City by-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, September 11th, 1913.

TOWN OF GALT.

TENDERS FOR RIVER WALLS.

Sealed alternative tenders addressed to the Town Clerk, Galt, Ontario, and endorsed, "Tenders for River Walls," will be received until noon of **Saturday, September 27th, 1913,** for the construction of:—

(1) A concrete retaining wall, reinforced, 680 feet in length, approximately, along the westerly bank of the Grand River, from Main Street to Blair Road.

(2) A gravity retaining wall, reinforced, 680 feet in length, approximately, along the westerly bank of the Grand River, from Main Street to Blair Road.

Plans and specifications may be seen at the office of the Town Clerk, Galt, Ontario, after Friday, September 19th, 1913.

Each tender must be accompanied by a marked cheque, payable to the order of the Town of Galt for 5 per cent. of the amount of the tender. The corporation of Galt does not bind itself to accept any or the lowest tender.

CHAS. D. CAMPBELL,
Galt, Ont., September 17th, 1913. Town Clerk.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

CANADIAN GOVERNMENT RAILWAYS.

Halifax Ocean Terminals Railway, Halifax, N.S.

Sealed tenders addressed to the undersigned and endorsed "Tender for docks, First Unit, Contract No. 3, Halifax Ocean Terminal," will be received at this office until twelve o'clock noon, Wednesday, the fifteenth day of October, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor to a depth of 45 feet at low water, and filling reclaimed areas.

Plans and specifications and form of tender may be seen and full information obtained at the office of the General Manager, Moncton, N.B., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Halifax, N.S.

The right is reserved to reject any or all tenders.

By order, L. K. JONES,
Assistant Deputy-Minister and Secretary.
Department of Railways and Canals,
Ottawa, September 2nd, 1913.

DEPARTMENT OF MILITIA AND DEFENCE.

Extension to Stables, Tete-de-Pont Barracks, Kingston, Ont.

NOTICE TO CONTRACTORS.

Sealed tenders, marked on the envelope, "Tender for Construction of extension to stables, Tete-de-Pont Barracks, Kingston," and addressed to the Director of Contracts, Department of Militia and Defence, Ottawa, will be received until noon, September 30 instant, for the construction of an extension to the stables at Tete-de-Pont Barracks, Kingston, Ont.

Specifications may be seen and full particulars obtained at the offices of the Officer Commanding the 3rd Division, Kingston, Ont., and the Director General of Engineer Services, Headquarters, Ottawa.

Tenders must be made on the form supplied by the Department of Militia and Defence, and accompanied by an accepted cheque on a Canadian Chartered Bank, for ten per cent. (10%) of the amount of the tender, payable to the order of the Honorable the Minister of Militia and Defence, which amount will be forfeited if the party tendering declines to enter into or fails to complete the contract in accordance with his tender.

The Department does not bind itself to accept the lowest or any tender.

EUGENE FISET, Deputy-Minister.

Ottawa, September 2, 1913.

Newspapers will not be paid if this advertisement is inserted without authority from the Department.—47356.
H.Q. No. 44-7-73.

CITY OF REGINA, SASK.

Sealed tenders, registered and clearly marked on the outside of the envelope "Tender for Power-House Equipment," and addressed to the City Commissioners, Regina, Saskatchewan, will be received up until noon of October 25th, 1913, for the supply of:—

One 3,000 k.w. steam turbine, with condenser.

One 25-ton capacity, hand power crane for 45-foot span.

Specifications may be obtained from E. W. Bull, Superintendent of Light and Power Department, Regina, Saskatchewan.

A marked cheque for 5 per cent. (five per cent.) of the amount of bid must accompany tender.

The City Commissioners reserve the right to reject any or all tenders.

PERMANENCE—

an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

DRAFTSMAN; first-class mechanical man wanted with industrial or power plant experience, piping, etc. State age, experience, salary and when at liberty, Box 128, *The Canadian Engineer*, Toronto.

MANAGER.—District Manager wanted by an established Consulting Engineer and Construction Corporation, based on co-operative plan, offices in Cleveland, Detroit, Buffalo and New York City. The position requires a business man with technical training, who is thoroughly capable of managing the engineering, architectural and drafting departments, and is strong on closing contracts. Highest references and $2,500 stock investment required. Contract with salary, commission and interest in business guaranteed. Box 136, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

MECHANICAL ENGINEER—Experienced Designer, Cost Estimator and Salesman, Works Supervision, all kinds of steam engines, boilers, hydraulic pumps, air machinery and mining plants, seeks position with Consulting Engineer, Contractor, Manufacturers or agency business. Highest references, some capital. Box 102, *The Canadian Engineer*, Toronto.

SUPERINTENDENT SEEKS re-appointment on heavy work, experienced in big plant, steam shovel work, rock, hardpan, concrete, etc. Highest references. Box 110, *The Canadian Engineer*, Toronto.

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PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 134478, granted on July 18th, 1911, to Julius J. Sands, of Fremont, Nebraska, U.S.A., for Grain Car Door, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention, and from whom full information may be obtained. Fetherstonhaugh & Smart, Castle Building, 53 Queen Street, Ottawa, Canada. Russel S. Smart, resident.

PATENT NOTICE.—Anyone desiring to obtain the invention covered by Canadian Patent No. 135782, granted on September 26th, 1911, to Merton D. Davis, of Surrey, England, for Cigar or Cigarette Holders, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh & Smart, 53 Queen Street, Ottawa, Canada. Russel S. Smart, resident.

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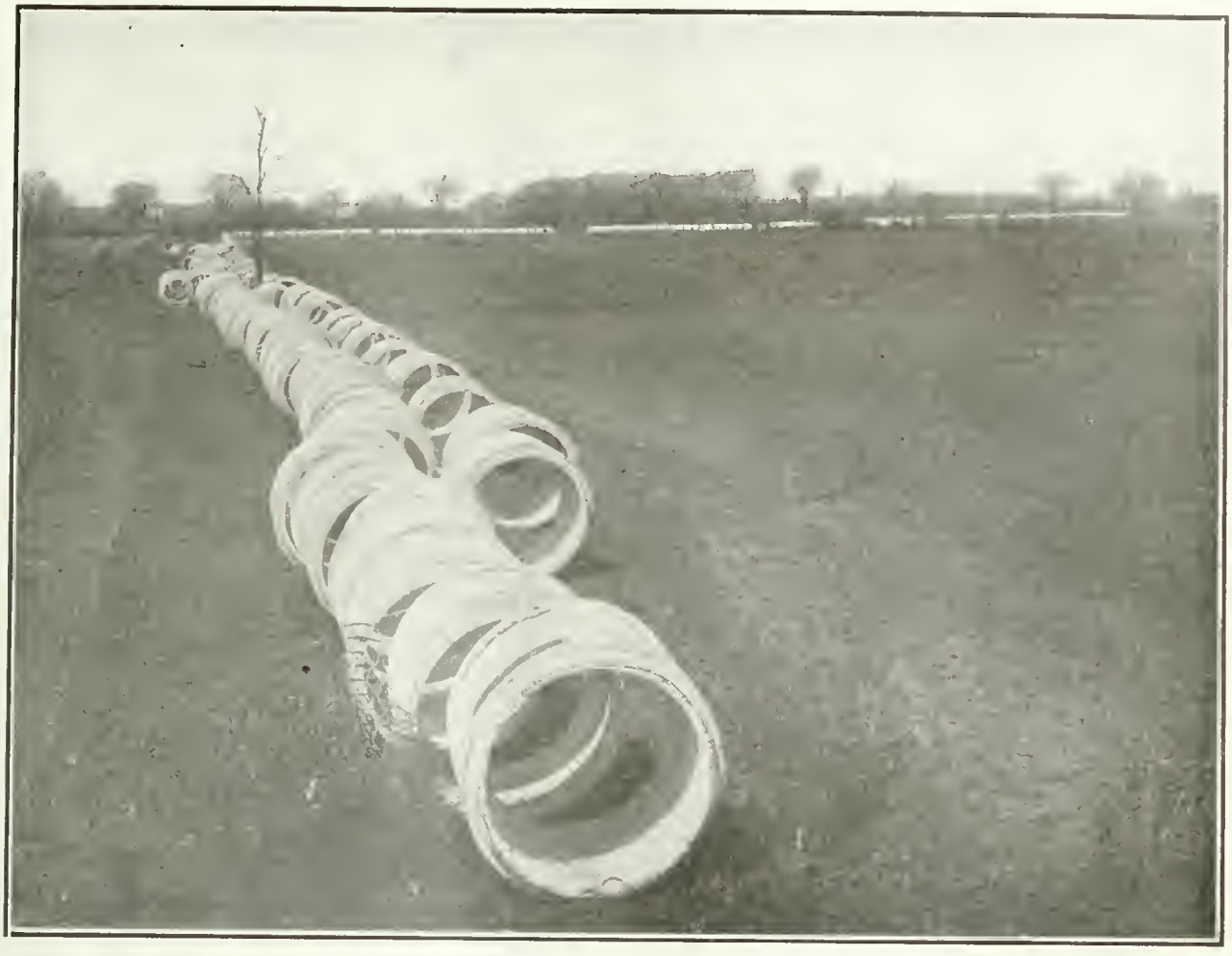

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QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
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MARKET CONDITIONS

Montreal, September 13th, 1913.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in., $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c, and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $16. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft. x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. of for galvanized; 3½-inch, $95; 4-inch, $108.

Toronto, September 17th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—⅜-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Robbie stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.25 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15⅝ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents pound, 1 to 9-case lots, 50 lbs to case. For each additional 10 per cent. nitro-glycerine add 1¼c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 5c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 5c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $6; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, September 16th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 60 lbs. and up, 10½ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 90, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tin out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.60; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

Volume 25. Toronto. Sept. 25, 1913

Contents of this issue on page 501

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

BENDING MOMENTS IN FLAT SLABS

A MODIFICATION OF GRASHOF'S GENERAL BENDING MOMENT THEORY, FOR CONSIDERATION OF UNIFORMLY DISTRIBUTED LOAD—THE LACK OF SUFFICIENT REINFORCEMENT A COMMON DEFECT IN MANY FLAT SLAB SYSTEMS

By V. J. ELMONT, B.Sc., A.M. Can. Soc. C.E.

WITH very few exceptions, the flat slab systems in use show lack of adequate reinforcement. The designs are very similar, as regards insufficient reinforcing, to those adopted during the period 1885 to 1895 in the making of ordinary slabs and beams. As long as the tension was at the bottom side of a structure the steel was placed correctly, and in general it was also correctly placed over columns, but for slightly more complicated structures and stress distributions but little understanding was shown. A great number of "systems" existed, formed, as a rule, by adding a few bars, here and there, to the usual reinforcing. As these "systems" were able to carry a test load of as much as twice the live load without failing and with a deflection of only a small fraction of an inch, their inventors considered these structures to be a complete success and assured architects and others interested in buildings of strength, rigidity, economy, etc., of the inventions, by means of neat printed matter and pictorially illustrated advertisements, showing a pile of well filled bags resting on the structure. There was usually added a list giving the various jobs where the "system" had been employed. The excellence of the invention was thereby made clearly evident without question.

To-day theoretical and practical experience will veto most of these early "systems." The same veto should be placed on the majority of the flat designs now in use.

The thorough and scientific test loadings, made by the University of Illinois (Prof. Talbot) and others, of flat slab floors in actual structures have shown the insufficiency of their reinforcing in a practical way. Below it is shown theoretically.

In nearly all flat slab designs it is found that the positive bending moments and the negative moment over the columns are provided for, more or less successfully. The existence of these moments are, of course, easily recognizable, even by those whose knowledge of mechanics does not extend much beyond the stresses and strains in a simply supported girder or truss. But the negative moments perpendicular to the sides of the panels are, as a rule, entirely neglected, although they have about the same numerical value as the maximum positive moments.

The following calculations are based on Grashof's general theory* modified by the general assumptions on which all calculations for reinforced concrete depend. The method adopted follows one given in a recent issue of "Deutsche Bauzeitung."

For an infinite slab, of uniform thickness, h, supported at a series of points, dividing it into square panels of side, 2a, and uniformly loaded with q per sq. unit, Grashof gives the following values for the deflections, z, at the various points x, y:

$$z = \frac{g}{4 \cdot A \cdot h^3} \cdot [(a^2 - x^2)^2 + (a^2 - y^2)^2]$$

where $A = \frac{m^2}{m^2 - 1}$. E, m is Poisson's constant, and E the modulus of elasticity.

The origin of the system of co-ordinates lies at the middle point of the diagonal of the panel, the directions of the x and y axes being parallel to the sides.

The horizontal normal stresses c_x and c_y at the point x, y, v (that is, the point whose distance is v from the centerplane of the slab) are

$$c_x = -A \cdot v \cdot \left(\frac{\delta^2 z}{\delta x^2} + \frac{1}{m} \cdot \frac{\delta^2 z}{\delta y^2}\right)$$

and

$$c_y = -A \cdot v \cdot \left(\frac{1}{m} \cdot \frac{\delta^2 z}{\delta x^2} + \frac{\delta^2 z}{\delta y^2}\right)$$

From the equation for z it follows that

$$\frac{\delta^2 z}{\delta x^2} = \frac{g}{A \cdot h^3} \cdot (3x^2 - a^2)$$

and

$$\frac{\delta^2 z}{\delta y^2} = \frac{g}{A \cdot h^3} \cdot (3y^2 - a^2)$$

$$\therefore \quad c_x = -\frac{g}{h^3} \cdot v \cdot \left[3x^2 - a^2 + \frac{1}{m} \cdot (3y^2 - a^2)\right]$$

and

$$c_y^2 - \frac{g}{h^3} \cdot v \cdot \left[\frac{1}{m} \cdot (3x^2 - a^2) + 3y^2 - a^2\right].$$

The corresponding bending moments per unit width are

$$M_x = -\frac{g}{h^3} \cdot \frac{h}{2} \cdot \left[3x^2 - a^2 + \frac{1}{m} \cdot (3y^2 - a^2)\right] \cdot \frac{h^2}{6}$$

$$M_y = -\frac{g}{h^2} \cdot \frac{h}{2} \cdot \left[\frac{1}{m} (3x^2 - a^2) + (3y^2 - a^2)\right] \cdot \frac{h^2}{6}$$

or

*Theorie der Elastizität und Festigkeit, Berlin, 1878, page 358.

$$M_x = -\frac{g}{12}\cdot[3x^2 - a^2 + \frac{1}{m}\cdot(3y^2 - a^2)]$$

$$M_y = -\frac{g}{12}[\frac{1}{m}\cdot(3x^2 - a^2) + 3y^2 - a^2].$$

Taking m = 3,

$$M_x = -\frac{g}{12}\cdot(3x^2 + y^2 - \frac{4}{3}a^2)$$

$$M_y = \frac{g}{12}\cdot(x^2 + 3y^2 - \frac{4}{3}a^2).$$

These moments, parallel to the axes, can be shown to be the maximum moments, and the stresses c_x and c_y to be the maximum stresses in points x, y, $\frac{h}{2}$. The bending moments vary only with the value c of the normal stress in the upper and lower side of the slab

$$M = \frac{h^2}{6}\cdot c,$$

the question of the direction of the maximum bending moments is accordingly reduced to that of the direction of the principal stresses. To find these advantage is taken of the fact that the stress distribution is a "plane" one for all points in the plane $z = \pm\frac{h}{2}$; the normal stress c_z (parallel to the z-axis) can with sufficient accuracy be assumed O and furthermore the shear stresses $s_x = s_y = O$ for the same reasons as for an ordinary beam. The necessary and sufficient requirements for a plane stress distribution are thus fulfilled.

To fully determine the stresses in the points x, y, $\pm\frac{h}{2}$ it is now only necessary to know the values of the shear stresses s_z. Grashof gives

$$s_z = -\frac{m-1}{m}\cdot A\cdot\frac{h}{2}\cdot\frac{\delta^2 z}{\delta_x\cdot\delta_y}$$

As the equation for z does not contain any product of x and y, $\frac{\delta^2 z}{\delta_x\delta_y} = o$ and therefore $s_z = O$; consequently c_x and c_y derived above are the principal stresses at the point, and then again M_x and M_y the maximum bending moments.

The distribution of the bending moments over the entire slab is given by the equations for the bending moments; by substituting $\frac{1}{2}$ for a (l the span) the equations will take the form

$$M_x = -\frac{gl^2}{12}\cdot[3\cdot(\frac{x}{l})^2 + (\frac{y}{l})^2 - \frac{1}{3}]$$

$$M_y = -\frac{gl^2}{12}\cdot[(\frac{x}{l})^2 + 3(\frac{y}{l})^2 - \frac{1}{3}]$$

In the following table is given the bending moments for different values of $\frac{x}{l}$ and $\frac{y}{l}$

$\frac{x}{l}$ =

	0.x centre of slab	0.1	0.2	0.3	0.4	0.5
0.x	$+\frac{gl^2}{36}$	$+\frac{gl^2}{39.6}$	$+\frac{gl^2}{56.3}$	$+\frac{gl^2}{189}$	$-\frac{gl^2}{81.9}$	$-\frac{gl^2}{28.8}$
0.1	$+\frac{gl^2}{37.1}$	$+\frac{gl^2}{40.9}$	$+\frac{gl^2}{59}$	$+\frac{gl^2}{225}$	$-\frac{gl^2}{76.7}$	$-\frac{gl^2}{28.1}$
0.2	$+\frac{gl^2}{40.9}$	$+\frac{gl^2}{45.6}$	$+\frac{gl^2}{69.3}$	$+\frac{gl^2}{514}$	$-\frac{gl^2}{64.3}$	$-\frac{gl^2}{26.3}$
0.3	$+\frac{gl^2}{49.3}$	$+\frac{gl^2}{56.3}$	$+\frac{gl^2}{97.3}$	$-\frac{gl^2}{450}$	$-\frac{gl^2}{50.7}$	$-\frac{gl^2}{23.7}$
0.4	$+\frac{gl^2}{69.3}$	$+\frac{gl^2}{83.8}$	$+\frac{gl^2}{225}$	$-\frac{gl^2}{124}$	$-\frac{gl^2}{39.1}$	$-\frac{gl^2}{20.8}$
0.5	$+\frac{gl^2}{133}$	$+\frac{gl^2}{225}$	$-\frac{gl^2}{327}$	$-\frac{gl^2}{64.3}$	$-\frac{gl^2}{33}$	$-\frac{gl^2}{18}$

(Over column)

The bending moments parallel to, and along the sides of the panel are thus positive at the middle point and equal to $+\frac{gl^2}{133}$ (see last line of table), decreasing to $-\frac{gl^2}{18}$ over the support; perpendicular to the sides the bending moments are negative (last column) over the entire length, $-\frac{gl^2}{28.8}$ at the middle point and $-\frac{gl^2}{18}$ over the support.

As the above calculations are based on a uniformly distributed loading, the negative moments derived therefrom can be considered as the maximum values for which the slab has to be dimensioned. The positive moments attain their maximum by partial loading. Judging from similar cases (continuous slabs and beams) it seems reasonable to assume that the maximum positive moment from a live load p per square unit will be

$$2\cdot\frac{pl^2}{36} = \frac{pl^2}{18},$$

$\frac{pl^2}{36}$ being the maximum moment at the centre of the slab for a uniformly distributed load. The resulting moment from a dead load g per square unit and live load p per square unit would therefore be

$$M = \frac{gl^2}{36} + \frac{pl^2}{18}$$

or for values of g varying from $\frac{3}{4}$p to $\frac{1}{2}$p, which covers nearly all practical cases, the maximum positive bending moment can be taken as

$$M = \frac{gl^2}{22},$$

where g is the total load per square unit (g = g + p).

Above Poisson's constant, m, has been taken equal to 3 which, according to the not very numerous experiments made so far on this continent and on the other side of the ocean, seems a fair figure. That the value of m is not of great significance will be seen by the table below, which gives the maximum negative moment over the

columns, the maximum negative moment between the columns and the maximum positive moment at the centre of the slab for m, 2, 3 and 4:

	Maximum negative moment over col.	Maximum negative moment between col.	Maximum positive moment at centre.
	gl^2	gl^2	gl^2
m = 2	$\frac{}{16}$	$\frac{}{32}$	$\frac{}{19}$
	gl^2	gl^2	gl^2
m = 3	$\frac{}{18}$	$\frac{}{28.8}$	$\frac{}{22}$
	gl^2	gl^2	gl^2
m = 4	$\frac{}{19.2}$	$\frac{}{27.4}$	$\frac{}{23}$

RAIL FAILURE STATISTICS.

In a report recently submitted by the Rail Committee of the American Railway Engineering Association, statistics concerning rail failures in the United States for the year ended October 31st, 1912, are published. The data shows wide variation in results, which the committee claims must be due, to a large extent, to the lack of uniformity in the performance of different mills, and also to a lack of uniformity in the product of any individual mill.

The report shows also that the average performance of the heavy sections (85-lb. to 100-lb.) is not quite so good as that of the lighter sections (72-lb. to 80-lb.). The average rate of failure in the open-hearth rail is lower than that of the Bessemer, although both are higher than last year. The rate of failure of the open-hearth rail in 1912 was 22% higher than in 1911, and 40% higher than in 1910. The rate of failure of the Bessemer rail was 68% higher in 1912 than in 1911, and 56% higher than in 1910.

The rate of failure of the Bessemer rail was, in 1912, 116% higher than that of the open-hearth in 1911, was 58% higher, and in 1910, 94% higher.

A higher percentage of failures has occurred in rails from the upper part of the ingot than in those from the lower positions.

For the past four years, head failures have predominated except in 1912, in which year there was a slightly higher percentage of broken rails. It will be remembered that the early part of 1912 was marked by exceptionally severe weather which was accompanied by an epidemic of broken rails. The committee regards this as an abnormal condition, however, and maintains that the majority of failures are head failures, such as split or crushed heads, and are due not to imperfect track conditions, but to defective material in the rail.

The appropriations for the Panama Canal for the year ending June 30th, 1914, amount to $16,265,393, and include the cost of drydocks, wharves, warehouses, a quarantine station, as well as two colliers of 12,000 tons capacity each, to be built in the United States. In addition to the above, $4,870,000 are appropriated for fortifications of the Canal, including $2,635,000 for sea-coast batteries, $173,000 for electric light and power plants, $285,000 for searchlights, $180,000 for filling in the swamp behind the military works on Margarita Island, and $1,000,000 for cannon and equipment and one 16-in. gun and carriage, etc.

WINNIPEG RAINFALL.

By F. Hill Parr, C.E., M.Inst.C.E., M.R.San.Inst.
Engineer to the Rural Municipality of Kildonan.

RAINFALL and the precipitation of snow forms an interesting and essential part of a municipal engineer's study, and it is only by the careful comparison of precipitations extending over years that an appreciative knowledge can be obtained.

The Dominion Government has established meteorological stations in many centres, and from these information is carefully and accurately conveyed by code daily, and by monthly and annual reports.

The attempt to set the following tables before those interested is a plea in the first instance for the further provision of these stations; in the second for the annual distribution of tabulated data, and in the third for the recognized establishment of stations in every municipality. For general information it would be difficult to find a more concise and better form than that in use known as "British Rainfall," edited and published by Dr. H. Mill, of London, England.

Table of Rainfalls, Municipality of Kildonan, 1906-1912, Inclusive. Rainfall up to and Including 0.19 Inch.—Table I.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Totals
1906	..	.12	.29	.30	.22	.22	.23	.07	.17	1.62
1907	...	.50	.42	.43	.39	.82	.20	.40	.17	3.33
1908	...	.17	.49	.88	.17	.29	.45	.17	.06	2.68
1909	...	.13	.41	.51	.13	.16	.15	.38	.05	1.92
1910	.29	.34	.63	.53	.28	.24	.15	.18	.10	2.74
1911	...	...	.40	.87	.41	.66	.33	.27	...	2.94
1912	.01	.23	.71	.47	.83	.36	.52	.18	.01	3.32
T't'l in.	.30	1.49	3.35	3.99	2.43	2.75	2.03	1.65	0.56	18.55
No. of precns	7	18	43	55	51	51	38	31	12	306
No. of traces	6	9	15	17	17	21	9	11	..	...
Average per month	.04	.21	.48	.57	.34	.39	.29	.23	.08	2.67

Average 0.06 per rainfall.

Humboldt assigned rainfall as varying with the latitude, the greatest being at the equator and diminishing towards the poles, in the following ratio: equatorial zones, 96 inches; at the 20th latitude, 80 inches; at latitude 45°, 29 inches; and 17 inches at latitude 60°. Again, this may vary throughout districts in the latitudes, owing to their positions in relation to the sea, large areas of water and the general configuration of the land surfaces.

Rainfalls From 0.20 to 0.30 Inch, Inclusive.—Table II.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Totals
	...	...	.28	.26	.24	...	...	...	...	...
1906	...	.25	.25	.28	.28	.27	...	...	.21	2.32
	...	...	...	...	...	.22	.27	...	...	...
1907	...	...	.23	...	.27	.26	.22	...	...	1.47
	...	...	...	.22	...	...	...	...	...	...
1908	...	...	...	.26	.20	...	.30	.29	..	1.27
	...	...	.21	...	...	...	...	...	.	...
1909	...	...	.22	.25	...	...	...	..	.	.68
	...	...	.23	...	.24	...	.30	...		...
1910	...	.21	.20	.25	.28	...	.21	24	.	2.16
	...	...	...	..	.20	.26	.20	...	...	...
1911	...	.20	.20	.28	.28	.24	.24	.20	.	2.77
	...	...	...	...	.24	...	.23	...	.	...
	...	...	.30	...	...	.30	.25	...	.	...
1912	...	.28	.26	...	...	.23	.26	...	.	1.88
T't'l in.	...	.94	2.38	1.80	2.23	1.78	2.48	.73	.21	12.55
Average per month per year		.13	.34	.25	.32	.25	.35	.10	.03	1.36
No. of Falls		4	10	7	9	7	10	3	1	51

Average 0.246 inch per rainfall.

As to the cause of rainfall, this does not call for any explanation here and as to evaporation and percolation, also falls without the province of this article; but again, conditions vary under each head to such a degree that for reliable figures for this continent the subjects should be diligently studied.

Rainfalls From 0.31 to 0.40 Inch, Inclusive.—Table III.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906	...	...	.35	...	.34	...	...	...	0.69
1907	...	...	.36	.35	.33	.40	...	...	1.44
1908	...	...	...	...	...	...	...	.34	.34
	...	...	...	.40	...	...	...	..	...
1909	..	...		.39	...	...	...	...	.79
1910	.38	...	...	.39	...	...		...	.77
	...	...	...	.36	...	...	...	...	...
1911	.	.31	.35	.34	...	.34	.36	...	2.06
	..	.38	.39	...	.31	...	...	...	...
1912	...	.36	.34	...	.33	...	...	.40	2.51
Totals	.38	1.05	1.79	2.23	1.31	.74	.36	.74	8.60
Average per month per year	.05	.17	.25	.32	.19	.10	.05	.10	1.23
No. of Rainfalls	1	3	5	6	4	2	1	2	24

Average 0.33 inch per rainfall.

Rainfalls From 0.41 to 0.50 Inch, Inclusive.—Table IV.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906		...	...	.44	...	...	...	...	0.44
1907	...	...	...	...	.48	...	...	...	0.48
1908	...	.46	.43	.44	.48	...	...	.43	2.68
	...	...	...	...	.44	...	...	...	...
1909	...	...	.41	...	.50	...	.45	...	1.36
1910	...	...	...	.46	...	.46	.42	.42	1.76
1911	...	...	...	.42	.45	...	.50	...	1.37
1912	...	.42	...	.44	.48	...	...	...	1.34
Totals	...	.88	.84	2.20	2.83	.46	1.37	.85	9.43
Average per month per year	...	.12	.12	.31	.42	.06	.19	.12	1.34
No. of Rainfalls	...	2	2	5	6	1	3	2	21

Average 0.449 inch per rainfall.

Two seasons form the meteorological year, viz., summer from the 1st of May to the 30th of September, and winter from the 1st of October to the 31st of April, but this cannot be applied as a hard and fast rule to the actual seasons of rain and snowfall.

Rainfalls From 0.51 to 0.60 Inch, Inclusive.—Table V.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906	...	...	.60	...	...	...	.54	...	...
	...	..	.56	...	...	...	...	...	1.70
1907	...	...	...	..	...	...	...	...	...
1908	...	.51	.60	..	..	.60	...	...	1.71
1909	...	...	...	...	..	...	...	...	...
1910	...	...	.59	..		...	...	...	0.59
1911	...	...	...	...	.	.	.57	...	.57
1912	...	...	...	..	...	...	.58	...	.58
Totals	...	.51	2.35	...	...	.60	1.69	...	5.15
No. of Rainfalls	...	1	4	...	...	1	3	...	9

Average 0.57 inch per rainfall.

Rainfalls From 0.61 to 0.70 Inch, Inclusive.—Table VI.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906	...	...	.66	...	.63	...	...	...	1.29
1907	..	...	...	...	...	.64	...	...	0.64
1908	..	..	...	.61	...	...	...	...	...
	...	...	...	.70	...	...	...	...	1.31
1909	..	...	...	...	.61	...	...	...	0.61
1910	.64	...	...	...	...	.70	...	...	1.34
1911	...	...	...	...	...	...	...	...	...
1912	...	...	...	...	.63	...	...	...	.63
Totals	.64	...	.66	1.31	1.87	1.34	...	...	5.82
No. of Rainfalls	1	...	1	2	3	2	...	...	9

Average 0.647 inch per rainfall.

In some instances in the tables certain subdivisions of rain and snowfall are given, and these occur only after the determination of one of the seasons, and with them has occurred a lowering or raising of temperature.

The precipitation of snow by seasons forms a not uninteresting table, and would be of greater value, were it possible to record the actual period of thaw each spring.

Rainfalls From 0.71 to 0.80 Inch, Inclusive.—Table VII

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906	..	...	...	.73	...	...	.75	...	1.48
1907		..	..	.77	...	...	...	...	0.77
1908	..	...	...	.75	...	...	...	...	...
	..	.	..	.74	...	...	...	...	1.49
1909	..	...	...	...	...	...	...	...	...
1910	.....	.80	...	.75	...	.74	...	...	2.29
1911	...	...	.76	...	...	...	...	...	.76
1912	...	..	...	...	...	.72	...	...	.72
Totals	...	.80	.76	3.74	...	1.46	.75	...	7.51
No. of Rainfalls	...	1	1	5	...	2	1	...	10

Average 0.75 inch per rainfall.

Rainfalls From 0.81 to 0.90 Inch, Inclusive.—Table VIII.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906	...	...	...	...	.85	.86	...	...	1.71
1907	...	...	...	...	.87	...	...	...	0.87
1908	...	...	...	...	...	...	...	...	...
1909	...	...	...	...	...	...	...	...	...
1910	...	...	...	...	...	...	...	...	...
1911	...	...	...	...	...	.83	...	...	0.83
1912	...	.86	...	...	.87	...	...	...	1.73
Totals	...	*.86	...	...	2.59	1.69	...	...	5.14
No. of Rainfalls	...	1	...	...	3	2	...	...	6

Average 0.84 inch per rainfall.

*6th April—Rain .42
Snow .44
.86

Rainfalls From 0.91 to 0.99 Inch, Inclusive.—Table IX.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906	...	...	...	.96	...	...	...	...	0.96
1907	...	...		..	...	...	...	...	...
1808	.	...	..	..	..	.94	.91	.98	2.83
1909	...	.	...	...	...	.	...	...	...
1910	..	...	..	...	...	..	...	...	...
1911	...		.99	...	...	...	...	...	0.99
1912	...	...	...	...	...	...	...	...	...
Totals	...	...	.99	.96	...	.91	.91	.98	4.78
No. of Rainfalls	...	...	1	1	...	1	1	1	5

Average 0.95 inch per rainfall.

The tables have been prepared with a view to establishing data for the calculation of the run-off from snow and rain. With regard to the latter, it is certainly regretable that automatic rainfall recorders are not more generally in use in the Prairie Provinces. The expense of establishment is possibly the reason of this, but surely municipalities that are contemplating the installation of sewerage

Rainfalls of 1 Inch and Upwards.—Table X.

Year	March	April	May	June	July	Aug.	Sept.	Oct.	Totals
1906	...	1.07	...	1.63	...	...	...	...	...
	...	...	...	1.71	...	...	...	...	4.41
1907	...	...	...	..	1.61	1.59	...	...	3.20
1908	...	...	...	..	1.28	...	...	...	1 28
1909	...	...	...	...	1 60	1.66	...	...	...
	...	...	...	.	...	1.26	...	...	...
	...	...	...	.	..	1.67	...	...	6.19
1910	...	...	...	...	...	...	1.67	...	1.67
1911	...	*1.72	2.80	...	1.38	...	...	1.15	8.09
	...	...	1.04	...	...	...	...	...	...
1912	...	...	1.59	...	1.05	...	1.25	...	...
	...	...	...	...	1.57	...	1.30	...	...
	...	...	...	...	...	...	1.34	...	8.10
Totals	...	2.79	5.43	3.34	8.49	6.18	5.56	1.15	32.94
No. of Rainfalls	...	2	3	2	6	4	4	1	22

Average 1.49 inches per rainfall.

*1.72 Rain 1.42
Snow .30
1.72

Monthly Precipitation for 7 Years, 1906-1912, Inclusive.—Table XI.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1906	1.29	.20	.53	1.64	2.99	6.31	2.56	1.35	1.52	.21	1.78	1.25	21.63
1907	2.07	.27	1.11	.99	.87	1.55	3.95	3.93	.69	.40	.72	.18	16.73
1908	.44	1.80	1.84	1.64	3.01	3.11	1.65	2.75	1.89	2.21	.55	.61	21.50
1909	.73	.67	2.49	1.26	1.25	1.55	3.84	4.75	.60	.52	.92	3.99	22.57
1910	.25	1.58	1.61	1.84	1.65	2.38	.80	2.14	2.75	.84	1.27	1.87	18.98
1911	.45	.81	.28	2.57	6.38	2.27	2.96	2.33	2.43	1.84	.59	.59	23.50
1012	.30	.18	.30	2.25	3.59	.90	6.09	1.63	5.50	1.15	.11	.78	22.78
T't'ls	5.53	5.51	8.16	12.19	19.74	18.07	21.85	18.88	15,38	7.17	5.94	9.27	147.69
Av'ge	.79	.78	1.16	1.74	2.82	2.58	3.12	2.69	2.19	1.02	.85	1.32	21.09
H'g't	2.07	1.80	2.49	2.57	6.38	6.31	6 09	4 75	5.50	2.21	1.78	3.99	23.50
L'w't	.25	.18	.28	.99	.87	.90	.80	1.35	.60	.21	.11	.18	16.73
No. of days	70	63	83	66	89	99	97	96	71	60	79	100	973
Average No. of days per annum	10	9	11.8	9.4	12.7	14.1	13.8	13.7	10.1	8.5	11.2	14.2	139

Number of Days of Precipitation, Including 10% of Snow and Excluding Traces.—Table XII.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1906	10	5	5	5	9	13	10	6	8	3	12	11	97
1907	12	7	8	8	9	11	14	16	9	6	6	3	109
1908	4	8	9	5	10	16	6	12	8	6	9	12	105
1909	9	10	16	14	10	9	12	7	4	8	10	19	128
1910	7	8	10	7	11	10	7	9	8	5	9	13	104
1911	11	7	7	6	9	15	13	12	11	9	7	12	119
1912	9	3	7	9	15	7	18	13	14	9	5	14	123
Total	62	48	62	54	73	81	80	75	62	46	58	84	785
Av'ge	8.85	6.99	8.85	7.71	10.42	11.57	11.42	10 71	8.85	6.57	8.28	12.00	112.14
High't	12	10	16	14	15	16	18	16	14	9	12	19	123
Lowest	4	3	5	5	9	7	6	6	4	3	5	3	104

Precipitation of Snowfalls Not Reduced in Inches.—

Table XIII.

Year	Jan.	Feb.	Mar.	Apr.	May	Sept.	Oct.	Nov.	Dec.	Totals
1906.....	12.9	2.0	5.3	...	...	...	1.4	14.0	12.5	48.1
1907.....	20.7	2.7	11.1	9.9	1.4	...	4.0	5.5	1.8	57.1
1908.....	4.4	18.0	18.4	5.0	...	2.3	...	4.9	6.1	59.1
1909.....	6.3	6.7	24.9	11.3	...	...	1.4	8.7	39.9	99.2
1910.....	2.5	15.8	3.0	7.0	0.4	...	...	12.7	18.7	60.1
1911	4.5	8.1	2.8	6.4	1.6	...	0.10	4.9	5.9	34.3
1912.....	3.0	1.8	2.9	5.8	...	...	5.7	1.1	7.8	28.0
Totals ..	54.3	55.1	68.4	45.4	3.4	2.3	12.6	51.8	92.7	385.9
Average .	7.75	7.87	9.77	6.5	0.5	0.32	1.8	7.4	13.2	55.12

Snow Precipitation by Seasons.

1906-7	73.7—rain at 1/10th	7.37 at 1/8th	9.21
1907-8	57.1	5.71	7.13
1908-9	62.5	6.25	7.81
1909-10	78.7	7.87	9.83
1910-11	54.8	5.48	6.85
1911-12	24.4	2.44	3.05
	351.2 ins.	35.21 ins	43.88 ins.
Five seasons 1906-7 to 1910-11	328.8	32.68	40.85

Average 65.36

Table XIV.

Rainfall Table	No. of Rainfalls Percentage	Intensity of falls Percentage
I.	0.66	0.167
II.	0.11	0.114
III.	0.052	0.078
IV.	0.046	0.085
V.	0.019	0.046
VI.	0.019	0.053
VII	0.022	0.068
VIII.	0.013	0.046
IX.	0.011	0.044
X.	0.048	0.298
	1.000	1.000

and water systems should not fail to provide the necessary means of obtaining such important information.

In conclusion, the writer wishes to express indebtedness to Mr. H. C. Cox, of St. John's College, Winnipeg, who supplied the records of the rainfalls, etc., from which the tables have been compiled.

WINNIPEG'S MUNICIPAL POWER PLANT.

The waterfalls and works of the Winnipeg civic hydro-electric power and light plant are located at Point du Bois, on the Winnipeg River, seventy-seven miles north-east of the city of Winnipeg. The water fall (naturally 32 feet) is increased by the power development dam to 47 feet. The total available power without storage is 60,000 horse-power, which can be increased to 100,000 horse-power. The present installation is 28,000 horse-power, the full capacity of the present building being 45,000 horse-power. The average flow of water is 25,000 cubic feet per second. The transmission line (owned by the city) is 77 miles long and 100 feet wide, upon which is constructed one line of double towers, with transformer station and distributing stations in Winnipeg. The cost of the plant, including power house, dams, wires, forebay, tailrace, intake, rack piers, for full installation, machinery, transmission line, transformer station and distribution stations is $5,400,000.00. The work of the first year's operation of the plant was entirely satisfactory. The cost of domestic lighting has been reduced seventy per cent., and that of power proportionately, and the plant is already paying its way, the revenue monthly covering the cost of interest, operating expenses, depreciation, advertising and other expenses.

The city of Hamilton is contemplating the purchase of a large gravel pit near Guelph. The gravel contained therein has been found to be well suited for use in civic construction, and if the city acquires it, the understanding is that a stone crusher will be installed and a railway switch run into it for immediate use.

AN UNUSUAL ENGINEERING OPERATION.

The accompanying illustration has been sent in by Mr. E. Bennett, a Toronto contractor, and relates to an incident described in *The Canadian Engineer* September 5th, 1912, in which issue an article appeared relating to the destruction of an arch span at Oakville, Ontario.

Readers are referred to the article. The illustration herewith is descriptive of the method of dynamiting and shows the position and simultaneous explosion by electric spark of the shots placed in the crown and near the haunches of the arch.

AMERICAN ROAD CONGRESS.

Systematizing the purchase of all road materials and equipment through the establishment of purchasing departments, somewhat along the lines followed by great railroad corporations, is strongly advocated by Maj. Henry G. Shirley, Chief Engineer of the Maryland State Roads Commission, in a paper which he will present at the third American Road Congress, which will be in session at Detroit, Mich., during the week of September 29. An intelligent selection of material and equipment, exact knowledge of values and prices and utilization of discounts and credits are among the advantages claimed for a centralized system for the purchase of road materials and equipment.

The construction and maintenance of concrete roads, a type which is attracting attention among road builders, will be explained in a paper by Mr. F. F. Rogers, State Highway Commissioner of Michigan, and the discussion on his paper will be opened by Mr. A. N. Johnson, State Highway Engineer of Illinois. A similar treatment will be given the subject of brick roads by Mr. J. M. McCleary, County Engineer of Cuyahoga County, of which Cleveland is the county seat and which has a large mileage of excellent brick roads, the discussion to be opened by Mr. R. Keith Compton, chairman of the Paving Commission of Baltimore.

Tars, oils and asphalts in connection with the construction and maintenance of roads have been so generally used in the eastern states as to bring out much valuable data. The basic paper on this subject will be presented by Mr. S. D. Foster, Chief Engineer of the Pennsylvania State Highway Department. The discussion will be opened by W. A. McLean, Chief Engineer of the Province of Ontario, Canada.

The lessons learned at the International Road Congress recently held in London will be presented at the big meeting in Detroit by Col. Wm. D. Sohier, chairman of the Massachusetts State Highway Commission.

There will be a host of other papers and addresses which will deal searchingly with every phase of the road subject from the standpoint of the engineer, the financier, the legislator and the road user.

THE BRITISH ROAD BOARD.

THE British Road Board was formed in 1910 for the purpose of aiding the county councils and other local authorities of Great Britain in the construction and maintenance of new roads and the improvement of existing roads. The board consists of four members: Sir Geo. S. Gibb, chairman; the Rt. Hon. Lord Pirrie, the Rt. Hon. Lord St. Davids, and the Rt. Hon. Sir J. H. A. MacDonald. W. Rees Jeffreys is the secretary of the board, and Col. R. E. Crompton is its consulting engineer. In addition it has an advisory engineering committee of six.

The board has published its third annual report, covering its operations for the year ending March 31st, 1913, and including, in nineteen appendices, a mass of statistical data relative to its work, and an explanation of the methods of administering its affairs.

While the report covers the year ending March 31st, 1913, in some cases figures are given up to June 30 of this year. Up to this latter date, the total of the grants and loans made amounted to £1,474,793. This was divided among the different kinds of work undertaken, as shown in the following table:

Improvement of road crusts	£1,210,012
Road widenings and improvement of curves, gradients and corners	120,466
Road diversions	29,395
Reconstruction and improvement of bridges	53,842
New roads and bridges	61,078
Total	£1,474,793

The grants and loans indicated up to June 30, 1913, amounted to £3,435,233, or £1,960,440 more than the grants and loans made. This difference is due to the fact that grants and loans may not be actually paid until some time after they are indicated or allotted, since the arrangements under which grants and loans are made may provide for the payment of half the sum indicated in any particular case at the beginning of the work and the remainder at its completion or in instalments payable at the time the grantees are ready to commence work, when the work is half completed and when the work is finished. In this connection, the method followed by the Road Board in making grants is of interest. As set forth in the report, this is essentially as follows:

Any local highway authority may apply for a grant or loan at any time, and all these applications are considered by the board so far as possible when they are received. In deciding upon the making of a grant or a loan, the Road Board investigates its advisability, taking into account the conditions in the district in question, as revealed by information obtained by conferring with the county councils from time to time in regard to the requirements in each county, and from other sources. According to the usual procedure, a county council when making up its estimate for the ensuing year submits to the Road Board a general statement including a list of the contemplated improvements for which assistance is desired. This statement is not usually treated as a formal application, but is followed by a conference of the Road Board and representatives of the county council. At this, and, if necessary, at subsequent conferences, the question is discussed and the decision arrived at by the Road Board after a consideration of the various requests from all of the counties applying for aid. After the Road Board has selected the improvements upon which it is willing to grant aid and has suggested the amounts to be devoted to the work, the local authorities bring in detailed plans and specifications of the work. The Road Board then submits each case to the treasury for its approval, which is usually prompt. The grants are then indicated by the Road Board.

The annual income of the Road Improvement Fund (calculated without regard to the date of the actual receipt of the sums involved) has steadily increased since the establishment of the board, and during the year 1912-13 amounted to £1,252,970 4s. 10d. The details of the income are shown in one of the accompanying tables.

In regard to the policy of the board in making grants and loans, the following statement is included in the report:

In settling the total amount up to which advances may safely be made at any date the board do not confine themselves to dealing with the balance in hand, representing cash received less commitments. They are prepared to anticipate their income to a certain extent, but in view of the limited experience available in regard to the rate at which commitments will mature, and the probability that as the procedure and operations of the board become better known to highway authorities there will be a constantly increasing acceleration in the maturity of commitments and the expenditure of money on assisted works, they have not thought it advisable to anticipate more than a year's income. They are confirmed in this view by the consideration that in their opinion the amount of road improvement work which is being undertaken by highway authorities (apart from urban street widenings to which, for reasons given in their previous annual reports, the board are not generally disposed to make contributions at the present time, except in special cases) is, generally speaking, as much as can practically be carried out by the staff and with the moneys at the disposal of highway authorities aided by advances from the Road Improvement Fund.

At the present time the board are making grants on the assumption that they can safely indicate a sum of about £1,700,000 in addition to the indications made up to June 30, 1913.

Yearly Income of British Road Board.

Item.	Apr. 30, 1909, to Mar. 31, 1910. £ s. d.	Apr. 1, 1910, to Mar. 31, 1911. £ s. d.	Apr. 1, 1911, to Mar. 31, 1912. £ s. d.	Apr. 1, 1912, to Mar. 31, 1913. £ s. d.	Total. £ s. d.
Motor spirit duties	290,702 15 9	410,376 5 7	591,781 18 7	702,381 10 3	1,995,242 10 2
Carriage license duties	.....	460,265 17 6*	403,270 19 11	493,790 6 9	1,357,327 4 2
Interests on investments and loans	.....	4,851 16 0*	23,064 13 7	56,798 7 10	84,714 17 5
Total annual income	290,702 15 9	875,493 19 1	1,018,117 12 1	1,252,970 4 10	3,437,284 11 9

*From Jan. 1, 1910, to March 31, 1911.

USE OF CEMENT AT COLLIERIES.*

By John Gregory.

CONCRETE by itself is much more capable of withstanding compressive than tensile stresses, the ratio being approximately 10 to 1, and in reinforced concrete the object of the designer is to increase the strength of those parts subject to tension by adding steel of suitable section. The size and disposition of the reinforcement are matters of calculation equiring considerable technical skill, as the various stresses have to be worked out and the several members of a structure proportioned accordingly. For important surface works this is somewhat out of the province of mining engineering, and it will be found an advantage to get designs from engineers or architects who have specialized in concrete work.

Underground Roadways.—With regard to the support of underground roadways, however, other conditions prevail. The crushing effect of the strata in deep mines is an unknown quantity, and as the stresses are chiefly in compression the writer has preferred to put in a thick concrete lining combined with heavy steel girders, rather than a correctly designed thinner lining dependent for its success upon an elaborate system of reinforcement. He is not prepared to justify this from a purely scientific standpoint, but it has the merit of being more easily put in by the ordinary colliery labor, and if the necessity should arise, it lends itself more readily to repair or renewal.

The first application at Sneyd Collieries was in 1908 when, owing to the failure of a brickwork barrel arch, 4 ft. in thickness, it was necessary to reconstruct the insets in a pit 1,860 ft. deep. Steel girders, 12 in. by 6 in. by 56 lbs. per ft., were obtained, bent to a circle having an internal diameter of 14 ft., each ring being composed of three segments, secured at the joints by fishplates and bolts. On the eastern side of the pit, the ground was very bad owing to the roadway intersecting a large fault having a downthrow of 100 yards, and here the girder rings were spaced 18 in., centre to centre. Where the ground was more settled, this distance was increased to 3-ft. centres. Sufficient ground was taken out to allow of at least 18 in. of concrete being put in, measuring from the inside face of the finished arch, and the concrete was well rammed in between and at the back of the girders, making a smooth finished barrel arch of 14 ft. diameter.

The girder rings were taken down the pit in sections and erected in position, a special portable standard being designed for raising the top segments. Temporary laggings laid on the top of the girder rings served to support the roof whilst the concrete was being put in, being removed as the work progressed, and although three parallel lines of rails were in use during the time the work was in progress, no interruption of coal-drawing was occasioned.

When cross-cuts joined the main road, the spacing of the girder rings was increased to allow of smaller rings having an internal diameter of 7 ft. 6 in. or 6 ft., to be inserted, their axis being at right-angles to the main tunnel. In these instances old rails were used to bridge the space between the large girders, resting on the inner flanges. The concrete lining at the junction was properly groined, and when finished had an exceedingly neat appearance.

The results achieved were so satisfactory that it was decided to adopt a similar method of securing a crut, 200 yards long, at a depth of 2,010 ft. This was also driven through the large fault already mentioned, and with the original timber supports the cost of upkeep of the road was very heavy. Girder rings of the same section but 10 ft. internal diameter were put in, the spacing again being dependent on the nature of the ground. Where it was necessary to provide manholes, two rings of 12 ft. diameter were placed eccentrically to the axis of the main tunnel. This work was also commenced in 1908, and so far as appearances go, it will be unnecessary to spend a single penny in maintenance during the life of the colliery.

Since the completion of the above, many of the main roads, airways, and water lodges have been lined in a similar manner. In very few instances have signs of crushing been observed, and in no case has it been necessary to renew the concrete, though this would be a much less expensive operation than renewing brickwork arches. The slight crushing which has taken place has invariably occurred where the roof had fallen to a considerable height, and the space intervening between the top of the concrete arch and the solid ground had been made good with chocks and loose débris, making the crush on the arch unequal. Now this is filled up solid with concrete or brickwork, or if this is not practicable, the concrete lining at the weak spot is considerably strengthened.

Other Colliery Purposes.—Stables and motor houses have been constructed in concrete, and although their initial cost is somewhat high, the saving in upkeep will soon repay for the first charge. In good ground a modified cross-section has been adopted, and the steel formers made from old pit rails bent to a shape resembling a square with rounded corners. The sides are smooth and dust is easily removed, and the entire absence of combustible material commends itself where electrical apparatus is installed.

In one or two instances, girder rings, 12 in. by 6 in. section, embedded in concrete in a similar manner to that described for the roadways, have been used with conspicuous success for pit-shaft repairs. Where the shafts cut the 100 yards fault already mentioned, brickwork lining, 4 ft. 6 in. thick, has been crushed, but where this has been replaced by concrete, no sign of weakness has yet been observed. Many other instances in which the use of concrete is a distinct advantage suggest themselves, and there seems no limit to its useful application. Straight steel girders, with concrete rammed in between, have been used in air-crossings, floors for double landings, foundations for machinery, etc. In several instances, main airways have been lined with concrete without the use of girders, the smooth surface of the finished work reducing the friction of the air and presenting no ledges for the deposit of dust.

On the surface the most important use to which concrete has been applied up to the present is in the construction of a bunker to hold 300 tons of pit dirt, and a gantry carrying a creeper and tram rails for conveying the loaded tubs to a tippler on the top. This work was designed and executed by reinforced-concrete specialists. The cost was approximately equal to that of a steel structure, and the advantages gained are an increased life and the saving of the expense of painting every few years.

Engine-room floors, stillages for oil stores, etc., on the surface have been put in by the colliery staff. For

*Paper read before the North Staffordshire Mining Institute.

work of this class expanded metal makes an excellent reinforcement, and data for the construction of floors suitable for safe working loads of from ½ cwt. to 6 cwts. per superficial foot can be readily obtained.

A further application of concrete, of special value where old shallow mines have been worked, is in the formation of rafts for the foundations of heavy or valuable buildings. For important work these should be properly designed to avoid unnecessary waste of material, but for small jobs the writer has found old rails interlaced with steel guide rods, or even wire ropes, quite successful. The examples given might be multiplied indefinitely.

Selection and Mixing of Materials.—For the benefit of those who might be inclined to adopt reinforced concrete, Mr. Gregory offered some practical hints on the selection and the mixing of the materials:—

Cement.—For all reinforced work, and particularly for underground application, when some considerable time generally elapses between the mixing of the concrete and its being placed in position, a slow-setting cement should be selected. Considerable variation exists in this respect with different makes, and before adopting any particular brand tests should be carefully made. The selected cement should, in addition, comply with the British standard specification as to fineness, specific gravity and tensile strength.

Sand.—This requires equally careful selection. When examined under the microscope the grains should appear sharp and angular. Many sands are mixed with clay or loam, and this is fatal to the making of sound concrete. Washing is sometimes resorted to with a view to eliminating these impurities, but in this district no difficulty is experienced in obtaining suitable qualities locally.

Aggregate.—For underground work the writer strongly advocates broken granite. In the work described two sizes have been used, namely, ½-in. chippings and 1½-in. screened stone. For many purposes on the surface broken bricks or saggars may be advantageously used, but it must be remembered that the sand and cement simply form a matrix or mortar binding the aggregate together, and the greater the strength of the individual fragments of aggregate, the greater the ultimate strength of the concrete as a whole. The aggregate forms the bulk of the finished concrete, and it is useless to get good cement and sand to bind together material which cannot in itself offer considerable resistance to a crushing load.

Gauging.—The correct proportions of the various classes of aggregate sand and cement vary according to the size and shape of the individual fragments. Theoretically, the intersticies or voids in the large stone should just be filled by the smaller stones, and the voids still remaining should be completely filled up by the mortar of sand and cement. In practice a considerably larger proportion of the smaller material must be used, in order to insure a compact concrete, owing to inequalities in mixing and stowing. The voids in the various grades of aggregate are easily determined by filling a box of known capacity level full with the stone to be tested, and adding a measured quantity of water until it is on the point of overflowing. With the aggregate adopted at Sneyd the following proportions by measure of the material give good results:—

1½ in. broken granite	36% or 9 parts
½ in. granite chippings	32% or 8 parts
Sand	20% or 5 parts
Cement	12% or 3 parts

The proportion of the neat cement to aggregate, including sand, is thus 1 to 7⅓. The aggregate, sand and cement are measured out accurately in the proportions stated above and then mixed well dry, after which a measured quantity of water is added and the whole thoroughly mixed wet.

Owing to the finished concrete forming a homogeneous whole without intersticies, the bulk is considerably reduced in mixing, and forms only 60 per cent. of that of the dry material. For making 1 cubic yard of concrete, therefore, the following table gives the quantity of each ingredient based on the proportions already stated:—

	Cu. ft.
1½ in. broken granite	16.2
½ in. granite chippings	14.4
Sand	9.0
Cement	5.4
	45.0

The mixing can be done by turning the material over with spades, but careful supervision is necessary, and it is difficult to ensure that the whole of the ingredients are thoroughly incorporated first in the dry state, and afterwards when the water is added. When much work is likely to be carried out, the writer strongly advises a machine, the cost of which is speedily recouped by the saving in labor, and absolute uniformity in the quality of the cement is secured.

Cost.—The cost of the application of concrete underground is dependent to a great extent on local conditions. The nature of the ground to be excavated and the facalities for the transport of the materials to the site are factors which it is necessary to take into consideration for each individual job. The following table gives the cost of the raw materials for 1 cubic yard of concrete as used at Sneyd Collieries, and will be some guide in working out an estimate:—

Material	Cubic feet	Weight in lbs. per cubic foot	Total weight in lbs.	Price per ton s. d.	Total s. d.
1½ ins. granite	16.2	84	1,360.8	9 6	5 9
½ in. chippings	14.4	84	12,906	7 6	4 0
Sand	9.0	80	720	6 6	2 1
Cement	5.4	95	513	36 0	8 3
Water	—	—	202.6	—	—
Total per cu. yard	—	—	—	—	20 1

The cost of stowing the concrete in position, including fixing the centering, is approximately 3s. per cubic yard, and mixing with the machine about 2d. per cubic yard. If girder rings are used, their cost has to be added, and as an example the cost per lineal yard of a barrel arch, 11 ft. in diameter, with rings spaced 3-ft. centres, is given:—

	£	s.	d.
1 girder ring 19 cwts. at £10	9	19	0
6.55 cubic yards concrete at £1	6	10	10
Stowing cement 6.55 cu. yds. at 3s		19	8
Fixing girder rings		7	6
	£17	8	0

This, of course, excludes the cost of excavation or of mixing the concrete and conveying it underground to the position required. Where the girder rings can be dis-

pensed with, it will be seen that the cost can be enormously reduced, the steel representing more than half of the total expenditure.

It is important that running water does not come in contact with the concrete until it has set, as the cement is liable to be washed out. When this has to be contended with, the general method adopted has been to put in temporary dams and pipe the water across the green concrete.

FUEL IN THE UNITED KINGDOM.

The industrial development of Great Britain is mainly due to the cheapness of fuel, raw material, labor and transport. The coal produced is anthracite and bituminous, and as the deposits to be found in Great Britain are being gradually exhausted, attention is being paid to the use of coal wastes, etc., which were formerly dumped over the tip as worthless. The cost of coal is low at the pit mouth, despite the enormous expenditure involved in the machinery, deep shafts and an increasing labor bill, yet the most inferior of slack and washery-refuse are now being consumed in considerable quantities for the development of cheap power. As one instance of the influence of cheap fuel and power the North-East Coast (England) Power system is referred to by R. O. Wynne-Roberts, M. Inst. C.E., in his report on the Coal and Power Resources of the Province of Saskatchewan. There are seventeen generating stations belonging to this company, of which six are coal-fired stations and the remainder waste heat stations, where steam for generating the electricity is obtained either from exhaust steam that has already done work in blowing, or other engines, or by steam raised by blast furnace gas, or from the waste heat and gas from coke-ovens; the total horse-power connected amounts to nearly 200,000. The engineer in his description of the work pointed out that cheap fuel is of paramount importance, and expressed his opinion that the future of electricity supply lies in the very large stations employing very big units of plants and established at the coal-fields. The above electrical installations have afforded facilities which have attracted several new industries to be located within the area of supply. The same remarks are applicable to the manufacture and distribution of gas, which is being adopted more generally each year.

The next International Geological Congress will be held in Belgium in 1917. "The Agricultural Resources of the World" will then be presented. Many geologists consider that the study of agricultural deposits of the world is the most important branch of geology, and by far the most important branch yet to be investigated. Owing to the fact that large territories of agricultural land have been discovered within the last ten years in Canada, South Africa and Australia, there is as yet no accurate compilation of the agricultural resources of the world. Another reason for the decision to investigate the world's agricultural resources is the attention at present being directed by political economists all over the world to the high cost of living. The geologists believe that if they can collect full details on the grain-growing land resources of the world, the march from the cities to the land will be strengthened and the price of food commodities will be moderated. Another topic that will be discussed in 1917 will be the nitrate, phosphate and soda deposits of the world. As these three chemical compounds form the basis of all fertilizers, the research to be conducted by the scientists will be of great importance to the subject of agriculture. Besides these topics the Belgium Council will be at liberty to consider two others which were suggested by the council. These are the world's copper deposits and petroleum resources.

BITUMINOUS CONCRETE PAVEMENTS.*

By Wm. B. Spencer,
President of the Continental Public Works Company, New York City, N.Y.

Up to the time of the advent of the automobile the question of modern highways was pretty well solved, except in the more highly trafficked streets of our great cities, by the discoveries of John Macadam, and the more recent improvements of the French engineers and the pioneers of this country. But in their system of road building the pioneers did not contemplate heavy vehicles carrying loads of from one thousand to twenty thousand pounds and passing over their prepared roadbed at the rate of from five to fifty miles an hour, sucking up the carefully placed filler or binder, and depositing it over our lawns, our farms and in our houses, permeating the entire atmosphere with a dust which was both objectionable and unhealthy. In response to the immediate cry of protest, engineers at once attempted to solve the puzzling problem. In the West temporary relief was found by taking the crude natural asphaltic or semi-asphaltic oils of California, Texas and Kansas and sprinkling them over the macadam roadways. This generally gave temporary relief from the dust nuisance, but it was found that these oils, which had not gone through the process of refining, contained many substances which were detrimental to the automobile tire. It was also found that they had a decidedly bad effect on the binding materials of the macadam roadways. A well-bound macadam roadway secures its cohesiveness by the hydration of its granular constituents, but when the surface coat is more or less thoroughly sealed by the application of a heavy oil, then the body of the mass is denied the water which prolongs its life, and shortly thereafter the road will commence to ravel.

Some time during the year 1903 an observer in the oil regions of California noted that a flock of sheep, which had been driven back and forth to pasture, over an oil-saturated piece of ground, gradually consolidated this soil to such a degree of hardness that it was not affected by vehicular traffic, and also produced a highway which was cheap and did not require the use of stone, which had always been deemed necessary for the construction of highways. A tamping roller, made as nearly as was mechanically possible to imitate the sheep's foot action on the soil, was designed, and the "Petrolithic" or tamped road was launched. In some sections of California it met with fair success, and is still in limited use in that section of the country.

In the summer of 1907 a road of the same type of construction was laid near New York City, and during the summer and fall season of that year it withstood traffic conditions remarkably well, but during the early winter frost penetrated the road and immediately thereafter a warm rainy period ensued, with the result that the road rapidly disintegrated and became a quagmire. The following spring it was found necessary to entirely remove the prepared roadway and substitute another form of road construction.

The Petrolithic specifications were substantially as follows:—

*Part of a paper read to the American Society of Engineering Contractors, and appearing in the Journal for June.

The earth roadway to be improved shall first be cleared of all vegetable and other foreign materials and shall then be crowned with a road grader, or by hand, to the proper line and grade, filling in all low places with suitable material. It shall then be plowed to a depth of not less than eight inches, after which a disc-harrow shall be run over the surface of the plowed roadway in order that all lumpy material shall be disintegrated. The road shall then be carefully graded to the required cross section, after which there shall be distributed one gallon of hot asphaltic oil to the square yard of pavement. The sheep's foot or tamping roller shall then be used until its teeth refuse to penetrate into the soil for a distance of more than one inch. The material shall then again be lightly harrowed and an application of hot asphaltic oil, at the rate of not more than one-half gallon to the square yard, shall be applied, and the surface shall then be lightly harrowed, after which the tamping roller shall be again used until the teeth refuse to penetrate. The surface shall then be covered with a coating of stone chips or sand and rolled with light circular roller.

Other experiments with the same or allied processes were made in the east during the ensuing year with no better results, and in so far as this type of construction is concerned, it has been virtually abandoned outside of California.

Various states and municipalities then attempted to improve on the water-bound macadam and its filler of stone chips by substituting heavy asphaltic or semi-asphaltic oil, by means of what is termed the penetration or grouting method. The initial process relating to the preparation of the base and first course of stone was substantially the same as in the preparation of the water-bound type of macadam. The second course, generally composed of what is known as inch and a half stone, was then spread upon the base course and rolled with a 10-ton roller to an average thickness of about four inches. An application of asphaltic oil, heated to a temperature of approximately 300° F., was applied, at the rate of one and one-half gallons per square yard, by means of pouring pots or sprinkling wagons and immediately thereafter a coating of stone chips was applied and the surface was then again carefully rolled with a steam roller. Immediately after this rolling another application of hot oil was made at the rate of approximately one-half gallon to the square yard, and another course of stone chips applied, after which the surface was again rolled, and after a short period of time, ranging from 3 to 24 hours, the road was opened to traffic.

The success of this type of pavement is somewhat problematical, and has been abandoned in many places. The States of New York and New Jersey spent many millions of dollars in this type of road construction during the seasons of 1910-1911, but during the season of 1912 the use of this type of construction was almost entirely abandoned. In order to make a success of this type of construction it has been found necessary to have almost ideal climatic conditions. A working temperature of over 55° F. has been found necessary because in a lower temperature the stone becomes so cold that it immediately chills the asphaltum when applied and prevents it from thoroughly penetrating the voids in the mass; an unstaple top surface coat is thus formed with an under strata which is poorly consolidated Traffic soon finds the weak spots in this pavement, with the result that ravelling soon begins and the complete disintegration of the pavement is only a matter of a short time. In order to secure even fair results from penetration work the following conditions are absolutely necessary: An asphaltic oil of approximately 18 Beaume gravity at 77° F. A flash point of not less than 400° F. A fixed carbon total of not more than 6%. A bitumen content of not less than 99%, and a paraffin scale residue of not more than 3%. This material should be heated and applied at a temperature of not less than 300, or more than 350° F. The temperature of the air should not be less than 60° F. The mineral aggregate should be bone dry and the asphaltic oil should be applied to the surface by means of sprinkling appliances containing an exact quantity of the material; templates, or other means of determining the exact quantity of oil to be applied per square yard of roadway should be laid on the prepared road surface, in order that an even distribution of the oil may be secured.

Power sprinkling devices employing compressed air as an atomizer have been used with fair results, but the continued decrease of this method of construction in favor of some method of the mechanical mixing of the cementing medium and the mineral aggregate, is proof evident that at its best the penetration system is only a step in the right direction from the water-bound macadam era to the present era of mixed bituminous surfaces.

Bituminous Macadam.—This type of pavement has been largely adopted for use on main highways and also on the principal streets of some smaller towns. A specification of this type of pavement as prepared by the State Highway Department of Pennsylvania is submitted herewith.

"After completion of the bottom course, telford or macadam, the bituminous macadam course is to be placed thereon. It shall consist of a mixture of bituminous material and good hard stone acceptable to the State Highway Department, trap rock preferred. When trap rock is used the stone shall be of such size as will pass through a two-inch ring and be rejected by a half-inch ring, and shall be entirely free from dust. When limestone is used it shall be of such size as shall pass through a three-inch ring and be rejected by a one-inch ring. When asphalt is used it shall contain not less than 90% bitumen and shall be heated to a temperature of 350 to 400° F. When tar is used it shall be heated to a temperature of 270 to 325° F. The bituminous material shall be mixed with the stone in a mechanical mixer and then spread on the telford foundation to a depth of five inches in the centre for a width of six feet, and to a depth of four inches on the sides, loose measurements, and thoroughly rolled and compacted. One and five-tenths gallons to two gallons of bituminous material per square yard of road surface will be required to make the mixture. The contractor shall, upon the direction of the engineer in charge, heat the stone to a temperature of 250 to 300° F. before mixing the compound. After the above-mentioned course has been thoroughly rolled in place and compacted with a ten-ton roller, to the satisfaction of the engineer or inspector in charge, and the surface swept clean, the surface shall be painted with the neat bituminous material, using five-tenths of a gallon per square yard of road surface, unless otherwise directed by the engineer. Immediately following the flush coat or painting there shall be applied a coating of clean rock screenings, ¼ to ¾ inch in diameter, of the same material as has been used in the four-inch course, to a depth of ½ inch and rolled into the voids in the surface. Should the bituminous binder appear on the surface after rolling, enough additional rock screenings must be applied to take up the surplus material."

This type of construction is one which leaves considerable to be wished for. Personal experience has led me to believe that the grading of the mineral aggregate is not done with sufficient care to give a minimum of voids in the mass, with the result that depressions and ravelling are apt to occur in a period of not more than three years after the pavement is laid.

Bituminous Concrete.—The specifications covering this type of construction are no doubt familiar. In a general way, however, a grading of mineral particles ranging from material which passed a 200-mesh sieve to a maximum amount of from 5% to 11%, to particles which passed in a 2-mesh sieve to a maximum amount of 10%, is used. Where this pavement has been laid with care and by experienced contractors it has met with extreme success, and is being specified in ever-increasing quantities in all parts of the country. During the season of 1912 the City of New York awarded contracts for the construction of over one million five hundred thousand square yards of this type of pavement in the Borough of Queens. The highways on which this pavement is laid are the main arteries of travel leading to and from Greater New York points on Long Island. Over eighty per cent. of this travel consists of pleasure automobiles and heavy auto trucks, and a majority of the remainder being heavy horse-drawn farm wagons. A traffic census taken on the Merrick Road this summer showed an average of over six thousand vehicles a day, with a daily total of approximately ten thousand vehicles passing over it on Saturdays, Sundays and holidays.

The pavements have been down for too short a time yet to be able to judge of their future wearing qualities, but what they have gone through the past season with excellent results is evidence of the fact that they will bear the heavy traffic imposed upon them for many years to come without the necessity of any large amount of repairs. The old roadbed consisted, in the majority of cases, of old macadam, which had been worn down to the base course of stones. This course was lightly scarified and sufficient 1½-inch stone was added to bring the road to the proper cross section and crown, and two inches below the finished grade. A layer of screenings or sand was then applied and worked into the voids by means of hand brooms and puddling with water, and the whole foundation was then thoroughly rolled with a 10-ton macadam roller. The bituminous concrete was then laid and raked by expert rakers and then thoroughly rolled with a 6-ton tandem roller until it had an ultimate thickness of two inches. The pavement was then dusted with a coat of Portland cement to fill any surface pores and was opened to traffic after a period of not less than 12 hours.

In order that the shoulders of the roadway should be protected, a layer of 3 rows of vitrified block were butted in against each side of the roadway and the joints were then poured with an asphaltic filler. In the outlying sections the wings of the roadway were carefully graded and suitable gutters were constructed leading to masonry seeping basins. In sections where storm water sewer systems prevailed the gutters were paved with either cobble or brick and the construction extended from curb to curb.

Among the other forms of modern bituminous pavements may be mentioned those which come either under the patents or control of the Warren Bros. Co., and consist of the well-known Bithulithic pavement, Warrenite and Amesite.

There is also another type of pavement which has recently come into vogue in the Middle West, and is also being used in some parts of the East. It bears the trade name of "Dolarway" pavement. This process consists of first laying a concrete base of suitable thickness of rather a rich mixture and providing suitable expansion joints. Immediately after the laying of the concrete and before the initial set has taken place, the top of the concrete is carefully trowelled, in order to have a uniform finish, and to bring the finer particles to the surface, after which the surface is broomed. Upon this foundation there is spread a layer of hot bitumen at the rate of about ⅓ gallon to the square yard, immediately after which a uniform layer of clean dry sand or stone screenings is spread in a sufficient quantity to cover the asphalt coat and leave a wearing coat not less than ¼ inch in thickness. This pavement is at the present time in its infancy and it is therefore impossible to form an opinion as to its permanent quality. One good feature of this type of pavement, however, is the fact that irrespective of the wear of the surface course there always remains the concrete foundation which can be used either for a new application of this same type of surface treatment, or it can be used for another type of pavement.

Sheet Asphalt.—This type of pavement has probably received more praise and at the same time more criticism than any other form of bituminous pavement, but in the writer's opinion there is no more substantial bituminous pavement laid than modern sheet asphalt pavement. In the early days, and even in more recent times, paving engineers have given too little attention to the details which go to make up a good modern pavement of this type. This lack of attention to details is slowly being eliminated, due greatly to the fact that intelligent bodies of engineers and contractors have been working together to standardize the specifications covering this type of pavement. A set of standard specifications covering the making and laying of sheet asphalt, which is the result of many years' study and labor, has recently been published by the American Society of Municipal Improvement. A digest of these specifications may be of interest:

Refined Asphalts.—The tests provide that all penetrations shall be made at 77° F., and are to be expressed in hundredths of a centimeter with a No. 2 needle acting for five seconds under a total weight of 100 grams. There is no distinction made between the so-called natural or lake asphalts and the oil asphalts; i.e., those derived by distillation from asphaltic oils, it being stated that all asphalts shall be prepared from a natural mineral bitumen, either solid or liquid, or a combination thereof, by suitable and approved methods of refining.

All shipments of refined asphalt shall be uniform in consistency, and shall not vary more than 15 points in penetration at 77° F. Ninety-eight and one-half per cent. of the total bitumen shall be soluble in carbon tetrachloride.

Flux.—The specifications covering the fluxes state in part that they shall be the residue obtained by the distillation of paraffin, asphaltic or semi-asphaltic petroleum, and shall be of such character that they will combine with the asphalt to be used to form an acceptable and approved asphalt cement.

Binder Stone.—The requirements are that the stone shall be clean, hard and free from any particles that have been weathered and are soft. It shall all pass a 1¼-inch screen, and from fifteen to thirty per cent. shall pass a ten-mesh screen. Particular attention is called to the latter requirement. Strict conformation with this phase of the specifications will produce a dense binder which

will have much to do with the ultimate life of the pavement.

Sand.—The careful grading of the sand particles has received more study in recent years, with the result that the modern specifications are as follows:

200 mesh, 0 to 5%				
100 mesh	and retained on	200	mesh,	10-25%
80	" "	100	"	6-20%
50	" "	80	"	15-40%
40	" "	50	"	10-30%
30	" "	40	"	8-25%
20	" "	30	"	5-15%
10	" "	20	"	2-10%
8	" "	10	"	0- 5%

Particular attention is called to the large percentage of particles which must pass the 80-mesh sieve and the small amount which pass a 20, 10 and 8-mesh sieve.

It is unusual to find a sand which can comply with both the fine and the coarse requirements of these specifications. The writer is at present engaged in the laying of a considerable amount of sheet asphalt pavement under these specifications in the city of Norfolk, Va., and it has been found necessary to secure two sands in order to produce a blend which meets the requirements of the specifications. The fine grain sand is secured in North Carolina, and the coarse sand is secured by dredging in the Chesapeake Bay. A blend of three parts of the former to one part of the latter produces a mixture which complies in every respect to the requirements of the standard specifications.

The exact quantities of materials used in making a nine-cubic-foot box of our Norfolk paving mixture are as follows:

Sand	880 lbs.
Carbonate of lime	170 lbs.
Asphalt cement	127 lbs.
	1,177 lbs.

A nine-foot box of this mixture lays approximately 5.28 square yards of finished pavement two inches thick after compression with a steam roller weighing not less than two hundred pounds per inch width of tread.

Asphalt Cement.—The requirements of asphalt cement are that it shall be composed of refined asphalt or asphalt and flux prepared in the proper proportions and melted in such a manner that they shall be blended into a homogeneous mixture complying with the following requirements:

(*a*) It shall be thoroughly homogeneous and shall not be oily to the touch.

(*b*) It shall have a penetration between 40 and 75 at 77° F., depending upon the sand and asphalt used and traffic upon the street on which the pavement is to be laid.

(*c*) It shall not flash below 300° F. when tested in a New York State closed oil tester.

(*d*) When heated in an open tin at a temperature of 325° F. for five hours in a hot air oven, it must not show a loss by volatilization of over 5% and the penetration at 77° F of the residue left after such heating must not be less than one-half of the penetration at 77° F. of the original sample before heating.

(*e*) When the pure bitumen of the asphalt cement is brought to a penetration of 77° F. of 50 and made into a briquette having a cross section of 1 sq. cm. it shall have a ductility of not less than 20 cm. at 77° F., the two ends of the briquette to be pulled apart at the uniform rate of 5 cm. per minute.

When the asphalt cement as used has a penetration greater than 50 at 77° F., an increased ductility of 2 cm. shall be required for every 5 points in penetration above 50 penetration.

Binder and Laying.—The binder mixture shall be heated to a temperature of between 200 and 325° and shall be mixed with from five to eight per cent. bitumen. On reaching the street it shall immediately be dumped on the concrete and at once spread with hot shovels and rakes to the required thickness, after which it shall be thoroughly rolled. No more binder shall be laid at any one time than can be covered by two days' run of the paving plant on surface mixture.

Wearing Surface.—The sand and the asphalt cement shall be heated separately to such a temperature as will give, after mixing, a surface mixture of the proper temperature for the materials employed. The sand when used must be at a temperature of between 250° F. and 375° F. The asphalt cement when used must be at a temperature between 250° F. and 350° F. The filler shall be added to the hot sand in the required proportions, and the two thoroughly mixed. The asphalt cement in the proper portion shall then be added and the mixing continued for at least one minute.

Laying.—The surface mixture shall be brought to the street in wagons at a temperature between 230° F. and 350° F., and shall be covered with canvas covers while in transit. It shall then be dumped on a spot outside of the space on which it is to be spread. It shall then be deposited roughly in place by means of hot shovels, after which it shall be uniformly spread by means of hot iron rakes in such a manner that after having received its final compression by rolling, the finished pavement shall conform to the established grade and have a thickness generally of not less than two inches.

The modern sheet asphalt specifications generally require a binder course from one to one and one-half inches in thickness, and a surface course from one to one and one-half inches to two inches in thickness. I have never been able to discover to my satisfaction why it has been found necessary to have such a thick wearing course, as of 2 inches. It is a well-known fact that generally after a surface course has worn much over one-half to three-quarters of an inch that the remainder of the course disintegrates very rapidly. Would it therefore not be better to reduce the thickness of the surface course to one inch, and increase the quality and thickness of the binder course by having a very dense mixture of sand and stone mixed with the proper percentage of asphalt cement, and of a thickness approximately two inches? A pavement of this type laid under my direction more than three years ago has given very good results, and especially in view of the fact that it was laid on a macadam foundation.

The St. Thomas-Windsor extension of the Hydro-Electric power line has been decided upon to pass through St. Thomas, Ridgetown, Rodney, Dutton, and a number of other points. The route selected will allow easy construction, and will be in proximity to the Michigan Central right-of-way. It will serve the largest area and the most thickly-populated district of any route under consideration. The entire line is 112 miles in length, and the construction of it is being commenced.

SOME PRACTICAL EXAMPLES OF PROVINCIAL LAND SURVEYING

TYPICAL INSTANCES IN THE RE-SURVEY OF OLD LINES, WHERE THE SURVEYOR MUST ARBITRATE — REMARKABLE ACCURACY OF OLD COMPASS LINES, THOUGH LITTLE USED FOR THAT PURPOSE IN PRESENT PRACTICE

By J. A. MACDONALD,
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NEARLY all of the lands in the older provinces of Canada have been surveyed by the magnetic needle or surveyor's compass; so that all lines, division and otherwise, roads, township lines, etc., are based on the magnetic meridian and not the astronomical or due north and south, east or west. These old lines, said to run north, are not due north, but ten to twenty degrees west of north, and the same proportion of error east and west. This does not matter much, but it would matter a good deal if all those compass-run lines were re-run by the astronomical meridian. It is only a few years ago that the land lines began to be run astronomically. The Dominion Government was the first to begin this innovation in dividing up the lands of the North-West Territories, where all lines are now run astronomically and where lines run with the surveyor's compass are not allowed. In the maritime provinces of Nova Scotia, New Brunswick and Prince Edward Island; in Quebec and old Ontario; all land lines were run by the magnetic meridian and any correction, retracement or resurrey work, in these provinces must be done with the compass. As all transits are provided with a compass the lines may of course be run with the transit. But the transit-compass is usually small, usually sluggish, and therefore not usually reliable; so that the regular surveyor's compass with 4½-inch needle is the proper instrument to use in this work.

Old Compass Surveys Wonderfully Accurate.—It is a matter of wonderment to engineers and surveyors, whose only experience is with the transit, how fairly accurate those old compass lines really are. These veteran surveyors are deserving of the greatest credit for the wonderful accuracy of their lines. No modern surveyor could duplicate such work with the magnetic needle. In fact, the modern surveyor has little respect for the compass as an instrument for running lines and courses. The minute accuracy of the modern transit, and the refinement of the courses, down to 30 seconds, causes men to marvel how correct bearings could possibly be run with the compass, when such refinement as seconds or even minutes are out of the question.

The compass, at best, especially in the hands of inexperienced instrument men, is not considered accurate up to 10 or 15 minutes. In fact, the old traverse tables used for calculating compass bearings, were only given to 15 minutes, that being considered the limit of compass accuracy. With the old compass surveyors, however, the limit of accuracy was by no means confined to 15 minutes or the quarter of a degree. With the sensitive needles and perfect order in which the compass was usually kept, and frequent tests made with a standard meridian, the accuracy was refined to 5 minutes and seldom more than 10 minutes. Old surveyors have told the writer—men who were familiar with the use of the modern transit—that they could, and usually did, run their lines within 5 minutes of the accurate direction given of the course. The state lines of the older states of the Union, and of the older provinces of Canada were run with the compass. The line between Pennsylvania and Maryland, run with the compass, is the marvel of modern surveyors for its wonderful accuracy.

Very Little New Work Now for the Compass.—There is practically no new work done now with the compass. By this I mean new work undertaken by the governments of the several provinces. For instance, in New Ontario all lands are now surveyed astronomically with the transit and the direction of the needle ignored, though the isogenic line is noted for reference. In railway surveys the compass is used throughout unless the country is full of mineral, as a check on the transit bearings. Were it not for the possibility of being able to run lines independent of the compass a good deal of territory could not be surveyed at all. In a large portion of northwestern Ontario the compass is of no use on account of the large amount of mineral in the ground beneath. The writer found, while railway surveying in Northern Ontario, between Winnipeg and Lake Abbitibi, that the compass was of no use as a check on the transit bearings on account of the prevalence of various minerals. The present prevalence of wire fences bounding farm and lot lines is a great stumbling block to using the compass on those lines. The proximity of railway tracks is another. In fact, wire of any form in close proximity to the compass makes its readings negligible.

The professional surveyor in the older provinces of Canada must, therefore, use great discretion in the pursuit of his work.

The Professional Land Surveyor Must be a Diplomat.—Of all professions, not excepting that of the doctor, the land surveyor must be a diplomat. In doing correction work, as resurveys and retracements, for the public, the greatest delicacy must sometimes, if not generally, be used in dealing with the interested parties. For instance, in re-surveying a division line between two owners on either side of the line, the task is a most difficult one to adjust fairly and satisfactory to both parties. All traces probably of the old line have been obliterated by time, fires, etc., the existing lines are far from being in correct position, and this incorrect position of the division line may be long-standing, through one and two generations, it may be. The father recognized these old lines during his life time, possibly aware that the division line was not in the right place. But the son who inherits the property will not stand for the crooked, sidling division line, and gets a surveyor to run the line correctly. Then trouble commences, as the man on the other side of the line, when he sees himself losing slices of his land, attempts to stop the survey.

Here is where the diplomatic ability of the surveyor comes in. If he is not diplomatic at this point, and knows the proper initiative, if he is brusque, obstinate and lacking in the great art of reconciliation and diplomacy, a law suit probably ensues.

It is said that it is the province of a doctor to prevent people from getting sick—at least very sick, and that of a lawyer to prevent law suits, so it is the province of a professional land surveyor, dealing with the public, to prevent litigation.

A Case in Point.—The writer was called on to resurvey a division line. The line had been run many years before, but fires and the clearing of the land from woods obliterated the original monuments. The line in places was very zig-zag, and apparently far out.

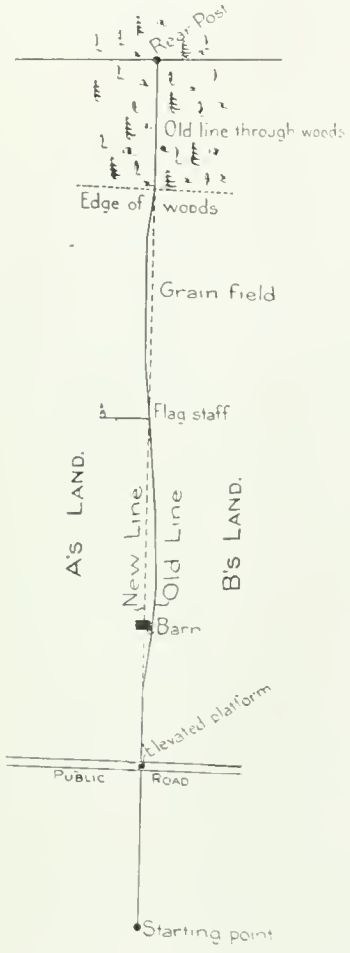

Fig. 1.

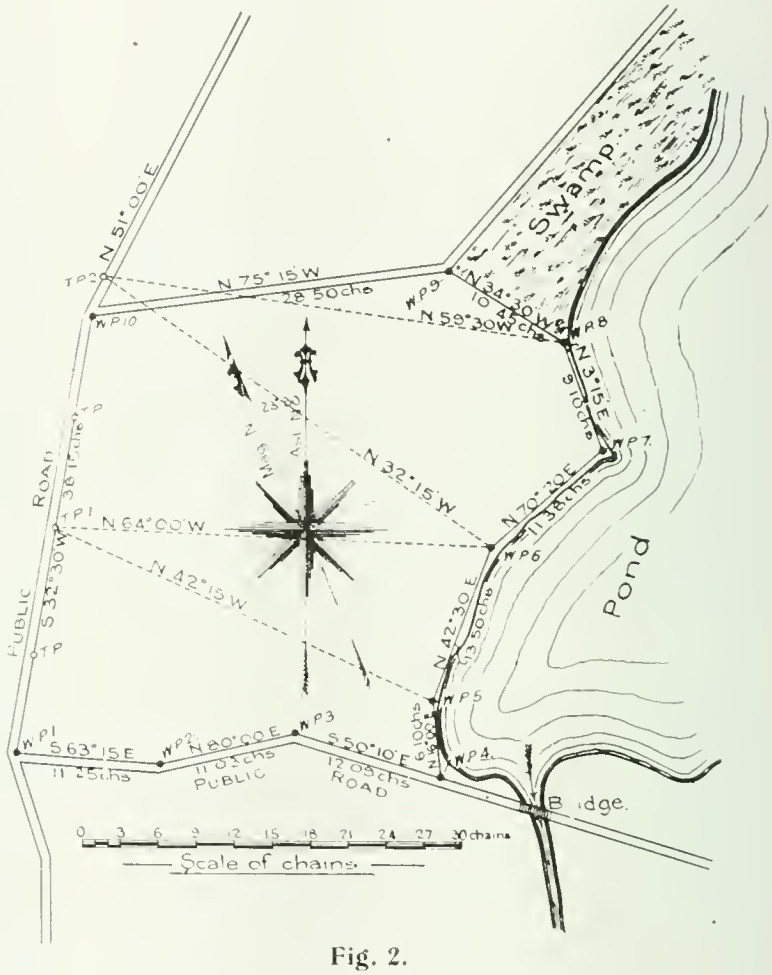

Fig. 2.

Fig. 1 gives a fairly good outline plan of the property. The full lines show the zig-zag position of the division fence line.

In making those correction surveys it is necessary for the surveyor to have a copy of the original deed showing the magnetic direction of the line in the year the land was surveyed. As the magnetic declination changes with years, it becomes a difficult matter to get the correct magnetic course's bearing. In some of the provinces, probably in all of them, there is a standard magnetic meridian laid out by the government under the direction of the Surveyor-General or the Minister of Public Lands, and of this meridian, usually the year the township outlines of the province were surveyed, all compass of magnetic bearings are referred. For example, in one Canadian province the survey of the township outlines was begun in 1776, when the magnetic declination was 15½ degrees. This, then, is the standard magnetic meridian for that province, and all lands transferred and deeded from the government are based or referred to this meridian. Property surveyed, say, 90 years later, in 1866, when the magnetic needle varied since some 8 degrees, would be shown by the surveyor to be this number of degrees west of the meridian, and lands surveyed fifty years before would be 3 to 4½ degrees west, as the case might be, at the particular date of the survey. This simplifies the work of the present-day surveyor, and he knows what he is at, once he determines the magnetic bearing of the original survey which can in most cases be readily obtained, if not of that particular lot, then of a neighboring bound surveyed approximately at the same time.

In Fig. 1 the magnetic bearing of the division line was, in this way, readily obtained, a reliable starting point is also obtainable, and this starting point is of the greatest importance in all surveys, as without a permanent monument to start from it will be almost impossible to make a correct survey.

In the survey in question the old post or starting point was admitted to be in correct position. Here the compass was set with the proper declination of the needle made to reconcile with the original survey, and it was found that the line on the ground, north to the public road, was approximately as it should be. At the road the compass was again set up to get a view of the existing line. The road was on high ground and a good view back and front could be taken. From the back sight and from the reading of the needle, the line for a portion north

of the road was also fairly accurately in correct line, but a few chains farther north the line zig-zagged most outrageously, and looking through the compass sights it was found that the barn of one of the property owners was directly in the line. Here was a "contretemps." The line to the rear from starting point might not be right, and, again, it very possibly was. The barn prevented seeing how the line fared farther on, and without having to offset the line at the barn, and the fact that the line at the road was on the highest ground, it was decided to erect a scaffolding or elevated view-point. This was constructed and the transit (not the compass here) was set up after. Back-sights being taken, it was an easy matter to see how the old line proceeded towards the north. It was found, after zig-zagging on B's property it deflected into A's. At about three-fourths of the distance the line went into thick woods. It was thought, and rightly so, that here the old line would be found; a flag-staff was therefore set at the edge of the wood, and the reading of the needle determined it was found that the original line came out as expected. Where the line of sight crossed the old line, as shown in Fig. 1, a fence pole, about 15 feet long with a small flag fastened to its top, was set up in exact range with the correct line of sight entering the wood. Pickets were set, and the line run straight, sometimes on one side of the old line fence and sometimes on the other, until the wood was reached, when it was found approximately directly in continuation, and followed to the front where old bearings were easily discernible.

The owner who found he was losing a big slice of his land and one-half of his barn was finally consoled by his gain of ground farther ahead and permitted the line to proceed. By the plan it will be seen that the true line went into the other man's grain field, taking off quite a slice of ground. He developed the idea that he would lose in this way all along the line farther on, but when the woods were reached, approximately striking the old line, and were proceeding along it, he was satisfied the new line was correct. Had it not been made plain to the man who lost part of his barn that he would gain farther on, he certainly would not allow the line to be run, and, as he had been 21 years in peaceable possession of the property under fence, he could hold the land in any law court, and have the old line remain as the true line. This is an example of a case where the surveyor must use great delicacy and discretion.

Another Case in Point.—Here an enclosed lot was to be surveyed by compass bearings, as done originally, the various bearings and distances obtained and a correct area of the property determined.

As will be seen in Fig. 2, this land has many sides, and affords some difficulties in the conducting of the survey. There were no division lines, however, which made the survey a less delicate matter, starting at the southwest corner of the lot, marked (1) along the public highway; the course by the compass is S. 63° 15′ E., and a distance of 11.25 chains to station (2). From station (2) the course is N. 80° 00′ E., distance to (3) 11.03 chains. From (3) to (4) the course is S. 50° 10′ E., distance 12.09 chains, at (4) a pond is reached. Here some offsets have to be taken to the banks of the pond, to arrive at the area of the land to the east of station (4). From station (4), the course is N. 16° 00′ E., distance 6.10 chains, and so on. From (4) to (9) the lines skirt the banks of the pond or lake. Offsets are taken to its banks, where necessary, in order to be able to plot the ground correctly, a row of telegraph posts are shown along the public road and marked on the plan T.P. Two of these posts are used for intersecting, in order to determine the degree of correctness of the courses and chainages of distances between monuments. These are a necessary check to the survey where the bounds are deeply angled. At station (5) the compass was sighted to T.P. (1), the course being N. 42° 15′ W.; at station (6) the course sighted to the same T.P. was N. 64° 00′ W. At this station an intersection was further taken to another telegraph post, marked T.P. (2) on the plan. Here the course was N. 32° 15′ W. Proceeding to (8) another intersection was taken to T.P. (2), the course being N. 59° 30′ W.

At station (8) we come to the edge of a marsh and to the delimitation of the pond. At (9) we strike a public highway, one of the bounds of the lot, the course from here to (10) being N. 75° 15′ W., and distance, 28.50 chains. At (10) is the main public roadway or street leading out of the city. This road runs N. 57° 00′ E., but turns at station (10) and runs S. 32° 30′ W. to station (1).

In calculating the area of this lot, resort is best made to Double Meridonal Distances, where there are so many courses and angles, as in this lot, this is the only proper method of calculation, and ensures the accuracy of the survey. As to the manner of computing by this method, the reader can refer to any book on surveying.

A lot of this kind and shape, plotted on a fairly large scale, say, 5 or 10 chains to an inch, can easily be calculated for area by means of triangles, the area of each being obtained by multiplying the length of the base by half the altitude.

Points About Plans to Remember.—All the bearings of a plan must be referred to a single meridian. It matters not whether the meridian is astronomical or magnetic. In nearly all of the land divisions of the older provinces the meridian is magnetic. The angle of any two lines may be given by the difference in their bearings.

The date of a survey is the date on which measurement was completed on the ground. The dates of commencement and ending of the survey which are entered on the title page of the field notes should include all traverse or other surveys within the field book.

The surveyor must not lose sight of the fact that the main object of his plan is to identify the boundaries of the parcels laid out; the plan must not be obscured by irrelevant details. Only the main topographical features are to be represented, and in so far only as they may assist in locating the boundaries. Traverse lines of rivers or lakes, generally are of doubtful utility; they are not boundaries, and as the feature which they define is liable to change, any measurements required may, if the transverse has been accurately plotted, be scaled off the plan with sufficient accuracy. Plans must be plotted carefully and accurately, and must be fair specimens of draughtsmanship.

The title of the plan of a group lot must state the number of the lot, the number of the group, a concise designation of the locality, the district, province or territory, the name of the surveyor, the date of survey and the scale. The designation of the locality must be that one which is in general use among the public in referring to the place.

The plan of a town site must show the whole of the section or lot in which the site is situated, the connections with the corners, and every section, quarter section or lot line passing through or bounding the site. It must exhibit the bearings and lengths of all boundary lines, the posts, the numbers of the blocks, town lots, avenues and

streets, the width and depth of the town lots, the width of the streets and avenues, and the houses and improvements. Only the essential topographical features are indicated.

The title of the plan of a town site must state the name of the town site, the number of the section, or lot in which the town site is situated, the province, district, or territory, the name of the surveyor, the date of survey and the scale.

Plans of highways must show the bearings and lengths of the courses, the monuments, their description, and the bearings and lengths thereto, the main topographical features and the area of the highway, computed to the nearest hundredth of an acre, in every separate parcel crossed by it.

Monuments.—In private or custom surveying wooden posts are used. In Dominion land surveys no wooden posts are now used, excepting in deep swamps. The corner posts of a survey are usually bigger and deeper in the ground than posts used elsewhere.

A wooden post for a corner of farm or settlement lot is 36 inches in length, to be one-half in the ground. It is squared 12 inches from the top, and the faces are about 3 inches wide. The top is bevelled to shed rain. Such a post, when perpetuated by a mound in the northwest, is not placed in the centre of the mound, but in the same position that an iron post would occupy. Mounds and pits are seldom used in provincial work of a correction or jobbing nature. In new government work I believe they are used by some of the provinces.

In the Dominion lands surveys pits and mounds are used throughout, as corner monuments, and also witness monuments, and a square-topped post is only used for settlement lots, group lots, etc. Stone mounds are also employed, whenever stones can be readily procured, and make good monuments for any kind of survey work. These two classes represent the style of boundary monuments largely used by Dominion land surveyors, in work in the western provinces.

MANITOBA'S FOREST WEALTH.

Manitoba has not been looked on as a forest country, but it has always had a considerable area of forest, and, since the boundaries have recently been extended, a large territory has been added which is almost entirely forest land. The forest flora of this province is varied. At the south-eastern corner the red pine of Ontario intrudes, intermingled with spruce, jackpine, tamarack, birch and poplar. Along the valley of the Red and Assiniboine Rivers was a mixed forest of elm, ash, oak, basswood, and ash-leaved maple, where trees were found ranging to 24 inches in diameter. Rising like islands from the agricultural plains, tracts like the Turtle, Riding, Duck and Porcupine Mountains, bore forests of oak, ash and poplar in the Turtle Mountains, and of spruce, jackpine, oak, elm, ash, poplar and ash-leaved maple in the others. The character of the virgin forest may be seen from the following extract from a report of explorations made by Professor Hind on the 8th November, 1858: "I beg to subjoin the circumference, five feet from the ground, of a few trees within 50 yards of our camp on the Riding Mountain: Aspen, 4 ft. 6 ins.: 4 ft. 6 ins.; 4 ft. 1 in.; 5 ft.: white spruce, 7 ft. 3 ins.; 5 ft. 6 ins.; 6 ft. 6 ins.; 6 ft.; birch, 3 ft. 6 ins.; 3 ft.; poplar, 4 ft. 9 ins.; 4 ft. 6 ins. These trees represent, as far as observations permitted, the general character of the forest on the summit plateau of the Riding Mountain."

OXY-ACETYLENE TORCH.

Some tests have been undertaken recently to determine the mechanism of cutting the practical consumption of oxygen and the effect of variations in the different heating flames produced by the oxy-acetylene blowpipe when cutting metal. The metal on which the researches were carried out was a sheet of Martin boiler-plate of a thickness of 10 mm. and a sheet of Martin extra hard steel from 28 to 30 mm. thick. This latter was similar to that used for locomotive girders. It was found that, contrary to the general impression, the act of cutting did not consist of a simple combustion of the iron. In fact, with small or medium thicknesses only a small percentage of the metal removed by the influence of the jet of oxygen was actually burned. It was also found that a heating flame could be too powerful, and so retard the cutting and give an irregular surface. With equal cutting surfaces it was also found that less oxygen was consumed by those blowpipes with a central jet than by those which had separate burners.

It is interesting to note that particular attention is being given in Germany to cutting and welding metals by the oxy-acetylene flame, and, according to an authority, an advanced course in the subject is being given to the students in one largest technical industrial schools in the country. Writing in "Indian Engineering," he points out that the method of application to the various trades is taught, including boilermaking, the work of the blacksmiths, copper smiths, machinists, shipbuilders, pipe-workers, electricians, aluminium-workers, etc. The method is also taught in twenty-one other technical schools, and at Nuremberg a special school is being built to be devoted exclusively to practical and theoretical teaching in this branch. Already oxy-acetylene cutting has begun to displace cutting by tools to a large extent. One direction in which a revolution is being effected is in piping. Instead of having short lengths with screwed joints, which necessitated a certain minimum thickness of m al to allow for the screw threads, the method now being commonly adopted is to use thin plates of steel or iron run through rolling machines to the required diameter and then butt-welded by the oxy-acetylene flame in an automatic machine. Jointless pipes of any length are thus obtained at less cost than formerly, the work proceeding on the spot where the pipes are being used, exactly according to requirements. There is a successful example of a repair to a large cast-iron cylinder which cracked and would have taken a month to re-cast. To prevent the chances of the cylinder developing cracks near the joint, owing to unequal contraction when cooling, it was covered with asbestos on the outside, while a wood fire was kindled inside, which maintained it at a dull red heat while the oxy-acetylene flame was being applied. After completion of the weld the cylinder was covered with insulation and allowed to cool very slowly. The insulation was removed after two days, when the joint was found to be perfect, without the trace of a shrinkage crack. The convenience of repairing by this method the machinery and boilers of ships at sea has only to be mentioned to be appreciated. It can also be realized how great is the saving in time in repairing and putting on the road again locomotives which otherwise might lie for weeks in the shops.

LARGEST DRYDOCK.

The drydock which is to be built at Quebec for the Dominion Government by a Montreal firm will, when completed, be the largest structure of its kind in the world. It is to be 1,150 ft. long and 137 ft. wide, or 100 ft. longer and 17 ft. wider than the Gladstone Dock, which was opened by King George at Liverpool.

The Canadian Engineer

ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Points in Choosing a Pavement 501
Steel for Canadian Shipbuilding 502
A Centralized Road Board Advocated for Canada 502

Leading Articles:

Bending Moments in Flat Slabs 485
Winnipeg Rainfall 487
An Unusual Engineering Operation 489
American Road Congress 489
The British Road Board 490
Use of Cement at Collieries 491
Bituminous Concrete Pavements 493
Some Practical Examples of Provincial Land Surveying 497
Oxy-Acetylene Torch 500
The Extent and Wear of Pavements in Canadian Cities 503

Engineers' Library 509
Coast to Coast 512
Personals 514
Coming Meetings 514
Railway Orders 73
Construction News 76

POINTS IN CHOOSING A PAVEMENT.

The information which *The Canadian Engineer* has accumulated, respecting the various types of pavements that have been laid in Canadian cities, forms the basis of an article appearing in another part of this issue. The data show a marked tendency toward greater uniformity in the use of pavements for special grades of traffic, and they also show that the question of traffic has been receiving more attention and scientific investigation during the past several years than had hitherto been given it, in the selection of pavements.

The opinions which our city engineers have expressed are of great value in that they are based upon constant personal observation. Where these opinions differ materially from the general conclusions at which highway officials in other countries, and even in other cities of our own country, have arrived are instances which are sources for information of particular value, and which bear out well the old-established belief in experience as the best teacher, though in many cases the most expensive.

That these general conclusions respecting paving practice at home and abroad are subject to modification for any city's particular requirements, does not entirely explain the wide diversity of opinion which still exists throughout the country concerning the pavements that are being used. Although Canada's expansive territory is subject to a considerable range of climatic conditions; to a varying quality in materials, and to a changing and varied collection of vehicular traffic, these factors are not sufficient in themselves to prevent the crystallation and adoption of a more uniform and a more scientific pavement selection than the actual results indicate from practice in the past.

Not that absolute uniformity is desired. *The Canadian Engineer* is not an advocate of hard-and-fast rules in the matter of street paving. Newer methods and materials are being continually introduced, and the trying-out process is slow. But there are many pavements that are well-established and do not belong to the novice class, and the evidence that among them there are pavements that have not been properly chosen in some cases points to towns and smaller cities the wisdom of careful selection. The durability of a pavement has one unredeeming feature, in that it does not furnish an early opportunity for the laying of a more appropriate pavement if a desire for such may develop.

Other characteristics besides durability enter most paving projects. Quietness is desired in residence sections, and on streets lined with office buildings. Sanitariness is desirable on all streets, and the street cleaning department of a city should be shown consideration where possible in the selection of pavements. The quality of unslipperiness is often at variance with the nature of the surface which assures other desired characteristics. Especially in cases of intersections busy with light and speedy traffic, and on ungraded streets, slipperiness is a most undesirable feature. Qualities such as the radiation of heat, reflection of light, emission of unpleasant odors and other factors which concern the pedestrian and the adjoining residents, are also worthy of some consideration.

Further, some pavements, though quite satisfactory when new, may be subject to a wear of such a nature as to render them wholly undesirable, long before they are in such an advanced state of wear as to warrant their being torn up and replaced.

These and other factors influence the choice of a pavement, some lightly, some considerably, depending

on local conditions; and, while one good quality may be obtained at times only at the expense of another, the search for the ideal pavement requires a judicious consideration of them all. The proper time to think of these items is before the pavement has been laid. There will be fewer discrepancies to overlook afterwards, as a result.

STEEL FOR CANADIAN SHIPBUILDING.

The old saw about the ill wind is given another chance in the case of the new Government regulation respecting materials that go into the making of Canadian vessels. The shipbuilding industry receives its share of the good in the clause which states that all vessels built for the Dominion Government must be built in Canada. The steel industry of Canada also should receive a healthful incentive from the fact that all material for the construction of these vessels must henceforth be British product, thus putting an end to the use of steel from the United States for this purpose. Whatever material Canada is not at present able to supply, for a yearly output, may be of such magnitude as to act as a last straw in the breaking down of indecision toward the establishment or the extension of other industries.

But the shipbuilding industry is not jubilant over the necessity of having to look in another direction, than has been the custom, for steel plate. There are items of cost and speed in getting actual construction under way, that are somewhat handicapped by the new rule. The length of time necessary for the delivery from England, of steel and other materials which Canada may not yet be in a position to supply, is going to hold up the fulfilling of contracts. Concerning cost, Canada has been purchasing United States steel for her shipbuilding at a better rate than it is claimed she can get it from Great Britain, the quality being practically the same. Or, she might buy from Belgium at a lower figure than that obtainable in either of the other sources of supply.

So that the Canadian shipbuilding industry is affected by the new regulation to the extent of an increased cost in the materials of construction, and of a longer period necessary for the completion of a vessel.

A CENTRALIZED ROAD BOARD ADVOCATED FOR CANADA.

Returning to Canada, after a study of the evidences of road engineering, as displayed in Great Britain and on the Continent, Mr. A. T. Laing, lecturer in highway engineering, University of Toronto, pronounces as the vital point in Canada's road situation to-day, the lack of organization.

"It is hopeless to expect a satisfactory treatment of the question so long as each municipality continues an independent policy of experimentation with one pet scheme or another at the caprice of a council. What is needed more than anything else at the present time is centralized authority, which, of course, must be accomplished by legislation. The establishment of a board modeled after the British Road Board and modified to meet the conditions here would greatly aid the movement and place it on a substantial basis."

The suggestion is not new to readers of *The Canadian Engineer*, and it is regrettable that engineers, who have a better knowledge than anyone else of the necessity of a comprehensive Dominion-wide road policy on a sound financial basis, do not bring the idea into more prominent publicity, now that the road problem is being so widely discussed in some of the provinces.

Of course, conditions in the two countries are vastly different, and Great Britain with her densely inhabited areas and her comparatively short roads is not a model for Canada to copy. But the principle is the same, and should work out as well in Canada as it has done in England.

BIG PAVING FIRM TO BE WOUND UP?

Application was made last week at Osgoode Hall, Toronto, to wind up the Canadian Mineral Rubber Company, Limited. J. S. Lovell, who was the petitioner, is a creditor for $2,500. It was suggested that this year's business will increase the company's liability by $200,000.

The company was incorporated in 1909, under Canadian laws. It owns a Gilsonite property near Price, Utah; a bituminous limestone property near Tucker, Utah, and also the entire $500,000 capital stock and $500,000 bonds of the American Asphaltum and Rubber Company, of Chicago.

The company manufactures "Pioneer" mineral rubber asphalt, insulating and waterproofing compounds, pipe coatings, paints, etc. The registered office in Canada is in Toronto, but the Toronto office is very small compared with the large staff at the Chicago headquarters of the American Asphaltum and Rubber Company, which handles a large volume of business throughout the United States.

The officers are: D. B. Hanna, Toronto, president; A. J. Mitchell, Toronto, secretary. The directors are the foregoing and Sir H. M. Pellatt and A. D. Davidson, Toronto; H. Sutherland, Winnipeg; J. M. Greata, J. J. Hill and D. Northall-Laurie, Chicago.

The outstanding capital stock of the company is $200,000 preferred and $800,000 common. The bonded debt is $825,000, most of which, it is understood, was issued in England, with the British Empire Trust Company, Limited, of London, as trustee.

It is generally thought that the application for winding up the company is probably the direct result of the suit against the American Asphaltum and Rubber Company, which was won recently in the Illinois courts by a competing company, the Standard Asphalt and Rubber Company, of Chicago. The latter company, which makes practically the same products as are made by the American Asphaltum and Rubber Company, claims to own the basic patents covering the methods of manufacture of many of the American Asphaltum and Rubber Company's products, and their contention was apparently upheld by the courts.

This suit and the subsequent application for the winding up of the Canadian Mineral Rubber Company are of immense importance to paving interests, both in Canada and the United States, because the Standard Asphalt and Rubber Company claim that their patents are basic patents covering every commercial method now known for producing asphalt products.

Toronto has 42.76 miles of macadam roads; Winnipeg follows with 33.75 miles.

The Canadian Pacific Railway Company's tunnel under the Selkirk Mountains is regarded as one of the most important enterprises which has ever been undertaken in the Canadian west. It will be five miles long, and will be built for a double track. The time prescribed for the execution of the works is forty-two months

THE EXTENT AND WEAR OF PAVEMENTS IN CANADIAN CITIES.

CLASSIFICATION OF DATA AND OPINIONS FROM CITY ENGINEERS ON THE VARIOUS TYPES IN EXTENSIVE USE AND THEIR GENERAL SUITABILITY FOR DIFFERENT KINDS OF TRAFFIC — STATISTICS COMPILED BY *THE CANADIAN ENGINEER*

IT is very difficult to fix, with any degree of accuracy, a definite period for the life of a pavement or a definite conclusion as to its serviceability, especially as conditions vary so greatly in different cities and on different streets of a city. No two highway engineers may be expected to agree in their estimates concerning the value of different pavements for this reason. Considering, for instance, the question of durability, although there are many streets on which an ordinary pavement might be considered to be efficient for fifteen or twenty years, or even longer, there are many instances where the same pavement has been carefully laid and has not exceeded ten years in life-time. Again, a stone pavement may withstand heavy traffic for fifteen years, while, under a lighter traffic, and provided it is not opened too frequently, it should last thirty or forty years, if well laid. Such a great deal depends upon the nature of the traffic to which a pavement is to be subjected, that the problem of pavement selection is mainly one of acquiring a composite knowledge of the many present and future conditions to influence its wear. An investigation of traffic is manifestly an important preliminary upon which the success of a proposed pavement depends.

The Canadian Engineer has set about to ascertain an analysis of the pavement situation in Canada—the service which the more extensively laid pavements have given, and the opinions of the engineers as to their suitability for the traffic over them.

The information contained in this article shows conclusively that while the paving of city streets has not entirely passed the experimental stage, there is a marked tendency toward uniformity of opinion among city engineers in the matter of selection. (The pavements that have been laid during the past several seasons, especially, bear this out.) And, where their opinions are shown to differ from the generally adopted conclusions respecting certain pavements, it is to be remembered that many of these types in Canada have served but a short portion of their lifetime, and also that every city has its own peculiar conditions of traffic.

The observations contained herein tend to show that the most suitable pavement has not always been the one selected; and that in many cases, the selection rather than the pavement, is within the range of criticism. Thus, while it is necessary for those who have paving to do to acquaint themselves with the characteristics of the different materials, as they may do by observation, and from the volumes that have been written about them, it is also necessary to study carefully the trend of local civic expansion and traffic.

It is not to be expected, therefore, that the city or town engineer who is in a quandry as to the best pavement to lay on his next street will find solution in the opinions expressed herein; but, the choices which other engineers have made, and the manner in which their pavements are answering, will go a long way toward a satisfactory selection, after he has equipped himself with a well-defined knowledge of his requirements.

From Table I. an idea may be obtained of the extent of Canadian pavements. A grand total is not indicated as a few cities are not represented, while some have included the present season's development and others have not. Mileages of macadam and gravel roads, and of some of the lightly used pavements have also been omitted from this analysis, in order that the more largely used pavements might be more simply described.

Table II. comprises the deductions from present opinions of city engineers in the matter of comparative suitability for different traffic conditions. Here, again, one must bear in mind that these opinions are derived from experience with whatever pavements were first laid, and may not, therefore, conform entirely to what the engineer might advise had he the laying of the pavements to do again.

Opinions as to the nature of wear of pavements and its effect upon the general condition of streets are summarized in Table III. As each type has been used in various grades of traffic in different cities, as indicated in Table II., the conclusions respecting wear are also varied. Where, in one city, a pavement wears evenly, and in another develops holes, the assumption that the nature of the traffic is different is borne out by the data submitted, and in every instance the table expresses the nature of deterioration under the traffic to which it has been more widely subjected, rather than under the traffic for which it might be termed the ideal pavement.

The question of durability of any individual type is far from being satisfactorily answered in the approximate comparison given in Table IV. Traffic does not lend itself to strict classification, nor does it confine itself to the streets best suited for it. As the life of a pavement advances residential streets may become business streets or may develop into channels of dense traffic between business sections. Again, "small" repairs may be occasioned from foreign causes, while the stage where "complete reconstruction" is necessary frequently depends upon the number of times the pavement has been torn up for the laying of mains, etc. At any rate, engineers are not of one mind in the matter of durability of the various pavements in use, nor are the methods and materials of construction so uniform throughout the Dominion that all pavements enter the test for longevity on an equal basis.

Opinions Respecting Pavements in Use.

Asphalt Block.—The earliest report of this pavement being laid in Canada dates 1904. It is generally conceded to be a good pavement for residence streets, and for light traffic streets without car tracks, although several western cities report its favored use for heavy traffic, it is not so recommended by eastern city engineers. It

is a too recently accepted material for authoritative opinions as to durability. It has not always worn well wherever laid, having developed a tendency toward holes and cobbling, and there are instances where disintegration of the lower part of the block has caused trouble. It is likely to endure ten years of service without extensive repair, a few engineers making a more conservative estimate. Many cities mention cost as a prohibitive feature against more general use. When the block commences to wear at the edges, and the surface becomes roughened, it is hard to keep clean.

Asphaltic Concrete.—This is one of the youngest of the pavement family and engineers do not commit themselves as to its wearing qualities. We find no record of asphaltic concrete having been laid in Canada prior to 1909. It is suitable for light to heavy traffic with a tendency to wear into holes. Mr. A. F. Macallum, city engineer of Hamilton, reports its use on grades of from 3% to 7%—too steep for the use of sheet asphalt. On the steepest grades transverse grooves were cut across the pavement every nine inches to eliminate undue slipping in unfavorable weather.

Bitulithic.—This pavement dates from 1902 in Canada, in which year it was laid in London, where it has proved satisfactory, although Mr. W. N. Asphlant, the city engineer, recommends a concrete base for the best results with it. Chatham has had it in use for ten years and reports an even wear with a tendency to holes. Bitulithic is not so liable to markings in hot weather, as asphaltic concrete. Mr. W. A. Adams, assistant city engineer, Lethbridge, endorses the advantages of using a stretcher on streets with car tracks, both inside and outside the rails. Concrete with wire mesh reinforcement has been satisfactorily used for this purpose. Bitulithic appears to answer for all ordinary traffic. It has the advantage of being comparatively noiseless and easily cleaned, although a squeegee coat, frequently applied, makes cleaning a little difficult, and requires the pavement to have a slightly higher crown.

Fifteen years is claimed to be its approximate lifetime before extensive repairs are necessary, although several place this limit at ten years, and in each of these latter cases the pavement has already been down for nine years.

Brick.—Toronto laid brick pavement in 1895, and Chatham in 1896. "Good under all conditions," including steep grades, heaviest traffic and streets with car lines, expresses its efficiency in so far as durability is concerned. Its tendency to edge-wear produces cobbles and holes. On streets with car tracks it will last eight years or more before any repairs are necessary, if carefully laid. On streets with heavy traffic and without car lines this period is extended to fifteen years, while twenty-five years is a conservative estimate for light residential traffic. But no engineer recommends its use for quiet streets.

Mr. L. W. Rundlett, of Moose Jaw, reports laying this summer a vitrified brick pavement in a subway under a railway track. The brick is laid on five inches of concrete, with a sand cushion and grouted with a 1 to 1 Portland cement grout. He regards it as an exceedingly satisfactory pavement for this location.

Table I.—Mileages of Pavements in Some Canadian Cities and Towns.

CITY OR TOWN	Asphalt Block	Asphaltic Concrete	Bitulithic	Brick	Scoria Block and Stone	Sheet Asphalt	Untreated Wood Block	Treated Wood Block	Concrete
Berlin, Ont.	....	....	2.00	Car track allowance	....	....	....	....	....
Brantford, Ont.	0.05	....	2.98	2.08	....	....	....	....	0.20
Calgary, Alta.	....	....	12.30	....	....	29.90	....	4.50	4.10
Chatham, Ont.	2.00	....	4.60	3.80	....	....	Replaced	....	0.70
Edmonton, Alta.	....	being laid	12.50	....	....	5.50	1.50	....	....
Fort William, Ont.	1.76	....	....	....	....	0.54	....	0.30	....
Guelph, Ont.	2.27	....	....	0.81	....	....	....	....	....
Halifax, N.S.	....	....	3.00	....	1.50	2.00	....	....	....
Hamilton, Ont.	....	3.00	....	4.00	Street intersections	20.00	....	3.00	....
Kingston, Ont.	0.73	....	....	....	....	....	....	....	....
Lethbridge, Alta.	....	1.08	0.50	....	....	....	....	....	....
London, Ont.	0.38	0.24	2.17	1.02	....	4.97	....	....	....
Maisonneuve, Que.	....	....	....	....	....	....	....	....	2.50
Moncton, N.B.	....	....	....	....	....	....	0.75	....	....
Montreal, Que.	....	....	....	....	....	....	....	....	....
Moose Jaw, Sask.	....	....	....	0.57	....	0.67	....	11.80	....
New Westminster, B.C.	....	....	5.40	0.28	0.47	....	....	0.29	3.10
Ottawa, Ont.	....	....	0.65	....	0.57	23.90	....	0.41	....
Port Arthur, Ont.	2.16	1.18	2.12	....	....	2.76	....	....	0.12
Quebec, Que.	....	....	....	....	....	....	....	....	....
Regina, Sask.	0.72	....	9.31	....	....	6.20	2.10	....	1.45
St. Boniface, Man.	0.81	....	11.7	....	....	....	1.90	1.57	0.31
St. Catharines, Ont.	2.50	2.00	5.00	1.00	....	....	....	....	....
St. John, N.B.	2 bridge floors	0.50	....	0.16	....	0.15	3.00	....	....
Steelton, Ont.	....	....	....	....	....	....	....	....	0.66
Stratford, Ont.	1.10	....	1.0	1.40	....	....	....	....	....
Toronto, Ont.	6.30	being laid	37.72	29.07	2.16	157.03	....	8.77	....
Vancouver, B.C.	....	8.80	5.30	1.40	2.80	5.30	4.20	22.30	3.20
Victoria, B.C.	....	....	....	0.50	....	44.00	....	3.50	....
Walkerville, Ont.	2.31	....	0.38	....	....	....	1.25	....	1.50
Winnipeg, Man.	....	12.00	....	....	....	81.00	26.50	....	....

Brick worn to any extent is not easy to keep clean when revolving brooms are used, but cleans thoroughly if flushing is resorted to.

Sheet Asphalt.—In 1887 Toronto laid its first sheet asphalt and its 157.03 miles now in use indicate that it has been found generally satisfactory. Approximately 350 miles of it are now in use in Canadian cities. It appears to withstand all kinds of traffic well, wearing fairly evenly, with a tendency toward ruts and holes under heavy traffic. It is generally conceded to be a slippery pavement in wet and frosty weather, and requires frequent cleaning for best service. Mr. Arch. Currie, city engineer, Ottawa, states that for his city's requirements this pavement, properly constructed, is the best that can be used. Several cities report a little cracking, not serious, in their asphalt pavements.

No repairs are necessary during the first four or five years. If good sand is used in its construction sheet asphalt will last from ten years under fairly heavy traffic, to 16 or 20 years on residential streets, before reconstruction is necessary.

There is such a tendency to tear up streets for the installation of sewer mains, water and gas services, etc., with an uneven and unsightly patching as a result that quite a number make mention of it in commenting upon the durability of this pavement.

Wood Block.—This type of pavement is considered satisfactory on both residential and business streets. It it well adapted for the heaviest kind of traffic, and has the advantage of being comparatively noiseless. Its tendency, however, toward slipperiness in wet and frosty weather is quite marked.

Untreated wood blocks were laid in Toronto as early as the seventies. St. John, N.B., reports their use since 1880, and Winnipeg had wood block pavements in 1885. Untreated blocks decay rapidly and require replacement after four or six years of wear. Some cities have run traffic of all kinds over them for a slightly longer period, but on the other hand, several report the necessity of repairs after three years of use. Walkerville, Ont., used cedar block very extensively some years ago, but found them to last only five or six years before extensive repairs were necessary, in spite of careful attention to little defects, and of the fact that they were laid on concrete base.

Creosoted wood block pavement goes back about ten years only, in America, with native woods. Some pavements have thrived in New York and Boston for that length of time, and upon them there have been no repairs to date. Treated wood block has not been in use sufficiently long in Canada, however, for engineers to acquire an opinion of its durability. Several hazard a suggestion of fifteen years under heavy traffic, and twenty years under ordinary wear before any extensive repairs are necessary.

Most of Moose Jaw's pavement is creosoted wood block, three inches in depth and laid on a sand cushion. They receive a 16-pound per cubic foot treatment. They have answered well up to the present, except where water and frost has got beneath them. This occurs particularly along the street car tracks, but Mr. Rundlett advises laying the blocks in a cement grout to obviate this difficulty.

The more scientific methods of laying wood block pavement is bringing it into favor for Canadian city streets. Vancouver, Saskatoon, and other western cities appear to be giving this type of pavement a good deal of attention and preference. The Forestry Branch of the Department of the Interior recently issued a bulletin containing the following:—

"Best results are obtained from rectangular-shaped blocks cut from Southern or Norway pine which are thoroughly seasoned and creosoted. This latter process not only lengthens the life of the wood but reduces its absorptive capacity for water, thus preventing the weakening of the wood-fibres and reducing its tendency to buckle. The most approved method of laying this pavement used in London, New York and other large cities, is to first make a concrete foundation four or six inches thick on which is laid a thin layer of sand, or, better still, of moist Portland cement, into which the blocks are closely set.

"The blocks are from five to nine inches in depth and must be free from defects. Care must be taken to place them with the grain perpendicular to the road-bed. If laid with the long edges at right angles to the curb the joints are apt to become worn by the calks on the horses' shoes, so, to prevent this and to best provide for possible expansion, the paving is laid at an angle of about sixty-seven degrees with the curb. The joints are usually filled with ground cement and the surface of the paving is then covered with a thin dressing of coarse sand, which beds into the pores of the blocks and roughens them.

"Such a pavement has the smoothness of asphalt and will last almost without repair for fifteen years under

Comparative Value of Different Pavements.

Pavement.	Per-centage.	Granite.	Sand-stone.	Asphalt (sheet).	Asphalt (block).	Brick.	Macadam.	Creosoted wood.
Cheapness (first cost)	14	4.0	4.0	6.5	6.5	7.0	14.0	4.5
Durability	20	20.0	17.5	10.0	14.0	12.5	6.0	14.0
Ease of maintenance	10	9.5	10.0	7.5	8.0	8.5	4.5	9.5
Ease of cleaning	14	10.0	11.0	14.0	14.0	12.5	6.0	14.0
Low traction resistance	14	8.5	9.5	14.0	13.5	12.5	8.0	14.0
Freedom from slipperiness (average of conditions)	7	5.5	7.0	3.5	4.5	5.5	6.5	4.0
(A) Favorableness to travel	4	2.5	3.5	4.0	3.5	3.0	3.0	3.5
(B) Acceptability	4	2.0	2.5	3.5	3.5	2.5	2.5	4.0
Sanitary quality	13	9.0	8.5	13.0	12.0	10.5	4.5	12.5
Total No. points	100	71.0	73.5	76.0	79.5	74.5	55.0	80.0

A.—Favorableness to travel is dependent chiefly upon smoothness and freedom from dust and mud; secondarily upon the qualities composing "Acceptability."

B.—Acceptability includes noise, reflection of light, radiation of heat, emission of unpleasant odors, etc. It chiefly concerns the pedestrian and the adjoining resident.

ordinary conditions. It is sanitary, noiseless, easily kept clean and has a certain springiness lacking in asphalt, and is much easier on horses' feet. Expert labor is not required in its laying and the cost of maintenance is practically nil, so that from the standpoint of cost as well, it compares favorably with the asphalt, macadam and brick now being used in Canadian towns and cities."

It is interesting to note that Minneapolis is laying approximately 215,000 sq. yds. of pavement this summer, over 82% of which is creosoted wood block.

Scoria Block.—This type of pavement is wearing lightly and evenly in Toronto, and is satisfactory for most kinds of traffic. Hamilton paved some street intersections in 1899 with this block, but replaced them later with wood block. Ottawa's scoria block pavements is wearing into holes, but Mr. Currie attributes this to a possible use of poor concrete on soft sub-grade, when the pavement was put in place. Scoria block appears to possess disadvantages due to slipperiness in unseasonable weather, and noise at all times.

Toronto has stone pavements in use since 1881. They are cobbling but are indicative of indefinite wear.

Concrete.—Concrete pavement is of comparatively recent date, no report indicating its use in Canada prior to about five years ago. One feature of the opinions concerning it is its durability. Many cities have begun its use but no repairs have been necessary, especially if carefully laid. The general expression of engineers upon this pavement is one of favor and satisfaction for residential streets and moderately heavy traffic. Mr. Owen McKay, town engineer, Walkerville, Ont., advises the use of reinforcing at the expansion joints, and several suggest continuous reinforcing throughout with steel plates at the joints. The pavement is very easily cleaned with broom or flusher. Chatham reports that a pavement put down in 1908 has cracked longitudinally with the street, and is wearing at the juncture of the crack with the expansion joints. No repairs have yet been made, but it is the intention to fill these cracks with asphalt at an early date.

The durability of concrete pavements is illustrated by a recent press reference to a road from Detroit to Dearborn, ten miles in length, constructed of macadam, asphalt macadam, and concrete. Here it was found that the concrete pavement which had been in use for about four years was greatly superior in surface to the others, which had not been in service for more than half that period. In another instant a piece of macadam laid less than a year ago at a cost considerably exceeding that of concrete, was in a much inferior condition to a strip over the same territory constructed of small stone and concrete some four years ago, and it is claimed that no road in Michigan excels this particular piece of concrete pavement. Concrete roads have proved so successful in Wayne county, Michigan, that hardly any other kind is now being laid.

Some Opinions From United States.

We quote the following from a number of letters which have furnished us with information concerning the use of various pavements in cities of the United States.

Capt. Mark Brooke, U.S. Corps of Engineers, and assistant to the Engineer Commissioner of the District of Columbia, expresses his belief that sheet asphalt should be expected, under ordinary conditions, to attain a life of approximately twenty to twenty-two years, although in some instances in Washington it runs over thirty years. He believes that asphalt block, if well laid, should approximate the same life. They have more sheet asphalt in that city than any other type, and on the whole it is as satisfactory as any.

Mr. Wm. H. Connell, chief of the Bureau of Highways and Street Cleaning, of Philadelphia, considers asphalt as a very desirable pavement on ordinary medium traffic streets where grades are not too heavy. He is putting in wood block pavements on streets with very heavy traffic, especially where it is desirable to have a quiet pavement and where a finely dressed granite block pavement would be too noisy, and is finding it very satisfactory under such conditions. Sheet asphalt is being used very largely in Philadelphia, as is shown by the following statement of mileage and yardage of the various types in use:—

Character.	Miles.	Sq. yds.
Granite block	352.99	6,653,532
Asphalt (sheet)	472.35	6,959,656
Asphalt (block)	7.49	72,532
Vitrified brick	163.63	2,376,224
Cobble	14.02	162,775
Rubble	6.69	93,182
Slag block	8.13	78,071
Cement and granolithic	11.03	54,242
Wood block	4.06	121,505
Totals of improved pavements	1,040.39	16,571,719

Mr. John B. Hittell, chief engineer of streets, Chicago, estimates the life of the various pavements principally used there to be as follows:—

Asphalt	12 to 15 years
Brick	12 to 15 years
Creosoted block	15 to 18 years
Granite blocks	30 to 40 years

Chicago has laid, up to the present time, more asphalt pavement than any other type. Under normal conditions granite block is considered the most durable for heavy traffic and asphalt for light traffic.

Mr. Nelson P. Lewis, chief engineer to the Board of Estimate and Apportionment, of New York City, states that the average life of an ordinary sheet asphalt pavement in the borough of Manhattan may be considered to be fifteen years, and about eighteen years in other boroughs. Asphalt is very extensively used, probably more than all other types of pavements combined. It is found most suitable for resident streets and where it is difficult to maintain good sanitary conditions.

Next to this comes stone block which, if well laid, should withstand very heavy traffic for at least twenty years, and under lighter traffic, unless frequently torn up for the laying of mains, etc., it should last thirty years or more. If laid on a concrete foundation it is found to be most suitable for very heavy traffic, although wood block has been found to be the satisfactory pavement on light grades. Of this type he does not express an estimate of its life as it has not been in use sufficiently long. There is every indication, however, that if well laid and not disturbed it will be as durable as stone block.

The United States Bureau of Agriculture issued a bulletin this summer containing, as a result of an enquiry as to the opinions of a number of city engineers in the United States, the following table, in which under the percentage column the various qualities desired in a pavement are assigned proportionate values, the total being 100 points. The pavement ranking first under any given quality is given the full quality percentage, the rest grading down from this value in proper proportion.

Returning to our Canadian cities, Mr. A. F. Macallum, city engineer of Hamilton, Ont., states that the standard pavements used there are wood block, asphalt, and a form of asphalt-macadam. Brick is used only in alley-ways. Sheet asphalt exceeds other types in quantity and is considered the best under normal conditions. It is used on light traffic streets, except on grades exceeding two per cent., where asphalt-macadam is laid instead. For very heavy traffic wood block is used.

Concerning the life of the asphalt pavement, Mr. Macallum states that it is very difficult to arrive at an estimate unless the conditions specified in its construction are very carefully followed. Some pavements of this type have been down for fifteen years and are in excellent condition, while others, down for only three years, are not in good condition, due principally to a poor mixture of sand used. The principal difficulty experienced there has been in securing a good, clean combination sand that will give a sufficiently dense pavement. Mr. Macallum holds this to be a most important thing in asphalt pavement work, as at present the asphalt itself is made to such a standard that, if the proper penetration is used, there is no danger in that proportion of the pavement.

He cites an experiment on one pavement of using no binder, but described it as unsuccessful, as the pavement moved and formed an undulating surface under traffic.

Judging from the manner in which treated wood block pavement, which has such a comparatively recent history, has stood the test of the heaviest traffic in that city for the past four years, Mr. Macallum places its life at what he considers to be a very conservative estimate, 10 years.

He adds that asphalt-macadam and other pavements of that nature depend for their lives altogether upon the hardness and toughness of the stone, which will vary a great deal according to the vicinity from which the stone is secured, the limestone from their own quarries being too soft for such a purpose.

Table II.

Opinions of Canadian city engineers concerning the suitability of various pavements as they have been used for different conditions of traffic. (Arranged in descending order of present popularity):—

Light Residential to Semi-Business:
Sheet asphalt, bitulithic, asphalt concrete, asphalt block, wood block, concrete.

Semi-Business to Medium Heavy Traffic:
Bitulithic, sheet asphalt, asphaltic concrete, wood block, asphalt block, concrete.

Heavy Traffic:
Brick, wood block, stone, and scoria block.

Along Street Railway Tracks:
Wood block, brick.

Quiet Streets:
Wood block, bitulithic, sheet asphalt, asphaltic concrete.

Graded Streets:
Brick.

The city of Winnipeg has more sheet asphalt pavements than all others combined, and it is considered the best pavement for the city's use from all points of view. The first asphalt pavements were laid in 1897, one upon a residential strees, and one in the heart of the wholesale district. Both are still in perfect condition. In 1911, pavements consisting of two inches of asphaltic concrete on a 4½-inch cement concrete base were laid. Mr. H. N. Ruttan, city engineer, states that no pavement will withstand heavy traffic in Winnipeg without concrete foundations. Cedar block has been used principally in lanes, where it is standing seven to ten years' wear.

Table III.—Opinions as to Nature of Deterioration.

Asphalt Block:
Edge-wear forming holes and cobbles; worn pavement noisy and hard to keep clean; disintegration of bottom of blocks.

Asphaltic Concrete:
Wears into holes; susceptible to marking in hot, sunny weather.

Bitulithic:
Wears evenly, with a tendency to holes under heavier traffic; susceptible to surface marks in hot weather.

Brick:
Edge-wear and cobbling under heavy traffic; increased noise and unsanitariness as wear increases; when worn badly it slows down traffic.

Sheet Asphalt:
Wears slowly into large holes or patches; heavy traffic causes ruts; cracks hasten deterioration.

Wood Block:
Rots rapidly if untreated, retarding traffic; treated block wears slowly and evenly; frost intrusion causes buckling.

Stone and Scoria Block:
Wears gradually into holes and cobbles; unsanitary when roughened.

Concrete:
Wear is slow and even if well placed; cracking and chipping develop otherwise.

The Bonding of Pavements.

There is a wide diversity among Canadian municipal authorities as to the number of years that each type of pavement should be bonded, asphalt block, for instance, being subject to bond requirements extending from five to twenty years although, generally speaking, its lifetime is not expected to exceed more than twelve or fifteen years. In the majority of instances a five-year bond is the policy followed for all types of pavement; some of the larger cities, however, requiring a ten-year bond on most of them. Regina, previously ten years, has reduced its requirement to five; St. Boniface, Man., on the other hand, requires a bond extending twenty years. In the case of London the majority of bonds has been for ten years, but as the Guarantee Companies now decline to bond contractors beyond five years one is taken for that length of time for sixty per cent. of the amount of the contract, the contractor still requiring to guarantee his pavement for ten years, the city retaining six per cent. of the contract price for that period and paying annually the contractors' interest on the guarantee, providing the terms thereof are complied with.

In Ottawa ten per cent. of the contract price is held as guarantee for ten years, the average lifetime of asphalt and wood block pavements being considered fifteen years and Nepean stone and Scoria block pavements twenty years. In Toronto, fifteen per cent. is withheld for ten years.

Table IV.—Consensus of Opinion as to Durability.

Pavement.	Small repair. Years.	Extensive repair. Years.	Complete reconstruction. Years
Asphalt block	5 to 10	10 to 12	12 to 15
Asphalt concrete	4 to 6	6 to 8*	8 to 10*
Bitulithic	5 to 8	10 to 15	15 to 20
Brick	8 to 10	10 to 15	15 to 18
Concrete	5 to 8	10 to 12	15 to 18*
Scoria block and stone	10 to 15	15 to 20	20 to 30
Sheet asphalt	4 to 8	10 to 15	15 to 18
Untreated wood block	3 to 5	6 to 10	10 to 12
Treated wood block	8 to 10	12 to 15	15 to 18*

*These pavements have not attained an age in Canada sufficient to place the figures beyond conjecture.

Financing of Pavements.

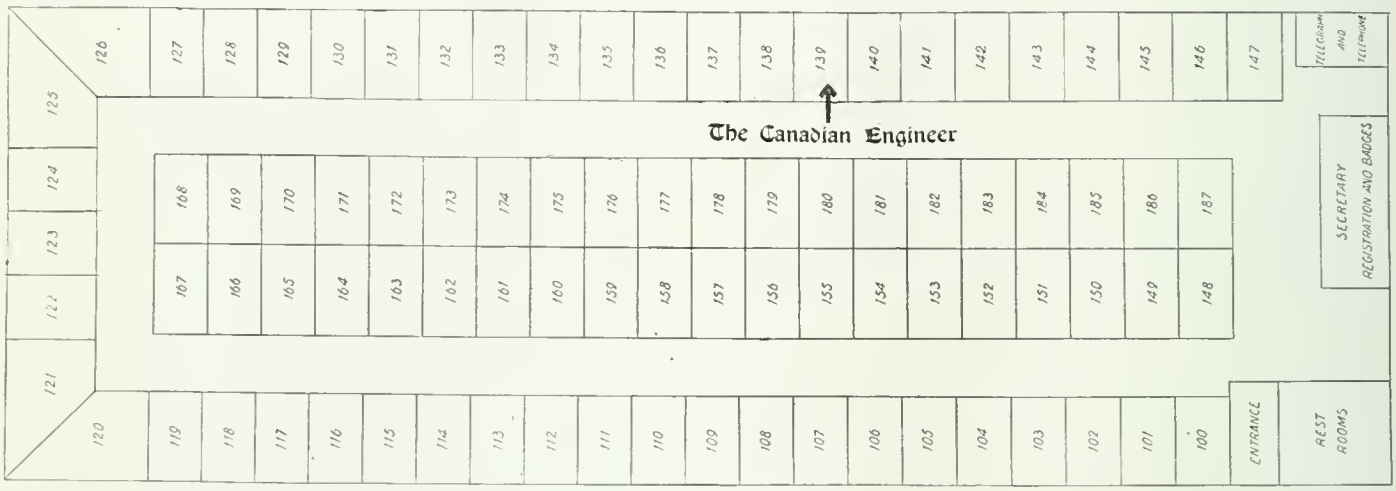
Hamilton does all its paving by day labor and, estimating the life of a pavement at ten years, bonds are issued against them for that length of time. In Toronto ten years is also considered as a fair estimate, and ten-year debentures are issued to finance them. In Winnipeg practically all paving is done by day labor. The money for paving is secured in all cases by the sale of thirty to fifty-year stock, i.e., the city may redeem any time after thirty years to fifty years. The term of assessment on sheet asphalt pavements is fifteen years, on asphaltic concrete, ten years; on cedar block pavement, seven years.

It is interesting to note that the city of New York has assessed the entire cost of the first pavement upon the abutting property and has paid from city funds the cost of all subsequent renewals, raising money for this purpose by the issue of fifty-year bonds. This policy is discussed at considerable length in the report of the Board of Estimate and Apportionment for 1912. Since then, however, the city has decided to limit to ten years the bonds issued to meet the costs of re-paving.

Washington's pavements are paid for in cash under appropriations made by Congress, the funds being derived from revenues of the District of Columbia, and a contribution on the part of the General Government on the basis of its ownership of property.

Philadelphia and Chicago issue five-year bonds against their pavements of various types.

THE CANADIAN ENGINEER AT THE DETROIT ROAD CONGRESS.



Plan of Exhibition Building.

The Canadian Engineer will exhibit at the Third American Road Congress at Detroit. Canadian visitors to the Congress are invited to make Booth No. 139, *The Canadian Engineer* headquarters, their headquarters also, during the week. Mail, telegrams, packages, etc., may be addressed care of *The Canadian Engineer*, Booth 139, American Road Congress, Wayne Gardens, Detroit.

NEW YORK'S PROBLEM OF SEWAGE DISPOSAL.

The pollution of New York harbor by the sewage from the metropolitan district has been gradually increasing, and it is recognized that steps must soon be taken to correct the conditions. In 1906 the New York State Legislature passed a bill requiring the city of New York to appoint the Metropolitan Sewerage Commission to study the pollution of the harbor and devise a proper method of correcting the conditions. The magnitude of the work of this commission may be realized when it is understood that the area studied is some 700 square miles, with a present population of about 6,000,000, and a future population of about twice this figure. Within the metropolitan district there are over 100 cities and towns, and the sewage produced is about 765,000,000 gallons per twenty-four hours. It is assumed that within thirty years the daily volume of sewage flow will be increased to 1,500,000,000 gallons. Of course, the volume of water in the harbor will not increase to furnish available dilution, and unless proper provisions is made for treatment of the sewage, a general intense pollution of the harbor is inevitable. The scope of the work of the Metropolitan Sewerage Commission includes a study of the facts and the formulation of a remedy for the existing and future conditions. As the work has progressed it has been found that the problem is of much greater magnitude than was at first anticipated, and several years' further study may be required before a final decision is reached.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

CONTENTS.

Book Reviews:

The Elements of Specification Writing; Reviewed by C. R. Young, B.A.Sc. 509

Simplified Formulas and Tables for Floors, Joists and Beams; Reviewed by C. R. Young, B.A.Sc. 509

The Improvement of Rivers 510

Engineering as a Profession 510

Catalogues Received 511

Publications Received 511

BOOK REVIEWS.

The Elements of Specification Writing.—By Richard Shelton Kirby, C.E., Professor of Civil Engineering, Pennsylvania College. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Publishers' agents for Canada, Renouf Publishing Company, Montreal. Cloth, 6 x 9 ins.; pp. vii. + 125. Price, $1.25 net.

Reviewed by C. R. Young, B.A.Sc.

Although a number of excellent works on the subject of engineering contracts and specifications have been issued within the past few years, Professor Kirby's book easily surpasses any of them as a text for students or beginners in the art of specification writing. The ground covered in it is only such as should receive attention in an engineering college, and the manner of presentation leaves little to be desired. This excellence of treatment is no doubt largely due to the fact that the work is the outcome of a series of lectures delivered by the author annually for the past six years.

An outline of the matters treated will indicate the comprehensive character of this compact little treatise. As an introduction to the subject, construction work is classified according to the character of the financial arrangement between the Owner and the Contractor, and the documents incident to a contract are enumerated and described in brief. The author then proceeds to discuss the legal essentials and the composition of a contract, the surety bond, the notice to contractors, information for bidders, and the proposal. Since the specifications are, to the engineer, the most important part of the contract, the author very properly devotes the major portion of his book to the consideration of their composition and subject-matter. General clauses are treated fully, a proceeding rendered possible by the fact that their character has been the cause of a strong movement towards uniformity during recent years. Specific clauses covering all manner of construction, materials and apparatus cannot be treated in anything but a general manner in a short text, and for this reason the author has contented himself with a few pages of general directions and the outlines of specific clauses required in specifications for sewers, roads and pavements, pipe lines, bridges and similar typical undertakings. The work is concluded by a useful list of references in periodical literature to the subject of contracts and specifications.

The value of Professor Kirby's book lies chiefly in its being a concise, well-ordered presentation of the principles underlying the preparation of specifications. It is not a collection of specifications, nor a legal treatise, but such a book as might be placed in the hands of an engineering student to give him an idea of what is really meant by specification writing. Sufficient examples are given to illustrate the principles and to serve as models, except in the case of the specific clauses, where, for considerations of space, this is not done. Reference to the pages of high-class technical journals, for these in reality introduce another educative factor commensurate with the knowledge of the particular subject obtained. The manifest fitness of this little book as a text for engineering colleges will no doubt result in its extensive adoption for that purpose.

Simplified Formulas and Tables for Floors, Joists and Beams; Roofs, Rafters and Purlins.—By N. Clifford Ricker, Professor of Architecture, University of Illinois. Publishers—New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Publishers' agents for Canada, Renouf Publishing Company, Montreal. Cloth; 6 x 9 ins.; pp. vi. + 77. Price, $1.50 net.

Reviewed by C. R. Young, B.A.Sc.

Like his larger work on roofs, this book of formulas and tables was evidently intended by the author for the use of architectural students and beginners in structural design. The structural engineer will find in it little which he has not already in one form or another. In some instances the methods of computation are much less expeditious than those in common use by structural designers.

The work which the author undertakes is to present simplified formulas for the computation of the section moduli, moments of inertia, total safe loads and limiting spans of beams in various materials and subject to various end conditions. Simplification is brought about by expressing lengths and distances in feet, loads in tons, constants for the material in tons per square foot and bending moments in foot-tons. The numerical coefficients are thus reduced to comparatively small quantities, rendering slide-rule computations easy and short. The resulting formulas are then arranged in tables extending across both pages, and covering the use of steel, cast-iron, Washington fir, hemlock, white oak, long-leaf pine, short-leaf pine, white pine and spruce. Preceding these tables are thirty pages of explanatory matter, and following them are tables or properties of cast-iron lintels and a table of four-place logarithms for those who do not use the slide rule. The application of the formulas to the design of floor joists, flooring, sheathing, rafters, purlins and lintels is made plain by examples.

Although the subject-matter is well presented in the main, certain indications of lack of care in preparation exist. On page 1, l is defined as the *clear* span in inches of the beam, while on page 4, L, which is obviously $l \div 12$, becomes

the "length of beam in feet, or distance between *centres* of beams." In the example on page 3, the required moment of inertia on the basis of limiting deflection is computed without stating for the guidance of the student what the maximum permissible deflection is in this case. The following beginning to a sentence is not particularly auspicious: "Also, that if these formulas can be materially simplified, much time and labor can be saved, and it may become . . ."

Apart from the cases which can be solved much more simply by reference to tables in existing handbooks, the matter presented in Professor Ricker's book will be found useful for the architectural draughtsman and junior structural designer, provided no building regulations prevent the adoption of the working stresses on which the simplified formulas are based. Where this does occur, some assistance may be obtained by deriving new simplified formulas from the general formulas which the author gives.

The Improvement of Rivers: A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by Means of Locks and Dams.—By B. F. Thomas and D. A. Watt, United States Assistant Engineers. Published by John Wiley & Sons, Inc., New York. Publishers' agents for Canada, Renouf Publishing Company, Montreal. Second edition, two volumes; 713 pages of text, 346 illustrations and 84 appended plates; cloth; 9 x 12 ins. Price, $7.50 net.

There are eighteen chapters in all having the following titles:—

Part I.—Characteristics of Rivers—Regulation—Dredging and Snagging—Dikes—Protection of Banks—Levees—Storage Reservoirs—Improvement of the Outlets of Rivers.

Part II.—General Design and Construction of Locks and Dams—Locks—Lock-gates and Valves—Fixed Dams— Movable Dams—Chanoine Wicket Dams—Gate and Curtain Dams; Bridge and Shutter Dams—Drum Wickets, Bear Traps, Rolling Dams—Accidents to Structures.

Both volumes are models of typographical excellence, and the editing and arrangement of subject-matter is admirable. One pleasing feature is an unusually complete system of cross-referencing, which enables the reader to find expeditiously all that the work contains with reference to any particular subject.

This book is remarkable in that it epitomizes world-wide engineering practice in river regulation and improvement. The method of treatment is distinctly practical throughout, and the chief merit of the books lies in the multitude of practical ideas which the encyclopedic scope of the work makes accessible to the reader. While there is much in both volumes of interest to hydraulic engineers generally, the nature of the subject dealt with makes them particularly valuable and interesting to engineers engaged on governmental and other public works. To them the book is confidently recommended.

The first volume consists of eight chapters, devoted principally to the discussion of river improvement for open navigation, "Improvement by Regulation" being the subtitle of this portion of the work. Chapters I. and II. are of an introductory nature, containing a more or less academic discussion of river characteristics, and a brief description of various schemes of regulation in use on the larger rivers of Europe and America. The remaining chapters, as their titles indicate, are devoted to the discussion of the various methods now in use for providing and maintaining open navigation on navigable streams. In Chapter X. the principles which govern the economic use of storage as an aid to navigation are covered in a general way.

As related to navigation alone, there is nothing in the first volume of vital interest to Canadian engineers, as it deals almost exclusively with navigation on silt-bearing streams, notably the Mississippi, and problems of this nature are rare north of the international boundary. The value of the first volume lies rather in the fact that the various metrods outlined for the improvement of open navigation can be effectively and economically applied to the prevention of flood damage on non-navigable rivers.

Volume II. consists of ten chapters covering river improvement by means of locks and dams, "Improvement by Canalization" being the sub-title. Chapter I. is devoted to general discussion of the principles of design. The succeeding chapters, entitled as above, cover the subjects dealt with more or less in detail. Most of the chapters furnish cost data, and also a considerable amount of mathematical discussion.

The chapter on fixed dams is too brief to be of much value, the intention of the authors being doubtless to indicate, in a general way only, the functions of fixed dams in connection with canalization, rather than enter into the details of a wide subject already well covered by Wegmann Schuyler et al.

The chapters on movable dams constitute the most interesting and important feature of the second volume, the various types now in use in Europe and America being described at length and amply illustrated.

The possibility of using this type of dam in Canada for the development of mill powers on torrential rivers is worthy of very serious consideration, and it is safe to say that no single publication extant contains more information bearing on this question than the work under consideration.

Engineering as a Profession: Scope, Training, and Opportunities for Advancement.— A. P. M. Fleming, M.I.E.E., and R. W. Bailey, Wh. Sc., Principal of the Technical Institute, Crewe, England. Published by John Long, Limited, London. 288 pp.; 4½ x 7½ ins.; cloth. Price, 75 cents, post paid.

"While much has been written as to the manner in which the technical and practical portions of an engineer's training should be co-related so as to ensure the best results, very little has previously been written setting forth the facilities that actually exist for obtaining the most satisfactory training and employment."

The book sets about to supply this deficiency by giving a broad, general outline of the fields of engineering activity, by discussing modern methods and facilities for obtaining a thorough training, and by enumerating suitable apprenticeship courses and scholarships for those who are and those who are not in possession of sufficient means for a university training.

It must be admitted that the major portion of the book deals exclusively with conditions and facilities for training in the British Isles, thus rendering its value to young men elsewhere as that for general information only. But its clear-cut classification of the various channels which a young engineer may follow up makes it a most acceptable addition to his library. The chapters concern: The Engineering Profession; The Training of the Engineer; Facilities for Obtaining Education and Training for a Minimum Financial Outlay; Engineering Appointments; Foreign Methods of Training Engineers; and Modern Developments in Engineering Training and Employment.

The curriculums of English technical institutions, the enumeration of Government and professional appointments, and the summary of apprenticeship courses for various branches of the profession, contained in this book, make it a useful one for university and professional men in any country.

CATALOGUES RECEIVED.

The Valve World.—Illustrated bulletin for the month of August. Issued by the Crane Company, Chicago.

Duntley Electric Grinders.—Illustrated bulletin. Issued by the Chicago Pneumatic Tool Company, 1010 Fisher Building, Chicago, Ill.

Foos Junior.—Illustrated catalogue dealing with gas and gasoline engines. Issued by the Foos Gas Engine Company, Springfield, Ohio.

Q. E. F. Runway.—Illustrated catalogue describing runway. Issued by the Herbert Morris Crane and Hoist Company, Limited, Toronto.

American Vanadium Facts.—Illustrated bulletin describing different uses of vanadium. Issued by the American Vanadium Company, Pittsburg, Pa.

Abram Cement Tools.—25-page catalogue describing the company's sidewalk finishing tools. Issued by the Abram Cement Tool Company, Windsor, Ont.

Universal Bulletin.—Describing pouring of concrete for the Ford Motor Service Building, Chicago. Issued by the Universal Portland Cement Company, Chicago, Ill.

Adjustable Speed Direct Current Motors.—Technical bulletin describing company's adjustable speed direct current motors. Issued by the General Electric Company, Schenectady, N.Y.

Chicago Pneumatic Power-driven Compressors.—Illustrated bulletin describing the different kinds of compressors. Issued by the Chicago Pneumatic Tool Company, 50 Church Street, New York.

Curtis Steam Turbines.—15-page illustrated catalogue describing the Curtis steam turbines, from 100 k.w. to 2,500 k.w. capacity for driving 60-cycle generators at 3,600 revolutions per minute, special features of construction and steam extraction. Issued by the General Electric Company, Schenectady, N.Y.

Continuous Current Dynamos and Motors.—A pamphlet, No. 18 B, of Bruce, Peebles & Company, Limited, Edinburgh, dealing exclusively with machines of the open type, including a full detailed specification and supplemented by tables of weights and dimensions for different frame sizes, list of ratings, etc. The publication is well illustrated and contains interesting technical data. Bruce, Peebles & Company, Limited, engineers, Edinburgh, Scotland.

The Heenan Refuse Destructor.—A 32-page catalogue dealing with the disposal of garbage, rubbish, etc., by the H. & F. Destructor. The catalogue is well illustrated with photographs of many installations in Canada, United States and Great Britain, some of them having the capacity of several hundred tons. Reading matter is instructive respecting modern methods of refuse collection and disposal, and illustrated uses to which clinkers produced by the H. & F. destructor may be put in building operations, etc. Published by Heenan & Froude, of Canada, Limited. Laurie & Lamb, managers, Board of Trade Building, Montreal.

PUBLICATIONS RECEIVED.

Fur Farming in Canada.—By J. Walter Jones, B.S.A. Published by the Commission of Conservation, Canada. Committee on Fisheries.

Ontario Railway and Municipal Board.—Seventh annual report to December 31st, 1912. Issued by the Ontario Railway and Municipal Board, Toronto, Ont.

Employers' Welfare Work.—Bulletin No. 123. Issued by the United States Department of Labor Bureau of Labor Statistics, Washington, D.C.

Fourscore Years.—Illustrated publication, containing a record of the company's contribution to industrial engineering. Issued by Lockwood, Greene & Company, 60 Federal Street, Boston, Mass.

Fifth Census of Canada, 1911.—Volume III., pertaining to manufacturers for all the industrial establishments having five employees or over. 432 pages, 6 x 9 ins.

Ontario Land Surveyors.—Annual report of the Association and proceedings of the twenty-first annual meeting, held in Toronto, February last. Published by the Association of Ontario Land Surveyors.

Tar and Wood Journal.—Special by-product number, which may be obtained by any reader interested in the wood, tar and allied trades on application to the Swedish Chamber of Commerce, 5 Lloyd's Avenue, London, E.C.

Union Scale of Wages and Hours of Labor.—120-page bulletin on scale of wages and hours of labor from 1907 to 1912. Issued by the United States Department of Labor Bureau of Labor Statistics, Washington, D.C.

Electricity on the New York Central.—Descriptive booklet, which illustrates and describes the important features of electricity as used by the New York Central system. Issued by the General Electric Company, Schenectady, N.Y.

Mining Operations in Quebec Province.—Report for 1912 of the Mines Branch, Department of Colonization, Mines and Fisheries, Province of Quebec, reviewing the entire industry for the past year. Supplemented with illustrations, maps and appendix.

Mines and Mining.—Bulletin No. 61, containing abstracts of current decisions on mines and mining from October, 1912, to March, 1913, by J. W. Thompson. Issued by the Department of the Interior, Bureau of Mines, Washington, D.C.

Game and Fur-bearing Animals.—A 166-page book, 6 x 9 ins. in size, and fully illustrated with photographs and maps, descriptive of fur-farming in Canada, and containing sections devoted to preparation of skins for manufacture, commerce in raw furs, Canadian legislation, and statistics of fur production.

Mining Operations in Quebec.—Report for the year ending December 31st, 1912, by Theo. C. Denis, Superintendent of Mines. Contains statistical tables and a review of the mining industry in the Province of Quebec. Issued by the Mines Branch, Department of Colonization, Mines and Fisheries, Ottawa.

Waterworks of Canada.—Compiled by L. G. Dennis, B.Sc., Hydro-Electric engineer of the Commission of Conservation. Published by the Commission, Committee on Waters and Water Powers. Presenting in suitable form for reference principal physical data respecting all waterworks systems in existence in the Dominion, and classified according to Provinces. The report is illustrated, and occupies 108 pages, 6 x 9 ins.

CANADIAN FIRM BUYS AMERICAN FACTORY

By adding to their factory, at one stroke, the entire equipment of another telephone cable-making factory, the Eugene Phillips Electrical Works, of Montreal, have greatly increased their capacity. The Phillips company completed recently the building of a quarter of a million dollar extension to their Montreal plant, and then equipped it by installing all of the machinery that had been previously used by the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, New York, in their telephone cable-making branch. This branch of the Stromberg-Carlson business was purchased outright by the Montreal firm.

The Eugene Phillips Electrical Works have been making telephone cable for about twenty-five years, but the addition of the Stromberg-Carlson machinery gives them sufficient output to handle very large contracts.

COAST TO COAST.

Winnipeg, Man.—A resolution introduced by H. D. Picket, Moose Jaw, at the recent convention of the Associated Boards of Trade of Western Canada, asking that the Dominion Governments of Ontario, Manitoba, Saskatchewan and Alberta provide for the construction and maintenance of a good vehicular highway between the Great Lakes and the Pacific Coast was passed unanimously, it being considered that such a road was needed, and would help the commercial and general interests of the country.

Kenora, Ont.—The engineers of the International Joint Commission, Arthur V. Arthur, Toronto, and A. F. Myers, Minneapolis, accompanied by Douglas N. McLean, of the Manitoba Hydrographic Survey, have examined the evidences relating to water levels here, and have inspected the new gauges which have been established. Arrangements were also made to start some survey parties from Kenora to examine places bordering on the shore of the lake, which might be affected by holding the water of the lake at various stages. Survey parties will begin operations at once.

Ottawa, Ont.—The whole question of the pollution of lakes, rivers and all navigable streams will be considered by an interprovincial conference, to be held in Ottawa in October. The Bradbury committee on the pollution of streams, which heard considerable evidence from experts and others on the matter last session, recommended a conference to discuss all phases of the question, at which all the provinces would be represented, and Hon. J. D. Hazen, Minister of Marine and Fisheries, has sent out an invitation to the various provincial governments asking that this be done. It is expected that the conference can be got together in October.

Vancouver, B.C.—That the Canadian Northern Railway engineers had puzzled over every possible entrance to False Creek, and that all plans were being forwarded to headquarters in Montreal were the statements made by Mr. T. G. Holt, executive agent of the company, to the civic bridges and railways committee. Whatever plan was thought most feasible would be submitted to the Railway Commission, and, with other obstacles out of the way, work could be started in a few weeks. Mr. Holt explained that getting over the Great Northern tracks was the problem they had been up against. To use an overhead crossing or a subway raised difficulties of grade, and the Railway Commission would hardly likely consent to a level crossing, although, Mr. Holt said, that would facilitate matters considerably. As to the filling in of the bed of the creek, Mr. Holt said it would be necessary to know the plans of the Sewerage Commission for the route of the China Creek extension. Ald. Crowe, Vancouver's member of the Sewerage Commission, however, informed him that the Commission was taking up that question now and would have details worked out at an early date. It is the Commission's intention to run the sewer down Clark Drive instead of through the creek. Mr. Holt wished to have a coffer dam built across the creek to keep the silt in, and this will be looked into. A report of Mr. C. A. P. Turner, engineer for the Georgia-Harris bridge, stated that hard footings had been found five feet higher than expected, and that a saving of $1,200 could be effected. Plans of the ground are being got out, however, before the committee agrees to change.

Toronto, Ont.—The Provincial Highways Commission will begin its peregrinations at once in the interest of good roadways in Ontario. New York State will form the basis of study, although the first observations will be made in Quebec. Mr. W. A. Maclean will meet Commissioners McGrath and Rankin in Montreal, and the party will go over the King Edward Highway, which runs south of Montreal to the international boundary at Rouse's Point. This road is some forty miles in length. It is being constructed by the Quebec Government and will be completed this fall. Quebec has a Provincial highway system, under which the Government supplies the township organizations with machinery, equipment and instruction, but with slight financial assistance. When the Commission arrives at Albany an extended conference will be held with Mr. John N. Carlisle, Chief Superintendent of State Highways. The New York system follows the French method of maintaining a central highway department, which extends assistance to the municipalities. The main arteries of traffic are built by the State with small contributions from the counties.

Edmonton, Alta.—Most important of the legislation to be taken up at the coming session of the Alberta Legislature probably will be the building by the Provincial Government of the Alberta and Great Waterways Railroad from Edmonton to Fort McMurray, 230 miles, from which point the Athabasca, the Great Slave and the Mackenzie Rivers are navigable to Fort McPherson, 2,100 miles. The primary purpose of the railway is to afford adequate transportation facilities to settlers, prospectors and trappers in the north country and provide an easy outlet for their products, including grain, minerals and fur. The estimated value of the raw fur trade of the north alone is a matter of between $6,000,000 and $6,500,000, of which about 50 per cent. has come out by way of Edmonton this year, the rest going to the United States through traders from Seattle and San Francisco, who send ships into the Behring Sea and to Herschell Island. "There are many reasons why the railroad should be built to Fort McMurray at once," said a prominent supporter of the Government recently. "From what I can gather I should say that work may be started this fall and rushed to completion. The chief survey has been made, and it is only a matter of assembling men and materials. Every man who has ever been in the north country must be in favor of the plan, as it will ultimately mean a railroad from Edmonton to Dawson, connecting the Yukon country with the outside world."

Quebec, Que.—In view of the increasing attention which is being directed to the adoption of oil as fuel in the British Navy, it is interesting to know that oil lands in different parts of the Empire are being sedulously developed. The decision of the Government to secure supplies as far as possible within the Empire has given a new impetus to the search for large oil deposits in different parts of the dominions, and it would be fitting that the premier dominion, Canada, should be reckoned among the fuel-oil sources of supply. In this connection Viscount Selby, who is chairman of the Eastern Canada Company, and who has just returned from the Canadian fields, supplies interesting details. In the course of a conversation Lord Selby remarked that he was greatly impressed with what he saw and heard during the visit. The most favorably situated oil fields in Canada, from a geographical and strategical point of view, he states, are those of Gaspe, which extend from the seacoast on the Bay of Gaspe, on the Gulf of St. Lawrence, for several miles in a north-westerly direction. It was in the Larocque district, in the North-West, that a considerable number of wells were put down, and good supplies of oil of a high quality obtained. What is known as an anticlinal formation extends from this district in a south and easterly direction down to the coast. The opinions of experienced drilling men and geologists in that country are to the effect that oil will be found there in large quantities. Should this be the case, the importance of the field from the points of view of supply for the British Navy and for marine and industrial purposes cannot be overestimated.

Winnipeg, Man.—The condition of the road to Selkirk at the present time is not conducive to the best feeling on the part of the users of this particular stretch of highway.

The work of putting the road in first-class shape was well commenced by the Government engineers, and just when the road-users were congratulating themselves that at last a piece of road work was to be done in a sensible manner, they were disappointed to find that a number of cross culverts were put in all at one time and the trail almost rendered impassable for want of a little trouble on the part of those in charge of the construction. There is one portion of the road where a deep gully has to be traversed in order to get by the new bridgework, and in the event of rain it simply means that a vehicle is stuck on whichever side of the gully it happens to be, and it is necessary to secure the aid of three or four teams to get through. Another cause for dissatisfaction is the method of laying gravel. It is piled on the centre of the road to a depth of about four inches, and has some stone mixed with it big enough to make it dangerous for a car when the wheels strike them and they roll on the hard surface of the road underneath. This sort of work is not what might be expected of engineers who are in the service of the Government, and unless some radical steps are taken to alter the method of procedure, the work might just as well have been done by the old system of jobbing. It is a waste of the taxpayers' money to put up a road in such a shape that the expense of after maintenance is almost as heavy as the original cost of construction.

The Pas, Man.—The plans for the Hudson Bay Railway terminals at this point have been approved. P. Gordon, resident engineer, is understood to be on his way back from Winnipeg, and is bringing with him the plans of the terminals, showing the layout of yards, freight-handling plant, roundhouse, shops and other details. It is stated that the Government has acquired half a section of the Finger mill property and a considerable area to the north and east of The Pas annex. The shops, freight sheds and depot will be immediately adjoining the original townsite, and the receiving and sorting yards at the other end of the new property. It was originally proposed to acquire a portion of the Indian reserve property, a part of which was purchased for the townsite, to be used for terminal purposes. The Indians, however, asked such an inordinate price for their land that the Government went to the other side of the annex for a site. It is expected that connection will be made with the terminal site and the present terminal of the line through the original townsite.

Nelson, B.C.—Rich in minerals, timber and agricultural resources, Duncan River and Howser Lake districts, the development of which has been retarded for many years by lack of cheap and expeditious means of transportation, may in the not distant future be opened up by improvements to Duncan River which would make that stream navigable. R. F. Green, M.P. for Kootenay, is interesting himself in the project, and J. P. Forde, resident federal works public engineer for Kootenay, will visit the district for the purpose of reporting upon the advisability of making the waterway navigable from main Kootenay Lake to Howser Lake.

Vancouver, B.C.—Work on the boring of the "pioneer" Rogers Pass tunnel through Mount Donald, at Glacier, on the main line of the Canadian Pacific Railway, is being actively prosecuted, stated Mr. J. G. Sullivan, chief engineer of western lines for the company, who arrived in Vancouver recently. He remarked that 125 feet of the drift has already been scooped out. The Canadian Pacific Railway is piercing the mountain with a 22 feet by 30 feet tunnel, five miles long. The contractors are adopting a new method, which is being eagerly watched by engineering experts. The "pioneer" tunnel will run parallel to the main bore, and work will be pressed by means of cross-cut borings. A large force of men are engaged at the scene of the operations, and camps have been established on each side of the mountain. Steam shovels are being used to grade the approach to the western portal below Glacier Station. Mr. Sullivan will conduct a general inspection of the work being carried on in connection with the Vancouver terminal improvement schemes at Port Coquitlam, and also on the lines of the British Columbia division.

South Vancouver, B.C.—"That in the opinion of this council the establishment of a municipal electric plant is a pressing necessity, and would prove of great advantage to the interests of the municipality." This resolution was unanimously passed by the South Vancouver Municipal Council on the motion of Councillor Campbell, seconded by Councillor Third, after thoroughly dicussing a report brought in by Municipal Electrician Rawden to the effect that at an initial cost of $600,000 an electric light and power plant could be established in the municipality capable of providing for the needs of the district for the next five years, and stating that electric light could be supplied at seven cents per kilowatt hour, and at two cents per kilowatt on the day load for power purposes. Mr. Rawden recommends a two-unit steam generating plant of the turbo-generator units type, with a nominal rating of 2,000 kilowatts, and a maximum rating of 2,500 kilowatts, which, he estimates, would meet the needs of the municipality for the next five years. The cost of the plant, Mr. Rawden estimates, would be approximately $400,000 for the first unit, and $200,000 for the second unit. This would not include the cost of a building, which, Mr. Rawden suggests, could be either temporary or permanent, and should be situated near the Fraser River. Provision was made in the estimates for an adequate system of street lighting, including 300 arc lamps and standard lamps for Main Street, Cedar Cottage, Fraser Avenue and Collingwood. Mr. Rawden points out that there are over 8,000 connections using electric light and power in South Vancouver, and a large number of dwelling houses not at present using electric light.

Ottawa, Ont.—The report on the water supply will be ready for either the first or the second meeting of the city council in October. The British engineers, Messrs. Binnie and Tickell, are still here, but they are making such progress in their work that there is a good possibility of the report being ready early in October. The mayor has stated that the reports which will be presented to the city council will be most comprehensive, taking in Lake Deschenes and other proposals which have been made from time to time. There will also be a report as to what the Government is prepared to do, though it is understood that as yet the Cabinet has not discussed figures. When special legislation was secured for raising five million dollars for the work, the stipulation was that a two-thirds vote of the city council or endorsation by the people would be necessary. It is generally understood that the five million will not be sufficient, but it is also believed that there would be no difficulty in getting special legislation to expend a couple of millions more on the same condition. If the estimated cost is not too far over the five million mark, there seems quite a probability of the council by a two-thirds vote settling the matter for good. It is believed that most people would be glad of the water question not figuring as an issue in the coming municipal elections.

Sault Ste. Marie, Ont.—Continuing his official tour of inspection, Hon. Frank Cochrane, accompanied by Hon. W. H. Hearst, met the members of the Sault Ste. Marie City Council and the Board of Trade recently and discussed matters of importance regarding the future development of the Soo. The subject of an ice-breaker for the Soo for the purpose of assisting in keeping navigation open for a longer period in the early part of the winter, to facilitate the handling of the grain shipments from the West, was brought up, and the hearty support of the Minister of Railways and Canals was promised in the prolongation of the navigation season. In answer to an enquiry as to the proposed new ship

canal here, the Minister replied that the matter was as yet only in its initial stages, but there would be no use of the Government deepening the Welland Canal without also taking care of the shipping interests at the Soo. To a question as to the location of the proposed new lock, Mr. Cochrane thought it would be to the south of the present one, as the Government has expropriated all the land in anticipation of this. The influence of the Minister of Railways and Canals was solicited in preventing the narrowing of St. Mary's River by means of docks being built out past the deep-water line, as it is contended that all the space available is needed at present for the handling of the large vessels plying up and down the river.

PERSONAL

T. AIRD MURRAY, consulting engineer, Toronto, has been engaged by the town of Whitby, Ont., as engineer in connection with the proposed establishment of a sewer system.

STEPHEN MORRISON, mining engineer, Scotland, has opened an office in Victoria, B.C. Mr. Morrison is interested in British Columbia development, and believes in the development of Pacific commerce to relieve the congestion of shipping in the Atlantic.

J. KEELE, of the Department of Mines, Geological Survey, has returned from the West, where, in company with Dr. Heinrich Ries, professor of geology at Cornell University, investigation into the clay resources of Canada has been continued this summer.

ARTHUR H. BLANCHARD, M. Can. Soc. C.E., consulting highway engineer and professor in charge of the graduate course in highway engineering at Columbia University, and PREVOST HUBBARD, Assoc. Am. Soc. C.E., consulting chemist, in charge of the division of roads and pavements, the Institute of Industrial Research of Washington, and lecturer in highway engineering chemistry in Columbia University, have formed a partnership under the firm name of Blanchard & Hubbard, highway efficiency experts, with offices at Broadway and 117th Street, New York City. At present Messrs. Blanchard & Hubbard are retained by Commissioner John H. Delaney as the advisory board on highways for the New York State Department of Efficiency and Economy, and a few days ago the announcement was also made that they had been delegated to serve as members of the United States Committee on "Standardization of Nomenclature of Road Materials," which committee is to co-operate with the Engineering Standards Committee of Great Britain.

OBITUARY.

D. A. McCAW, of Welland, Ont., a third year student in civil engineering at the University of Toronto, died on September 15th after an illness of only several days' duration.

DONALD MATHESON, a young engineering student connected with a survey party in Northern Ontario for the Canadian Pacific Railway Company, died on September 20th as a result of blood poisoning from the bites of black flies.

JAMES ROSS, well known in engineering and financial circles, died at his home in Montreal on September 20th, 1913, after a short illness. Death was due to acute heart trouble.

Mr. Ross was born in Scotland in 1848, and, after completing his education there, spent a few years in railway, harbor and waterworks in England. He came to America in 1870, and became resident engineer of the Ulster and Delaware Railway, and subsequently was chief engineer. Mr. Ross was in turn connected with the Wisconsin Central Railway and the Lake Ontario Railway. He moved to Canada, and was appointed chief engineer and then elected general manager of the Victoria Railway. In 1878-1879 he built the Credit Valley Railway, and was its general manager. He was consulting engineer for the Ontario and Quebec Railway. Mr. Ross took control of the construction of the Canadian Pacific Railway west of Winnipeg in 1883, and in 1885 completed that line over the Rocky Mountains. He took up his residence in Montreal in 1888. Mr. Ross assisted in building many of the leading railways in Canada and in electrifying her street railways, such as those of Toronto, Montreal, Winnipeg, St. John, etc. He carried out work of a similar character in England and Jamaica, and was the first president of the Mexican Power Company, which developed an immense water power at Necaxa and controls the electric business of the city of Mexico. Subsequently he became president and active head of the Dominion Coal Company.

From among his numerous business connections it might be mentioned here that he was vice-president and managing director of the Montreal Street Railway; vice-president of the Toronto Street Railway, president of the Winnipeg and St. John Street Railways, president of the Dominion Bridge Company, vice-president of the Montreal Light, Heat and Power Company.

Although Mr. Ross had withdrawn from most of his business activities, he retained the presidency of the Dominion Bridge Company and St. John Railway until his death.

Mr. Ross was a member of the Canadian Society of Civil Engineers and also of the American Society of Civil Engineers.

ROYAL ARCHITECTURAL INSTITUTE

The Royal Architectural Institute of Canada closed its Sixth Annual Convention, held in Calgary, September 15th and 16th, with the following election of executive officers: J. H. G. Russell, Winnipeg, Manitoba, retains his office as president, and Alchide Chausse, of Montreal, is honorary secretary. The vice-presidents are Roland W. Lines, Edmonton, Alta., and J. P. Ouellette, Quebec. J. W. H. Watts, of Ottawa, is honorary treasurer.

Quebec was chosen as the next place of meeting, the date to be September, 1914.

COMING MEETINGS.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found sommaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20252—September 5—Authorizing Lake Erie and Northern Railway Co. to construct across three (3) highways in Tp. Brantford.

20253—September 3—Amending Order No. 20134, dated August 16th, 1913, by inserting figures "65, 66, 67" before figures "68" in seventh line of paragraph 6 of said Order.

20254—September 5—Granting leave to Hydro-Electric Power Commission of Ont. to erect and maintain its 40,000 volt line across wires and across track of C.P.R., on Arthur Street, Elmira, Ont.

20255—September 4—Authorizing Edmonton, Dunvegan and B.C. Ry. Co. to construct across twenty-six (26) highways in Prov. of Alta.

20256—September 4—Approving plans and specifications of Morrison Drain to be constructed under Michigan Central R.R., Tp. Harwick, Ontario.

20257—September 5—Recommending to the Governor-in-Council for sanction Book of Rules of London and Lake Erie Ry. Co.

20258—September 3—Authorizing C.N. Alta. Ry. Co. to construct proposed spur to Wellman Gravel and Supply Co. across public road between Secs. 30 and 29, Tp. 54-1, W. 5 M., Alta.

20259—September 4—Authorizing C.N.R. to construct across Coteau St., City of Moose Jaw, Sask., by means of structure carrying highway over railway.

20260—September 3—Authorizing C.N.R. to construct spur for A. MacDonald Co., Ltd., from Loop Line on which Fort William Station is situated, across Vickers St., to serve Lots 417 and 418, Wiley Addition, Fort William, Ont.

20261—September 5—Authorizing C. N. Western Ry. to construct across C.P.R. main line in Sec. 2-13-6, W. 4 M., Alta., by means of overhead structure.

20262—September 4—Authorizing C.P.R. to construct additional track (double track) across Que., Montreal and Southern Ry. at mileage 18.81 from Farnham, on C.P.R. main line, Farnham, to St, Johns, Que.

20263—September 4—Authorizing C.P.R. to open for traffic portion of Weyburn Westerly Branch from Assiniboia, mileage 112, to Woodrow, mileage 145.7, Sask.; trains be limited to a speed not exceeding 18 miles an hour.

20264—September 4—Authorizing the C.P.R. to construct additional track (double track) of its main line, by means of a bridge, across C.N.O.R., at mileage 92.84 of C.P.R. main line, Toronto Subdivision, Ont. Division, in Lot 4, Tp. York.

20265—September 5—Approving location C.P.R. station at Dand, Man., on its Boissevain to Lauder Branch.

20266—September 4—Authorizing the C.P.R. to construct Bridge No. 19.00, near Mitigan, B.C., Shuswap Subdivision, B.C. Division and Bridge No. 97.2 over Vermillion River, near Larchwood, Ont., Lake Superior Division, Cartier Subdivision.

20267—September 4—Extending, until November 1st, 1913, time within which C.P.R. be required to complete work of diverting Nine Mile Road, in Lots 5 and 7, Con. 9, Tp. South Gower, Ont.

20268—September 3—Authorizing C.P.R. to open for traffic portion of double track, Farnham Subdivision from mileage 6.7 at Farnham, to mileage 18.7, at Iberville Jct., distance of 12 miles.

20269—September 3—Authorizing C.P.R. to construct Bridge No. 88.29, near Glacier, B.C., on Mountain Subdivision, B.C. Division.

20270—September 6—Authorizing C.P.R. to construct additional track (double track) of main line across Fifty-six (56) highways, mileages 55.39 to 110.5, Swift Current Subdivision; and Medicine Hat Subdivision, mileages 0 to 6.

20271—September 4—Authorizing G.T.P.Ry. to construct two spurs for Northern Lumber Company, in Block 12, Eastwood Addition, Edmonton, Alberta.

20272—September 4—Authorizing G.T.P. Branch Lines Company to construct and operate a wye, turning out from its Cutknife Branch at mileage 47, in N.W. ¼ Sec 10-45-23, W. 3 M., Dist. West Sask.

20273—September 5—Authorizing G.T.P. Branch Lines Company to carry traffic over portion of Regina-Boundary Branch, Sask., between Talmage, mileage 66.5 and Boundary line, mileage 155; trains operated over said line to be limited to speed not exceeding 25 miles an hour.

20274—September 3—Amending Order No. 19643, dated June 16th, 1913, by striking out words "Branch Lines Company," where they occur in recital to said Order, and substituting therefor words "Railway Company."

20275—September 3—Approving location G.T.P.Ry. stations, in Province of B.C.—namely, Mount Robson, mileage 1078.8 west of Winnipeg, Rge. 3, Albreda, mileage 1088.5 west of Winnipeg, Rge. 3, and Eddy, mileage 1127.6 west of Winnipeg, Lot 7236; and rescinding Order No. 19010, dated April 8th, 1913, in so far as it approves of said stations at Mount Robson and Albreda.

20276—September 3—Authorizing G.T.P.Ry. to construct its Lake Superior branch across highway between Lots 20 and 21, Con. 3, and Arthur Street, Tp. Neeping, Ont.

20277—September 4—Authorizing G.T.R. to construct siding to and into premises of Goodyear Rubber Company, town of Bowmanville, Ont.

20278—September 2—Authorizing G.T.R. to construct siding into premises of John Heney and Son, Limited, Ottawa, Ont.

20279—September 5—Authorizing G.T.R. to reconstruct bridge No. 113 over Coaticook River, at Mile Post 164.98, 2nd Dist., Que.

20280—September 3—Authorizing G.T.R. to reconstruct Bridge No. 241, at mileage 52.29, over Portage Creek, Parish of Dewittville, Co. Godmanchester, Que.

20281—September 3—Authorizing G.T.R. to construct siding commencing at a point on Middle Div. of its railway, and on Lot 23, in Tp. Raleigh, now in City of Chatham, Ont., thence extending in a westerly direction and connecting with C.P.R. spur line on said Lot No. 23, said branch line to be constructed within three (3) months from date of this Order.

20282—September 5—Authorizing G.T.R. to construct siding and spur therefrom, commencing at a point on its railway south of Main Street, town of Welland, extending in south-westerly and southeriy direction to an into premises of Canada Forge Company, Limited, on Lot 24, Con. 5, Tp. Crowland, Co. Welland.

20283—September 5—Approving and authorizing clearances of tramway at the Grand Trunk Railway Company's siding at Lindsay, Ont.

20284—September 5—Authorizing G.T.R. to construct siding into premises of MacDonald Thresher Company, Limited, Stratford, Ont.

20285—September 3—Authorizing Que., Montreal and Southern Ry. to use and operate bridge over St. Francois River, between St. Francois du Lac and Pierreville, Que.; provided trains operated over said bridge be limited to a speed not exceeding 5 miles an hour.

20286—September 4—Authorizing Q.M. and S. Ry. to construct branch line across St. Thomas St., town of Longueuil, to and into premises of D. Brisette and Company.

20287—September 3—Authorizing C.P.R. to construct spur for Dwyer Elevator Company, Limited, Fort William, across and along Sixth St. and across Third Ave., said City of Fort William, Ont., together with two sub-spurs on said Elevator's Company's lands.

20288—September 8—Authorizing G.T.R. to construct siding commencing at a point on that portion of its railway

known as "Ashbridge's Bay Spur," east of Cherry St., Toronto, Ont.; thence extending in a south-westerly and southerly direction along and across what is known as "The 150-foot Roadway," and across Keating's Channel, for a distance of 133 ft.; thence in a southerly and south-easterly direction a distance of 2,415 ft. in Toronto Harbor Industrial District, subject to certain conditions.

20289—September 5—Authorizing C.N. Western Ry. Co. to construct across C.P.R. main line in Sec. 18-13-6, W. 4. M., Alta, subject to certain conditions.

20290—September 5—Authorizing C.N. Western Ry. Co. to construct across C.P.R.Co.'s spur line at Redcliff, Alta, subject to and upon certain conditions.

20291—September 8—Authorizing C.P.R. to construct highway crossing over its railway opposite Ninth Ave., town of Blairmore, Alta; and rescinding Order No. 18368, authorizing Applicant Company to open up, at its own expense, original road allowance known as Twelth St., across its tracks.

20292—September 8—Authorizing Q.M. and S.Ry. to construct, subject to terms of consent of village of Montreal South, spur track for Messrs. Lapointe and Maillonx in said village of Montreal South.

20293—August 18—Approving revised location Edmonton, Dunvegan and B.C.Ry. from mileage 120.7 to mileage 122.88, through Tp. 70, Rge. 1, W. 5. M., Alta.

20294—September 8—Approving location Alberta Central Ry., from mileage 10 to mileage 20, Red Deer to Sounding Creek, being from Sec. 22-37-26, W. 4 M., southerly and easterly to Sec. 5-37-25, W. 4 M., Alta; and authorizing construction of said railway across eleven (11) highways.

20295—September 8—Rescinding last paragraph of Order No. 19532, dated June 9th, 1913, that free delivery area therein set out be replaced by following extended free delivery area: "Steelton: In the triangular portion bounded by Wellington St., John St. and Cathcart St., and on botb sides of Wellington St., from John St. to Hudson St."

20296—September 2—Directing that C.N.R. construct standard portable station and loading platform at Eriksdale, Man., work to be completed within 30 days from date of this Order.

20297—September 6—Authorizing C.P.R. to construct industrial spur and two sub-spurs for Manitoba Rolling Mills Company, Limited, being from mileage 20 of Winnipeg Beach Subdivision; thence in a south-easterly direction through river Lots 26 and 27 of parish of St. Clements, Manitoba.

20298—September 9—Extending, for a period of three months from date of this Order, time within which G.T.R. complete branch line into premises of Dominion Canners, Limited, Simcoe, Ont.

20299—September 9—Extending, until September 30th, 1913, time within which C.P.R. and G.T.R. install electric bells at crossing of Perth Road, one mile north of city of Kingston.

20300—September 9—Extending, until November 30th, 1913, time within which C.P.R. complete spur for Thomas Jackson and Son, Winnipeg, Manitoba, authorized under Order No. 19450.

20301—September 10—Authorizing C.P.R. to construct Bridge No. 24.20 over Crazy Creek, Shuswap, Subdivision, B.C. Division.

20302—September 9—Authorizing C.P.R. to construct, by means of a grade crossing, additional track (double track) of main line, Sask., Division, Swift Current, Subdivision, across highway between Sec 14-18 and Sec. 33-17-6, W. 3 M., at mileage 50.69.

20303—September 9—Authorizing C.P.R. to construct, by means of grade crossing, additional track (double track) of main line, Sask. Division, Swift Current Subdivision, across highway between Secs. 16 and 17, 17-9, W. 3. M., at mileage 80.97.

20304—September 9—Amending Order No. 19842, dated July 19th, 1913, subject to terms and conditions set out in letters of Mr. C. W. P. Ramsay, Engr. of Construction for C.L.O. and W.Ry., and Mr. E. W. Oliver, Ass't. to Chief Engineer of C.N.O.R., of date June 9th and 18th respectively, by striking out clause 2 of operative part of Order.

20305—September 10—Authorizing C.N.O.R. to construct bridge across Petawawa River (Middle Crossing), mileage 150.15 from Ottawa, Montreal-Port Arthur Line, Tp. Fitzgerald.

20306—September 10—Authorizing C.N.O.R. to construct bridge across Petawawa River (East Crossing), Tp. White, Ont., mileage 142.5, from Ottawa, on Ottawa-Capreol Line.

20307—September 11—Authorizing the C.L.O. and W.Ry. to swing a scaffold, temporarily, for thirty days from date of this Order, under the structure carrying its railway over the tracks of the G.T.R., at mileage 69.25, in Lot 3, Con.1, Tp. Tyendinaga, with a height of not less than 18 ft.

20308—September 9—Authorizing the C.L.O. and W.Ry. to swing a scaffold, temporarily, for thirty days from date of this Order, under structure carrying its railway over the tracks of the G.T.R., at mileage 121.52, Lot 23, Con. A, Tp. Hamilton, with a beight of not less than 18 ft.

20309—September 10—Authorizing the C.P.R. to open for the carriage of traffic that portion of the Suffield West Branch of its railway from mileage 00 to Terrace, a distance of 26.4 miles.

20310—September 9—Authorizing the C.P.R. to construct, maintain and operate a branch line of railway, or spur, to and into the premises of R. Graham and Sons (Shale Products, Limited), Lot 1, 2nd Con., west of Tp. of Caledon, Co. Peel, at mileage 19.6, Orangeville Subdivision, near Inglewood Jct., Ont.

20311—September 9—Extending the time within which the C.P.R. shall comply with the requirements of General Order No. 108, until January 1st, 1914.

20312—September 9—Authorizing the Quebec, Montreal and Southern Ry. to construct, maintain and operate branch line of railway or spur, for the Sir W. G. Armstrong-Whitworth Company, Limited, at Longueuil, Que.

20313—September 11—Authorizing the Cor. of the Tp of Brantford to construct at its own expense, a public highway to be known as "Linden Avenue," over the railway of the Brantford and Hamilton Electric Railway Company, within the limits of the Tp. of Brantford.

20314—September 11—Authorizing the Essex Terminal Ry. to construct its railway across Lloyd Ave., town of Ojibway, Ont., at rail level.

20315—September 10—Approving, subject to the conditions contained in the agreement between the G.T.P. and Isaac Greenizen, dated December 11th, 1912, the revised location of the G.T.P. station at mileage 422, Prince Rupert East, Lot 33, B.C.

20316—September 11—Authorizing the G.T.P. Branch Lines Company to carry traffic over that portion of its Tofield-Calgary Branch, Alta., between Beiseker, mileage 163, to mileage 197.7.

20317—September 11—Authorizing C.P.R. to construct, by means of a grade crossing, its Manitoba Division, Napinka Subdivision, across road allowance between S.W. ¼ Sec. 4, and S.E. ¼ Sec. 5-2-14, W.P.M.

20318—September 12—Granting leave to C.P.R. to terminate agreement, entered into between the company and Daniel Silver, dated December 1st, 1910, in pursuance of Sec. 12 of said agreement, under which siding was constructed to premises of Daniel Silver in S.W. ¼ Sec. 26-21-20, E.P.M. Manitoba.

20319—September 12—Authorizing the C.P.R. to change present grade crossing in road allowance between Lots 30 and 31, Con. 2, Tp. of Scarboro, and construct additional track (double track), by means of grade crossing, across said road allowance between Lots 30 and 31, at mileage 89.7 on main line, Toronto Subdivision.

20320—September 12—Approving standard 20-foot concrete arch of C.P.R., as shown on plan No. B-14-29, on file No. 23072.

20321—September 9—Approving location Edmonton, Dunvegan and B.C. Ry., station grounds in S.W. ¼, Sec. 34-55-25, W. 4 M., Alta; station to be located at a point 400 east of Rue Champlain, on north side of track, town of Morinville.

20322—September 11—Authorizing Essex Terminal Ry. Co., to construct, at rail level, across Weaver Ave. and Elliott Road, town of Ojibway, Ont.

20323—September 12—Authorizing C.N.R. to construct across public road between Secs. 22 and 27, Tp. 36, Rge. 10, W. 2 M., Thunderhill Branch.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Belleville, Ont., gun shed	Sept. 29.	Sept. 18.	82
Fort William, Ont., examining warehouse	Oct. 7.	Sept. 18.	82
Fraser River, B.C., jetty and dredging	Sept. 30.	Aug. 21.	80
Galt, Ont., river walls	Sept. 27.	Sept. 18.	88
Gull Harbor, Man., extension to wharf	Oct. 7.	Sept. 18.	80
Halifax, N.S., railway terminals.	Oct. 15.	Sept. 18.	88
Kaslo, B.C., construction of wharf	Oct. 7.	Sept. 18.	80
Kingston, Ont., barracks	Sept. 30.	Sept. 18.	88
Meaford, Ont., extension and construction of revetment wall	Sept. 29.	Sept. 4.	80
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Petite Riviere, Est. Quebec, construction of a break-water	Oct. 7.	Sept. 11.	82
Regina, Sask., power house equipment	Oct. 1.	Aug. 28.	86
Regina, Sask., power house equipment	Oct. 25.	Sept. 11.	86
Taghum, B.C., bridge	Oct. 14.	Sept. 18.	78

RAILWAYS—STEAM AND ELECTRIC.

Fredericton, N.B.—Tenders will be received up till the 25th of September, 1913, for the erection of freight sheds and platforms. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, secretary.

+—Montreal, Que.—The Canadian Pacific Railway has awarded GEO. A. FULLER CO. the contract for the erection of a station. The contract price is $150,000.

Montreal, Que.—The request of the Southern Counties Railway to extend its car line across McGill Street, east on Youville to St. Peter, and north on St. Peter to Youville Square, and thence west on the square to McGill Street, has been favored by the special committee of aldermen given its consideration.

Moose Jaw, Sask.—There is reason for believing that the Canadian Northern Railway will build another line through Humboldt, running from Regina, via Craven and Humboldt, to Prince Albert.

New Westminster, B.C.—The members of the council have under consideration plans submitted them by the C.N.R. for an entrance to and passage through the city.

St. John, N.B.—The St. John Railway Company will have its extension to Kane's Corner, near East St. John, in operation this month. A further agreement has been made between the company and the city council to extend the line from Kane's Corner along the Marsh Road, so as to complete the circuit for which the people lately petitioned. The entire circuit will be completed within sixty days.

Vancouver, B.C.—The excavation work on the Great Northern Railway cutting in Grandview will soon be completed. Ballasting for a double set of tracks has been practically finished. However, when the work in the cutting is complete, four lines will have been laid.

Victoria, B.C.—An important agreement, which will require parliamentary approval, has been signed on behalf of the New South Wales Government, and of Messrs. Norton, Griffiths & Company, for the construction of railways on the North Coast, including one which will shorten the route to Queensland, and another from Condobolin to Broken Hill, the latter place being an important mining centre which at present is only served by a railway from South Australia. The total cost of the railway scheme, it is estimated, will be $15,000,000. The lines are to be completed within two and a half years.

BRIDGES, ROADS AND PAVEMENTS.

Assiniboia, Sask.—Tenders will be received up till the 30th of September, 1913, for the construction of cement piers for a bridge over Sturgeon Creek. Plans and specifications may be obtained from Frank Ness, Clerk of the Municipality.

+—Chambly Canal, Ont.—The Dominion Government has awarded the HAMILTON BRIDGE COMPANY the contract for the construction of a steel bridge. The contract price is $2,450.

+—Dundas, Ont.—The town council has awarded the HYLAND CONSTRUCTION CO., Belleville, the contract for the construction of a bridge. The contract price is $5,000.

Halifax, N.S.—Tenders will be received up till the 30th of September, 1913, for the construction of a number of bridges and culverts in the County of Halifax. Plans and specifications may be obtained from Department of Public Works and Mines, Halifax. E. H. Armstrong, Commissioner Public Works.

London, Ont.—Judging from the tenders for the steel superstructure of the Wharncliffe road bridge, received by the board of works, the construction for the connecting link between West and South London will exceed the $25,000 appropriation voted to the work by the citizens. The lowest tender was that of the Hamilton Bridge Company, for $18,751.50. This, with the contract for the concrete work let some time ago, will bring the cost to $25,192, or $92 above the appropriation without providing for any extras. These extras will likely run the bridge cost up another $1,000.

▲—Ottawa, Ont.—Tenders will be received up till the 2nd of October, 1913, for the construction of asphalt pavements. Plans and specifications may be obtained from Arch. Currie, city engineer.

South Vancouver, B.C.—Construction is being carried on night and day on the pavement being laid on Kingsway Road, a stretch of miles of asphalt, bitulithic, and granitoid highway which will link the cities of Vancouver and New Westminster, for which formal opening ceremonies are being considered. When completed South Vancouver and Burnaby will have a road equal in magnificence to any highway in America.

Sturgeon Creek, Sask.—Tenders will be received up till September 30th, 1913, for the construction of two cement piers for a bridge over Sturgeon Creek on Saskatchewan Avenue, and also for a steel bridge at said point. Plans and specifications may be obtained from the engineer's office, municipal office, St. Charles. Frank Ness, clerk rural municipality Assiniboia.

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+—**St. Francis De Sales, Que.**—The town council has awarded M. J. STACK & CO. the contract for the construction of macadam pavements.

+—**St. John, N.B.**—The city council has awarded MR. MICHAEL GEORGE the contract for the construction pavement of concrete base with bitulithic surface on Owen Street, between Germain and Charlotte Streets. The contract price is $5,703.

Toronto, Ont.—The Works Commissioner has recommended that a treated wood block pavement be laid down on Teraulay Street, from Queen to Agnes Streets, at a cost of $30,000.

Toronto, Ont.—The Board of Railway Commissioners have approved of the plans of the Bloor Street viaduct with the alteration of one arch.

LIGHT, HEAT AND POWER.

Fort William, Ont.—One outcome of the official discovery that Fort William is paying more than Port Arthur for her supply of electrical energy from the Kaministiquia Power Company is that the mayor, City Manager McCulloch and Utilities Manager A. L. Farquharson have been empowered to take the matter up with the Kaministiquia Power Company at once, and at the same time to request the Hydro-Electric Commission of Ontario to submit estimates on the price at which they will be prepared to deliver one block of one thousand horsepower for one year and another block of one thousand horsepower for four years—making five thousand horsepower in all.

Kingston, Ont.—Mr. MacRow, manager of the Montreal Street quarry, has found the service of the thirty horsepower 550 volt alternating current motor which is used to operate one of the crushers, so much to his satisfaction, that he is negotiating with the Utilities' Department for the installation of a forty horsepower motor to operate another crusher, and also of an air-compressor to run the drills and hoisting apparatus. Mr. MacRow has also the intention of placing another motor in another quarry, a short distance to the north of the one mentioned.

Kingston, Ont.—The utilities committee of the City Council has been charged to take up again the matter of securing cheap power from the Hydro-Electric Commission.

Medicine Hat, Alta.—The city council are planning the expenditure of $250,000 to build another large addition to the present power plant and install electrical generating machinery to furnish 2,500 kilowatts of power. The old plant is at present furnishing about 450 kilowatts, and the new plant, which will be running within a few weeks, has a capacity of another 1,500 kilowatts. Practically all the power that can be turned out by the new and the old plants has been spoken for, and it will not be very long before the demand will be in excess of the supply. It is this realization that is causing the city fathers to turn their attention towards caring for the ensuing years.

Moose Jaw, Sask.—The date of installation of the 1,500 K.W. generator, the contract for which was let to Williams & Robinson, Rugby, Eng., in April last, to be in place and in operation by October 15th, has been projected to November 15th at the earliest.

+—**Ottawa, Ont.**—The contract has been let to the CANADIAN CRACKER WHEELER CO., of St. Catharines, Ont., for motors and electric apparatus for the Grand Trunk Pacific shops, Transcona, at the estimate of $26,500.

Portage la Prairie, Man.—Mr. E. J. Chamberlain, representing the Great Falls Company, has made a proposition to bring power to Portage upon the same conditions as the offer of three years ago, which at that time was futile. Recently Portage la Prairie has been endeavouring to come to an agreement with the city of Winnipeg officials concerning the bringing to Portage of power from Winnipeg.

▲—**Regina, Sask.**—Tenders will be received up till the 25th of October, 1913, for supplying equipment for powerhouse. Specifications may be obtained from E. W. Bull, Superintendent of Light, Heat and Power Department.

Regina, Sask.—Tenders will be received up till September 25, for plumbing, heating, and ventilation of the new wing, Regina General Hospital, and also for the Isolation Hospital. Plans and specifications may be obtained from N. R. Darrach, architect, Regina.

+—**Toronto, Ont.**—An agreement has been closed between Sir William Mackenzie and the Baltimore Utilities Company, to furnish the latter with 46,000 horsepower of Canadian electricity, the power to be delivered at the international line by the Electrical Development Company of Ontario, which has its plant at the Falls, to the Canadian-American Power Corporation. By that company it will be distributed. The contract is held by MESSRS. BERTRAM, GRISCOM & CO., of New York, who propose to capitalize at $3,000,000.

Toronto, Ont.—Sir William Mackenzie has just closed an important agreement with the Baltimore Utilities, by which he will sell them 46,000 horsepower of Canadian electricity. The power is to be delivered at the International line by the Electrical Development Company of Ontario, which has its plant at the Falls, to the Canadian-American Power Corporation, by which company it will be distributed. Some idea of the importance of the contract effected by Sir William may be gathered from the fact that the Toronto Street Railway uses only 40,000 horsepower.

Windsor, Ont.—At a recent meeting of the Detroit Common Council a communication was presented by Mayor Marx from Mayor Clay, of this city, inquiring as to whether Detroit was prepared to enter into a contract to purchase hydro-electric power from the city of Windsor, providing a rate was quoted lower than the current is now being produced in Detroit. The Common Council discussed the matter at considerable length and will send a definite report to Mayor Clay shortly.

GARBAGE, SEWAGE AND WATER.

+—**Fort William, Ont.**—The city council has awarded the CANADA IRON CORPORATION the contract for supplying the sixteen inch and special pipe. The contract price was $35 per ton for the 16-inch and $60 a ton for the special.

+—**Fort William, Ont.**—MR. RAY R. KNIGHT, city engineer, will lay the pipe on Island Two and across the Mission River. The lowest tender from a contractor for laying sixteen inch pipe was 59 cents, while the city engineer's tender was for 55 cents; the lowest contractor's tender for laying eighteen inch pipe was 68 cents, the city engineer's, 65 cents. The lowest contractor's tender for laying the pipe across the Mission was $5,753 and they ran as high as $14,000, while the city engineer's tender was for $5,753.

+—**Fort William, Ont.**—The contract for supplying the 6-inch iron pipe in the last-mentioned item was let to the CANADA IRON CORPORATION at $35 per ton, and for the supply of special pipe at $60 per ton. The cleaning and grading of streets on the island is to be done by W. T. RANKIN for $1,735.

Hamilton, Ont.—During a recent discussion at the meeting of the Board of Control over the removal of sand from the vicinity of the filtering basins, Mayor Allan stated that he thought the basins should be done away with altogether. He considers them a detriment to the waterworks system rather than a benefit, as he contends that the water merely passes through them, and that by reason of the fact that decayed vegetable matter grows in them, there is some danger of contamination from this.

+—**Moncton, N.B.**—The City Council has awarded Messrs. GOVANG & LE BLANC the contract for extension to sewers. The contract prices are: 10-inch pipe sewer $1.06 per foot; 12-inch pipe $1.15 per foot. Daniel Gotro was the only other tenderer his prices being $1.15 per foot for 10-inch and $1.22 for 12-inch pipe.

Montreal, Que.—That Montreal's new $3,000,000 filtration plant regarding which there has been so much discussion this summer, is not large enough, and that within twelve months at the latest another $1,000,000 or more will have to be spent on the work in order that it may meet the requirements of the city, is a situation which officials of the city aqueduct department disclosed at the City Hall recently. That the matter is a serious one, and one which will have to be taken up without loss of time, is evident from the statement made public regarding the city's consumption of water, and the steps which are about to be taken to increase the pumping capacity.

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New Glasgow, N.S.—The town council in New Glasgow is asking for bids up to September 30th for the construction of 2,050 lineal feet of 24-inch sewer, and 550 feet of 20-inch sewer. Included in this, there is about six thousand cubic yards of excavation in trenches from 3-feet to 26-feet in depth. Pipe may be of reinforced concrete instead of vitrified clay. D. F. McLeod, town engineer.

Ottawa, Ont.—City Engineer Currie has presented his report to the city with regard to a temporary water supply, and outlined three plans. The first scheme, of an all-land route, would cost $283,000 and would take sixteen or eighteen months to install. The second scheme would have cost about $190,000, and would take about ten months. In this scheme the present pumps at the sedimentation basin would be used to create a greater head and thus make it possible to have the pipe near the surface, thus effecting a saving in pipe and excavation. A surface line, with new pumps at the mouth of the intake, would cost about $163,000 and take about eight months to carry through, was the third scheme.

Ottawa, Ont.—Tenders will be received up till September 27th, for supplies in connection with 40-inch steel intake pipe. Plans and specifications may be obtained from Arch. Currie, City Engineer.

+—Port Arthur, Ont.—The city council has awarded the THUNDER BAY CONTRACTING COMPANY the contract for the erection of a pumping station. The contract price is $12,500.

+—Sarnia, Ont.—The Imperial Oil Company has awarded the SMART TURNER MACHINE CO., LIMITED, Hamilton, the contract for supplying a power rotary force pump.

▲—Toronto, Ont.—Tenders will be received up till October 4th, 1913, for the construction of a sewer on Wychwood Avenue, in the Township of York. Plans and specifications may be obtained from office of Frank Barber, C.E., 57 Adelaide Street East, Toronto. Frank Barber, Township Engineer.

+—Victoria, B.C.—Water Commissioner Rust made the following recommendations relative to the awarding of the contracts for the concrete and steel pipe line, steel trestles and telephone line. The bid of the GRAFF CONSTRUCTION COMPANY for the concrete pipe line at $308,160 was recommended; that of the MACDONALD, GODSON COMPANY for steel pipe at $444,998, and the bid of F. H. FOLSOM for $8,625 for the telephone line. In connection with the steel trestles the bid of the CANADIAN NORTHWEST STEEL COMPANY at $24,808 was the lowest, but this price does not include erection. The GRAFF CONSTRUCTION COMPANY submitted a proposal to erect concrete structures in the place of steel for $40,000, but made this offer conditional upon their being awarded the contract for the concrete pipe line, and the city's consulting engineer, Mr. Wynn Meredith, recommended that the offer be accepted, provided the company's bid for the concrete pipe line is accepted. In connection with the steel pipe line the bid of MESSRS. JONES & RANT was lowest at $398,263, but it was based upon a percentage basis—that is, the city was to pay the cost and the company would supervise the work for a certain percentage cost. The bid was deemed irregular, and Mr. Meredith recommended the next lowest, that of the MACDONALD, GODSON COMPANY.

Victoria, B.C.—The City Council have decided to submit a by-law to the ratepayers to authorize the expenditure of an additional $1,500,000 to complete the Sooke Lake Waterworks scheme.

Winnipeg, Man.—The city has recently had a report on a new system of waterworks by Rudolph Hering and Jas H. Furetes, of New York, and Frederick P. Stearns, of Boston, who have reported favorably on bringing water 95 miles from a lake by gravity in a concrete pipe to carry 85 million Imperial gallons per 24 hours, at a cost of $13,045,600. Legislation authorizing this work to be carried on has been obtained and the city council at its meeting on the 8th instant, unanimously passed the appropriation and sent it to the people for ratification by election of the taxpayers, and it is to be voted on on October first. There is practically no doubt but that it will be ratified and the work of completing the surveys and plans will at once go on and contracts will probably be let during the coming winter. The months of September, October and November are the best months of the year in which to examine the country along the line of the pipe, and it would be better for contractors intending to tender to make an examination of the ground during these months, as it is somewhat difficult of access in the winter and early spring. Advertisements for bids will appear in the leading papers of America and Europe after the appropriation has been authorized by the people. The above statement is made now so that parties wishing to examine the ground may know the present standing of the matter. There is practically no doubt that this work will go on and the contracts be let during the coming winter.

Winnipeg, Man.—The Trades and Labor Council have passed a resolution unanimously adopting and endorsing the Shoal Lake waterworks scheme, and recommending all labor men entitled to vote on money by-laws to exercise their franchises for the furthering of the proposition.

INDUSTRIAL WORKS.

Athabasca, Alta.—A delegation from the local board of trade has waited upon the Premier at Edmonton requesting that the Alberta and Great Waterways be constructed from Athabasca, and that work be started as early as possible.

Brantford, Ont.—Instructions have been given to City Engineer Jones by the Waterworks Commissioners, to provide plans for the construction of a dyke across the waterworks property near the foot of West Mill Street, the low-lying lands between the canal and the river in the direction of Wilke's dam. The dyke will be about one-half mile wide.

+—Caledonia, Ont.—Messrs. McGregor and Co., have awarded to THE SMART-TURNER MACHINE CO., Hamilton, Ont., the contract for one of their duplex pumps.

Fisher River, Man.—Tenders will be received up till noon of the 15th of October next, for the construction of a residence on the Agency ground in the Peguis Indian Reserve at Fisher River, Man., in Section 17, Tp. 17, R. 1, west of the 1st Meridian. Plans and specifications may be seen at the Indian Offices at Winnipeg, Selkirk, and Portage la Prairie, and at the post-offices at Teulon, Arborg, and Stonewall, or may be obtained upon application to the Department at Ottawa. J. D. McLean, Assistant Deputy and Secretary.

Fort William, Ont.—Senator N. Curry, president of the Canadian Car and Foundry Company, has stated construction on the plant at West Fort William is progressing favorably, and that the company's expectation is to commence business about the end of the year.

▲—Galt, Ont.—Tenders will be received up till the 27th of September, 1913, for the construction of river walls. Plans and specifications may be seen at the office of the town clerk, Galt, Ont.

▲—Halifax, N.S.—Tenders will be received up till the 15th of October, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor, and filling reclaimed areas. Plans and specifications may be obtained from Department of Railways and Canals, Ottawa. L. K. Jones, Assistant Deputy-Minister and Seretary.

+—Island River, B.C.—The Dominion Government has awarded W. J. PENPORE CO., LIMITED, the contract for dredging required here.

Little Dipper Harbor, N.B.—Tenders will be received up till the 15th of October, 1913, for the construction of a breakwater. Plans and specifications may be obtained from Mr. E. F. Goodspeed, District Engineer, St. John, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Mace's Bay, N.B.—Tenders will be received up till the 14th of October, 1913, for the construction of a breakwater. Plans and specifications may be obtained from Mr. F. G. Goodspeed, District Engineer, St. John and the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

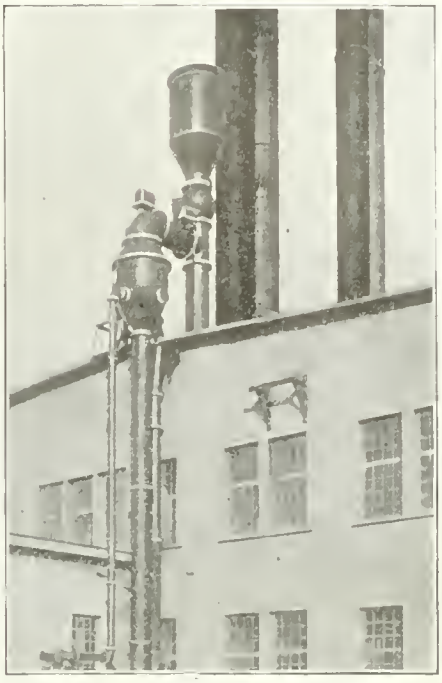
McAuley's Shore, P.E.I.—Tenders will be received up till the 7th of October, 1913, for the construction of a wharf. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Newcastle, Ont.—Tenders will be received up till the 15th of October, 1913, for the repairs to eastern pier here. Plans and specifications may be obtained from J. G. Sing, District Engineer, Toronto, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

CONDENSING APPARATUS

specially designed to secure

GREATER STEAM ECONOMY



WORKS: WILLIAM and SEIGNEURS STREETS, MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps, centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works' Plants.

Hampton
(or Travis)
Hydrolytic Tank

for the rapid sedimentation of sewage. Used in connection with an electrolytic hypochlorite treatment, the process is

Absolutely Odorless

Effluent free from disease germs. This tank is not an experiment. Proved efficient and economical by

NINE YEARS' USE

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Leaflet on request.

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Union Building, Clinton Street
NEWARK, N. J.

Also engineers for the electrolytic treatment of water.

A Perfect Weir Gage

Carries an unusually large card and will register without any reduction through a variation of two feet or on a two to one reduction through a variation of four feet.

Can be applied anywhere where fluctuation is within limit named and where great accuracy is desired.

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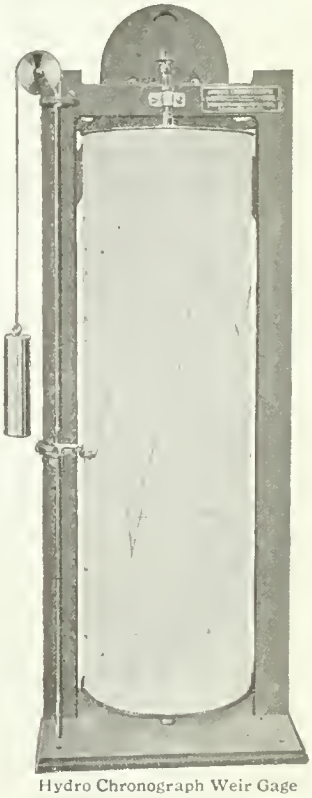


Hydro Chronograph Weir Gage

Hydro Manufacturing Co.
700 BULLITT BUILDING, PHILADELPHIA, Pa.

▲—**Ottawa, Ont.**—Tenders will be received up till the 15th of October, 1913, for section No. 2 of the Welland ship Canal. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, Secretary.

+—**Quebec, Que.**—The Transcontinental Railway Commission has awarded Contractor GOSSELIN, of Levis, the contract for the construction of the workshops of the railway at St. Malo. The contract price is $1,500,000.

Roy's Beach, B.C.—Tenders will be received up till the 9th of October, 1913, for the construction of a wharf. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

+—**Rustico, P.E.I.**—The Dominion Government has awarded MR. V. T. BERTRAM, Toronto, the contract for the dredging required here.

+—**St. John, N.B.**—The city council has awarded R. ROBERT & SONS the contract for the construction of a ferry wharf. The contract price is $9,800.

St. John, N.B.—A powerful new dredge, the "Don Frederico," has arrived at Halifax. She is a big ladder dredge from Scotland, and when completely equipped, will be used at the harbor mouth on the work formerly carried on by the NORTON-GRIFFITHS DREDGING CO.

+—**St. Vital, Man.**—The Provincial Government has awarded the WINNIPEG ENGINEERING CO. the contract for the construction of an underground feeder system. The contract price is $40,000.

Vancouver, B.C.—Tenders will be received up till the 27th of September, 1913, for oil burning installation in dredge "Ajax." Plans and specifications may be obtained from C. C. Warsfield, Esq., New Westminster, and the Department of Public Works, Vancouver. J. L. Nelson, Superintendent of Dredges.

Vancouver, B.C.—The steel-work upon the warehouses for the new Great Northern dock on Burrard Inlet, a short distance west of the British Columbia Sugar Refinery, are now well advanced, and the filling-in of the section of the dock between the two piers is almost complete.

+—**Windsor, Ont.**—The Cleveland Foundry Company, Cleveland, will locate a plant in this city. It will cost $200,000.

MISCELLANEOUS.

Bassano, Alta.—In spite of the desire of the town to delay the closing of the dam on account of the waterworks intake not yet being completed, the C.P.R. have announced that the gates for the $6,000,000 irrigation dam at Bassano will be tested not later than October 1st.

Berlin, Ont.—Berlin has disposed of all the debentures issued by the city council this year, amounting to $281,000, a portion bearing 5½ per cent. interest, and some 6 per cent. Of the debentures, $60,000 was raised for extensions to the electric and gas plants, $30,700 for double-tracking the street railway, $50,000 for extensions to the waterworks plant, $87,500 for new trunk sewer, $11,000 for new park lands, and the balance for local improvements constructed last year.

Bogota, Colombia.—The control of a petroleum field of over 1,200 square miles in extent, in Colombia, has been secured by the Colombian Syndicate, Limited, of Canada.

+—**Calgary, Alta.**—The Ranchmen's Club has awarded MESSRS THOMAS, JAMIESON & McKENZIE, the contract for the erection of a club building. The contract price is $20,000.

Fort William, Ont.—Tenders will be received up till the 14th of October, 1913, for the erection of an examining warehouse. Plans and specifications may be obtained from Mr. H. E. Mathews, Winnipeg; W. P. Merrick, District Engineer, Fort William, and the Department of Public Works, Ottawa. R. C. Desrochers, secretary.

Fredericton, N.B.—The plans of the new freight sheds to be erected by the Intercolonial Railway, and for which tenders are being invited up to September 25th, have been received in Fredericton.

Guelph, Ont.—The students, ex-students, and friends of the Ontario Agricultural College intend erecting a hockey rink on the college grounds this season, and every effort will be made to have it completed for use this winter.

+—**Hamilton, Ont.**—The Canadian Westinghouse Company has awarded MESSRS. H. G. CHRISTMAN & SON the contract for the erection of a new foundry. The contract price is $150,000.

Harriston, Ont.—The board of trade and town council have been successful to such an extent in their negotiations with manufacturing houses for the establishment of plants in Harriston that building operations may soon be under way on the Livingstone property.

London, Ont.—The Colonial Commerce Exchange will establish a business institute, club, and hotel for the centralization of the trade coming overseas at London. Should the Earl Grey scheme fail, the company propose securing the Aldwych site for their construction.

+—**Montreal, Que.**—The city council has awarded MR. JOS. MONETTE the contract for the erection of a fire station. The contract price is $65,100.

+—**Montreal, Que.**—The Harbor Commission has awarded the RAYMOND CONCRETE PILE COMPANY, Montreal, the contract for driving approximately 1,010 Raymond concrete piles.

+—**Moose Jaw, Sask.**—The International Linseed Oil Co. has awarded the CLARK CONSTRUCTION COMPANY of Chicago the contract for the erection of their plant.

+—**New Westminster, B.C.**—MR. JOHN CALBICK has been awarded the contract for building the additions to the Provincial Exhibition buildings. The contract price is $17,500.

North Vancouver, B.C.—A largely signed petition has been put before the city council of Vancouver, asking that Sutherland Avenue, from Lynn Valley Road, north to Twenty-Fifth Street, and thence west along that boulevard to Lonsdale Avenue, be graded and macadamized with a view to forming a highway of good roads between Lynn Valley and North Lonsdale as well as to providing a circular driveway within the city.

+—**Ottawa, Ont.**—MR. T. C. JAMES has been awarded the contract for the erection of a business block. The contract price is $100,000.

+—**Ottawa, Ont.**—The contract has been awarded to the firm of CROCKETT AND SHARLE, Fort William, Ont., for the construction of the Customs building to be erected on Mackenzie Avenue, Ottawa, the tender price being $993,000.

Ottawa, Ont.—It is expected that tenders will be called for shortly for the construction of Vancouver drill hall and immigration building.

+—**Port Arthur, Ont.**—The Great Lakes Dredging Company have awarded THE SMART-TURNER MACHINE CO., of Hamilton, Ont., the contract for one of their duplex pumps.

+—**Regina, Sask.**—The Grand Trunk Railway has awarded the RAYMOND CONCRETE PILE COMPANY, Montreal, the contract for driving approximately 1,000 Raymond concrete piles for the Qu'Appelle Hotel.

St. John, N.B.—Hon. John E. Wilson is agitating in the Provincial Government the need of a provincial building in this city, suitable for various needs of the province, such as the Equity Court, the Immigration Office, the Government's own rooms, etc.

St. Thomas, Ont.—The Union Label Stores Co. plan to erect a branch store in St. Thomas for the sale of their goods. Their plan and principles of the company have been endorsed by Union Labor representatives of the city.

+—**Trenton, Ont.**—The contract has been awarded ROGER-MILLER & SONS, CO., for putting in forty pairs of gates between Trenton and Rice Lake on the Trenton Canals, a work which will require one and half-years for its completion.

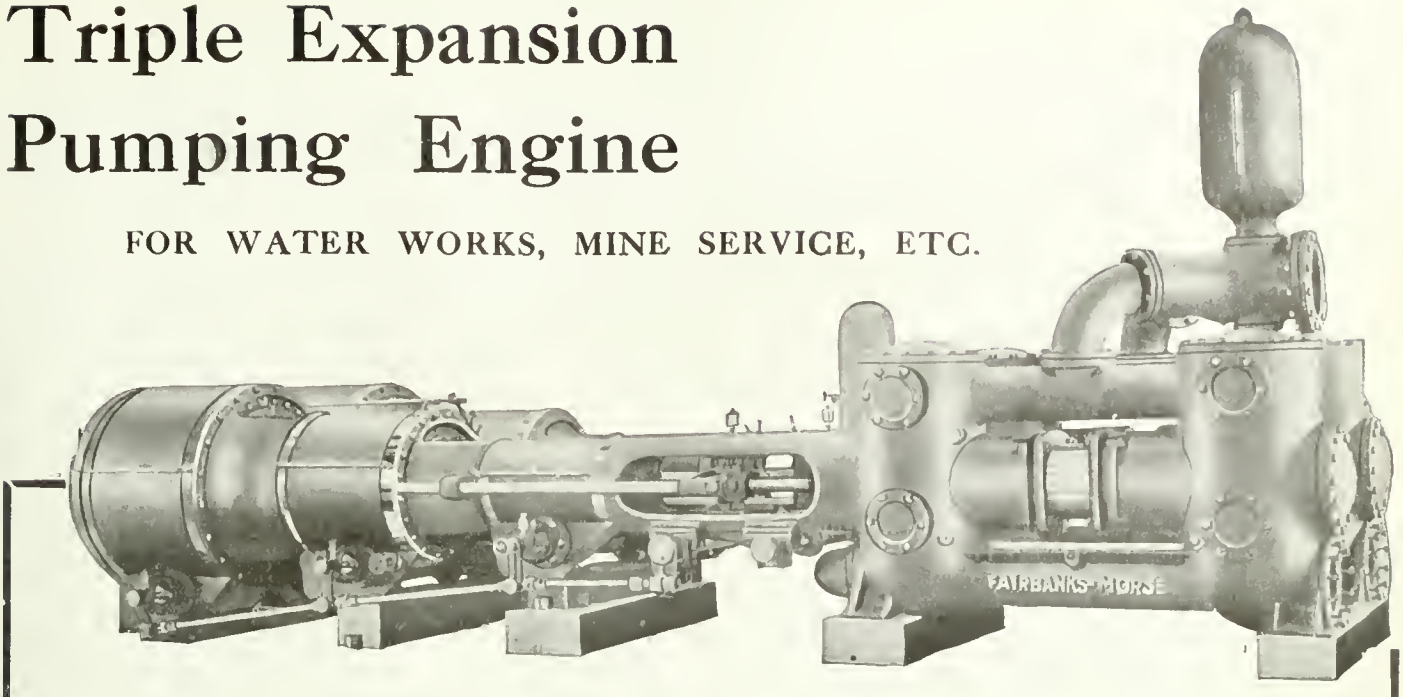
Vancouver, B.C.—The announcement was made by A. B. Godfrey, district superintendent of the British Columbia Telephone Company, that the work of replacing the old style telephone wires on the down-town streets of Trail with modern lead cable will soon be completed.

Vancouver, B.C.—Tenders will be received up till the 29th of September, 1913, for the erection of North Vancouver school. Plans and specifications may be obtained from the Department of Public Works, Victoria. J. E. Griffith, Public Works Engineer.

Vancouver, B.C.—The board of works committee have decided not to retract from its request to the British Colum-

Triple Expansion Pumping Engine

FOR WATER WORKS, MINE SERVICE, ETC.



The Fairbanks-Morse Triple Expansion Duplex Outside Centre Packed Plunger Pumping Engine shown here is very economical in the consumption of steam. The economy of operation makes this Pump preferable to all others in many situations.

The steam end is fitted with semi-rotative valves. The plungers being externally packed are always in sight and any leakage can be at once detected. All parts are easy of access. The stuffing boxes are large and deep, so that ample allowance of packing may be used.

This type of pump is heavily proportioned throughout in order to meet the demands of heavy service. It is designed to give long and satisfactory service at a minimum cost. It has a 24-inch stroke and a capacity of 2,500,000 gallons per 24 hours.

Departmentalising a Great Business

The marketing of one article is a very simple problem. As the number and variety of the products you sell increase, the complexity of your merchandising problem grows.

Our business has grown in the last dozen years from a comparatively few products into an enormous number of lines. This tremendous growth has necessitated the organizing of our business along departmental lines with able, efficient men at the heads of the various departments.

As organized now we can serve the mechanical field better than any house in Canada. In addition to being manufacturers, we are literally a large "departmental house for machinery and mechanical goods." This bringing together of a vast number of lines and classifying them according to departments is the kind of combination in industry that makes for efficiency, economy and better service.

It is just as great a convenience to Engineers, Contractors and Builders to be able to get their supplies from one House as it is to the general public to shop in a large, modern department store. In dealing with us you can get what you want "under one roof." Write, phone or call.

The Canadian Fairbanks-Morse Co., Limited

"The Departmental House for Mechanical Goods"

ST. JOHN QUEBEC MONTREAL OTTAWA TORONTO
WINNIPEG SASKATOON FORT WILLIAM CALGARY VANCOUVER

bia Electric Railway to lay permanent tracks on Hastings Street from Nanaimo to Renfrew Street, and have recommended that the company be required to proceed with the work this year.

Vancouver, B.C.—The Coca Cola Co. contemplate the erection of a plant in this city for the manufacture of their product. At present its location in either Winnipeg or Vancouver is still under consideration.

Vancouver, B.C.—Information has been received that the Union Steamship Company, of New Zealand, propose to build another steamer for service on the Pacific similar to the Palace Niagara.

+—Victoria, B.C.—Mr. C. E. Watkins has awarded MESSRS. FULTON BROS. the contract for the erection of his apartment block. The contract price is $45,000.

Victoria, B.C.—It is said that plans for a new east wing to the courthouse corresponding to the west wing, are being prepared by the provincial architects of Victoria, the cost of which will amount to several hundred thousand dollars.

+—West Toronto, Ont.—The Swift Canadian Co. have awarded THE SMART-TURNER MACHINE CO., Hamilton, Ont., the contract for a duplex pump.

Winnipeg, Man.—Tenders will be received up till the 30th of September, 1913, for out-buildings Portage la Prairie boarding school. Plans and specifications may be obtained from the Department of Indian Affairs, Ottawa. J. D. McLean, secretary.

CURRENT NEWS.

Berlin, Germany.—The first congress of the German Society organized to deal with the question of the efficacy of the divining rod and its scientific value in discovering and locating deposits of potash, coal, subterranean caves and water streams, met at Halle on September 19th, and was attended by delegates from foreign countries. The members of the congress include the President of the Province of Saxony and other provincial, municipal, and university officials.

Fort William, Ont.—Engineers of the Lighthouse Bureau, Washington, have finished installing a new apparatus at Whitefish Point, Lake Superior, and now mariners will be guided by one of the largest lights in the world. It has 3,000,000 candle-power. The increased intensity was obtained by changing from oil to incandescent oil vapor. The new light is the largest on the Great Lakes. Up to this time the Split Rock and White Shoal lights have been the most powerful, 1,200,000 candle-power. They can be seen 25 to 50 miles, but the new light can be seen 75 miles, except during storms.

Hamilton, Ont.—The Hon. Robert Rogers, minister of public works, has inspected the local harbor in order to ascertain what the local harbor commissioners desire to have accomplished; mainly the necessity of developing Stipe's inlet for wharf and harbor purposes for the benefit of east end manufacturers.

Lethbridge, Alta.—The Richardson Automatic Scale Co., of Passaic, N.J., have found it desirable to establish a Canadian branch of their firm at Lethbridge. Orders from the Ellison Milling Company of Lethbridge, Alberta Farmers' Co-operative Elevator Company and the Ogilvie Milling Company, of Medicine Hat, are awaiting manufacture at Lethbridge.

New Westminster, B.C.—Another unit in the equipment being installed by the city for the work in connection with harbor improvements in nearing completion. Carpenters are now engaged in housing in the machinery on the big Lidgerwood derrick, which will be used in unloading the barges of sand and silt and depositing it behind the quay walls along Front Street. This machinery will be operated by electricity, 6 360-kilowatt transformers having been installed and connected with the power cables of the British Columbia Electric Railway. The dredge John A. Lee is now receiving the finishing touches, all the machinery being in place, and oil burners are being placed under the boilers. The dredge will be ready in about a week. The city tug "Haro" has passed inspection, and is ready for active service. Work is progressing rapidly on the dock and already eight bents of poles are in place, capped and ready for sheet piling.

Ottawa, Ont.—A commission of citizens who have given special attention to city planning, has been selected by the Dominion Government to draw up a plan for the systematic development of the capital district.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received. 993.—A French concern would like to get in communication with Canadian manufacturers or agents willing to undertake the construction of a new patent mechanic pump in Canada. 1002.—A French concern exporting Portland cement would like to open relations with Canadian buyers. 1003.—A firm in Berlin, Germany, largely interested in calcium carbide and its products, desires to hear from producers in Canada able to undertake supplies to Germany. 1004.—A well-established firm in Frankfurt-on-Main, Germany, is open to represent Canadian works manufacturing the above articles. Highest references given. 1006.—A prominent firm in Vienna, Austria, is open to represent Canadian mining companies producing asbestos, talc, etc., for which there is a large market in Austria. The firm is well recommended. 1030.—A German company desires the addresses of Canadian firms who would be interested in purchasing pumps for waste and refuse water, etc. 1033.—A gentleman in Marseilles, interested in the import and export trade with various countries, desires to represent Canadian exporters, as an agent or on commission, in all commodities; machinery, foodstuffs, manufactures, provisions, grain, etc. He also has business relations in Algeria, Tunis, Morocco, Spain, Italy and Egypt. 1038.—An Austrian merchant is seeking supplies of corundum and desires to get in touch with Canadian producers and shippers. 1043.—A very important French concern manufacturing all kinds of motor vehicles would like to appoint several agents for the different provinces of Canada. The names of the firms making these inquiries with their addresses may be obtained upon application to:—The Inquiries Branch, the Department of Trade and Commerce, Ottawa, or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary, and Chambre de Commerce du District du Montreal.

NEW INCORPORATIONS.

Fort William, Ont.—Young and Lillie, Limited, $500,000. S. Crawford Young, W. C. Lillie, M. I. Hall.

Newcastle, N.B.—Miramichi Dredging Co., Limited, $4,350. W. H. Belyea, C. C. Hayward, John Ferguson.

Quebec, Que.—La Compagnie Dorval and Pondot, $20,000. Joseph Dorval, J. Aurele Dorval, J. E. Belanger.

Souris, Man.—Geo. McCulloch & Sons, Limited, $300,000. George McCulloch, H. M. McCulloch, R. J. McCulloch.

Montreal, Que.—Emery L'Esperance, Limitee, $20,000 Alphonse Beaulieu, Emery L'Esperance, Odilon Magnan.

Sudbury, Ont.—The Merritt Lumber Co., Limited, $20,000 G. E. Buchanan, J. Somerville, McKossock, J. H. Clary.

Three Rivers, Que.—La Compagnie Hydraulique Electriquede Levrard, Limitee, $20,000, Ludgor Carignan, Arthur Roux, Adelard Roux.

Eastman Village, Bolton Tp., Que.—Compagnie de Betes a Fourrure, Limitee. $10,000. The Reverend A. Emile Genest, Leon Menard, J. Israel Robin.

Toronto, Ont.—Depot Harbor Elevator Co., Limited, $40,000. G. H. Sedgewick, D. McArthur, H. A. Beckwith. Kerry & Chace, Limited, $40,000. W. H. Irving, J. R. Rumball, H. H. Davis.

Quebec, Que.—Gaspe Steam Ship Company, $100,000. E. Bouchard, F. Bouchard, J. A. Bouchard. La Compagnie des Habitations Salubres de Quebec, $1,000,000. J. G. Garneau, J. T. Ross, D. O. LeEsperance.

Winnipeg, Man.—Poncelet Tube Beading Company, $20,000. A. J. Poncelet, Ernfeld, H. P. Blackwood, N. Bernier, both of Winnipeg. Dunmore Tractor and Implement Company, $200,000. H. Prince, W. J. Donovan, A. M. Doyle. Butler and Earhart, $20,000 (grain mills and elevators). C. G. Earhart, F. S. Butler, both of Minnesota, U.S.A., E. A. Woodward, Winnipeg. Manitobite Stone Works, $250,000. S. W. Smith, M. W. Deed, W. Isles, W. P. Walace Construction Company, $20,000. E. A. Conde, J. A. Ptolemy, A. B. Rutherford.

When designing

structures do you pay sufficient attention to the various matters that govern insurance ratings?

Not only can you add greatly to the fireproofness of buildings by adopting our suggestions, but it is very likely that you can do so without the improvements costing anything ultimately. They will be paid for by the lower insurance rates.

Correspondence solicited. We have a staff of engineers and inspectors trained in this highly specialized line. Make use of our services.

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LIMITED

INSURANCE ENGINEERS

and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

Sewers last indefinitely—or rather they should do so. They will last indefinitely if laid with MIMICO PIPE.

Round Pipe and Square D lings

To be permanent a sewer should be built of a good material that can be handled and inspected simply and surely MIMICO PIPE is finished completely and perfectly at the factory and when delivered can be easily tested. It is far preferable to any material made of several ingredients any one of which may cause failure by being defective, and the mixing of which requires most careful, skilled attention.

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The Ontario Sewer Pipe Co.

LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

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MONTREAL

NOW READY

Text-Book on Highway Engineering

By Arthur H. Blanchard, C.E., A.M., Professor of Highway Engineering in Columbia University, New York City, and Henry B. Drowne, C. E., Instructor in Highway Engineering in Columbia University, New York City. 8vo, xiii+762 pages, 234 figures and 4 charts. Cloth, $4.50 net.

This book has been made mainly from the standpoint of the instructor and the student; giving, first, the logical order and arrangement of the subject-matter, and second, sufficient detail to thoroughly acquaint the student with the principles and practice of modern highway engineering.

FOURTH EDITION, Revised and Enlarged

Text-Book on Roads and Pavements

By Frederick P. Spalding, Professor of Civil Engineering, University of Missouri. 12mo, xii+408 pages, 51 figures. Cloth, $2.00 net.

In this edition the author has practically rewritten the entire book, new chapters being added on Bituminous, Macadam and Concrete Pavements, and modifications being made of the chapters on brick, asphalt and wood pavements.

SECOND EDITION, Revised and Enlarged

Street Pavements and Paving Materials

By George W. Tillson, C.E. 8vo, xii+651 pages, 97 figures. Cloth, $4.00 net.

A manual for city pavements; the methods and materials of their construction. For the use of students, engineers, and city officials.

SECOND EDITION, Enlarged

A Treatise on Roads and Pavements

By Ira Osborn Baker, C. E., D.Eng'g., Professor of Civil Engineering, University of Illinois. 8vo, xi+698 pages, 171 figures, 72 tables. Cloth, $5.00.

The purpose of the new edition of this volume was to add a chapter on Automobile Roads and Concrete Pavements. This is due to the remarkable increase in the number and power of automobiles in the past decade, which has led to the development of new forms of road surfaces designed specially to resist motor traffic.

TENDERS CALLED FOR

NOTICE TO CONTRACTORS.

ASPHALT PAVEMENTS.

Sealed tenders addressed to the Chairman and Members of the Board of Control, City Hall, Ottawa, will be received by the Secretary of the Board of Control, up to 4 p.m. Thursday afternoon, October 2nd, 1913, for the construction of asphalt pavements on:—

Clarence Street, from King Edward Avenue to Chapel Street.

O'Connor Street, from Queen Street to Laurier Avenue.

Any tender received after the above stated time will be declared informal.

Specifications and full particulars may be obtained on application at the City Engineer's office, City Hall, Ottawa.

The Corporation does not bind itself to accept the lowest or any tender.

ARCH. CURRIE,
City Engineer.

Ottawa, September 23rd, 1913.

TOWN OF GALT.

TENDERS FOR RIVER WALLS.

Sealed alternative tenders addressed to the Town Clerk, Galt, Ontario, and endorsed, "Tenders for River Walls," will be received until noon of **Saturday, September 27th, 1913,** for the construction of:—

(1) A concrete retaining wall, reinforced, 680 feet in length, approximately, along the westerly bank of the Grand River, from Main Street to Blair Road.

(2) A gravity retaining wall, reinforced, 680 feet in length, approximately, along the westerly bank of the Grand River, from Main Street to Blair Road.

Plans and specifications may be seen at the office of the Town Clerk, Galt, Ontario, after Friday, September 19th, 1913.

Each tender must be accompanied by a marked cheque, payable to the order of the Town of Galt for 5 per cent. of the amount of the tender. The corporation of Galt does not bind itself to accept any or the lowest tender.

CHAS. D. CAMPBELL,
Galt, Ont., September 17th, 1913. Town Clerk.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

CANADIAN GOVERNMENT RAILWAYS.

Halifax Ocean Terminals Railway, Halifax, N.S.

Sealed tenders addressed to the undersigned and endorsed "Tender for docks, First Unit, Contract No. 3, Halifax Ocean Terminal," will be received at this office until twelve o'clock noon, Wednesday, the fifteenth day of October, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor to a depth of 45 feet at low water, and filling reclaimed areas.

Plans and specifications and form of tender may be seen and full information obtained at the office of the General Manager, Moncton, N.B., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Halifax, N.S.

The right is reserved to reject any or all tenders.

By order, L. K. JONES,
Assistant Deputy-Minister and Secretary.
Department of Railways and Canals,
Ottawa, September 2nd, 1913.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

WELLAND SHIP CANAL.

SECTION No. 2.

NOTICE TO CONTRACTORS.

Sealed Tenders, addressed to the undersigned and marked "Tender for Section No. 2, Welland Ship Canal," will be received at this office until 12 o'clock noon on **Wednesday, October 15th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, St. Catharines, Ontario.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered bank of Canada for the sum of $150,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
L. K. JONES,
Asst. Deputy Minister and Secretary.
Department of Railways and Canals,
Ottawa, 22nd September, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—48056.

TENDERS FOR CONSTRUCTION OF SEWER.

Sealed tenders plainly marked as to contents will be received at the office of the undersigned up to noon on Saturday, October 4th, 1913, for the construction of a sewer on Wychwood Avenue, in the Township of York.

Plans and specifications and all information may be obtained at the office of Frank Barber, C.E., 57 Adelaide Street East, Toronto. The lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer.

Toronto, September 24th, 1913.

MEXICAN EAGLE ASPHALT

TRADE MARK

East Main Street, Hamilton, Ont., paved with Mexican Eagle Asphalt.

Mexican Eagle Asphalt is the purest asphalt on the market. It is also a favorite among city engineers for its high cementing value and ductility. That means that sheet asphalt pavements constructed with Mexican Eagle Asphalt take first place among permanent pavements. Because there is no doubt but that sheet asphalt is in general the most satisfactory pavement. Read the experiences of a few Canadian cities:

OTTAWA, ONT.

Five-sixths of the thirty miles of permanent pavement in Ottawa is sheet asphalt. The principal business and residential streets are paved with it. The city engineer's department says that, if properly constructed, asphalt has been found to be about the best pavement they can have. Ottawa has a great many streets constructed with Mexican Eagle Asphalt.

WINNIPEG, MAN.

Winnipeg has laid eighty-one miles of sheet asphalt since 897, for all kinds of traffic. City Engineer Ruttan installed the first municipal asphalt paving plant in Canada. In their experience the asphalt has worn uniformly and has been extremely satisfactory, particularly the pavements constructed with Mexican Eagle Asphalt.

VICTORIA, B.C.

Sheet asphalt is pr ctically the only kind of pavement laid in Victoria, only four out of the forty-eight miles of permanent paving being of any other type. It has been Victoria's experience that no repairs at all are necessary in the first five years, and extensive repairs are necessary only after ten years' wear.

TORONTO, ONT.

As in most cities, asphalt predominates in Toronto, over 157 miles of sheet asphalt pavement having been laid since 1887. The average cost of maintenance per square yard during ten years has been only slightly over five cents a year. For both residential and business streets it is the principal pavement. One of the many Toronto streets that are laid with Mexican Eagle Asphalt was illustrated in the Sept. 11th issue of The Canadian Engineer.

LONDON, ONT.

The city engineer of London says that asphalt pavements in London that have been down nine years are in good shape and will likely be so for another four or five years. Of less than nine miles of pavement in London, over five miles are sheet asphalt.

HAMILTON, ONT.

Thousands of tons of Mexican Eagle Asphalt have been sed in Hamilton during the past five years. Asphalt greatly predominates there, two-thirds of the thirty miles of permanent paving being sheet asphalt. The principal business streets are paved with it. The average cost of maintenance per square yard for the first five years has been two cents a year.

For prices, analyses, samples, etc., please address

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

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Second-hand Contractors' Machinery For Sale

In stock for immediate shipment at prices to save you money :—

1—No. 3 Ransome concrete mixer.
1—No. 2 Ransome concrete mixer.
1—Ideal automatic concrete mixer.
5—6ft. Ransome concrete carts.
13—5ft. Sterling concrete carts.
4—Steel tray charging barrows.
4—1 yd. ore buckets.
1—8"x 10"x 8" steam driven air compressor.
1—6" x 5" x 7" steam driven air compressor.
1—6" belt driven centrifugal pump.
1—4" belt driven centrifugal pump.

Send for our illustrated catalog.

H. W. PETRIE, LIMITED
General Machinery Dealers. TORONTO, Ont.

Tenders Called For

DEPARTMENT OF MILITIA AND DEFENCE.

Extension to Stables, Tete-de-Pont Barracks, Kingston, Ont.

NOTICE TO CONTRACTORS.

Sealed tenders, marked on the envelope, "Tender for Construction of extension to stables, Tete-de-Pont Barracks, Kingston," and addressed to the Director of Contracts, Department of Militia and Defence, Ottawa, will be received until noon, September 30 instant, for the construction of an extension to the stables at Tete-de-Pont Barracks, Kingston, Ont.

Specifications may be seen and full particulars obtained at the offices of the Officer Commanding the 3rd Division, Kingston, Ont., and the Director General of Engineer Services, Headquarters, Ottawa.

Tenders must be made on the form supplied by the Department of Militia and Defence, and accompanied by an accepted cheque on a Canadian Chartered Bank, for ten per cent. (10%) of the amount of the tender, payable to the order of the Honorable the Minister of Militia and Defence, which amount will be forfeited if the party tendering declines to enter into or fails to complete the contract in accordance with his tender.

The Department does not bind itself to accept the lowest or any tender.

EUGENE FISET, Deputy-Minister.

Ottawa, September 2, 1913.

Newspapers will not be paid if this advertisement is inserted without authority from the Department.—47356.
H.Q. No. 44-7-73.

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES—IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

GAS AND GASOLINE ENGINE, ten horsepower, Fairbanks-Morse; excellent condition; bargain. Can be seen in operation. Review Company, Bridgeburg, Ont.

COAST TO COAST.

Brandon, Man.—What with street paving, car-barns, rocmac, trips to the east to sell debentures and the resulting disputes in the city council chamber, a project for the real good of the city and the welfare of its inhabitants is, according to Alderman Shillinglaw, being ignored. This is the building of a large and up-to-date incinerator. A short time ago Alderman Shillinglaw outlined a proposition to the city fathers whereby the dangers of typhoid and other epidemic diseases would be very much lessened, if not entirely eliminated, and the question of the proper disposal of garbage and offal from the slaughter houses satisfactorily answered. This can only be done, in Mr. Shillinglaw's opinion, by means of a large incinerator, in which all refuse, garbage and germ-producing matter could be in a few minutes reduced to a harmless ash. The incinerator that the alderman would like to see in operation would cost about $40,000, and it would serve the requirements of Brandon for many years. Among the citizens generally the subject has not, as yet, received much attention, but there is no doubt that when the present strenuous times are past, the matter will be gone into more fully. The practical use, especially from a sanitary point of view, of the incinerator was most evident at the military camp at Sewell, where one of these important aids to sanitation was in constant operation behind every cook tent. The most noticeable feature at Sewell camp was the cleanliness of the lines and total absence of foul odors.

Victoria, B.C.—With the completion of the great dam which the Vancouver Island Power Company has been constructing for the past year at its Jordon River power plant, one of the largest works of its kind in Canada is now ready to fill its part in the development of power for the operation of commercial enterprises in the southern end of Vancouver Island. The dam, which is the highest of any in Canada, and has cost nearly three-quarters of a million, will provide storage capacity sufficient to assure an ample supply of water throughout the summer for the operation of the turbines. The necessity of additional storage capacity became imperative when the company undertook to raise the capacity of the power plant from 12,000 to 32,000 horse-power. The work of installing the additional units in the power house has been under way for some months. With this increase in power and the Brentwood Bay steam auxiliary plant of 6,000 horse-power in reserve, the company will have ample power to operate the lines of the British Columbia Electric Company, and meet the remarkable increase in the demand for power for industrial and commercial purposes. Mr. G. M. Tripp, mechanical superintendent of the company, went to Jordon River recently to make a thorough inspection of the new work.

A box of GROUND MICA in your MACHINE SHOP
will pay for itself in two weeks if used in tempering steel tools.
O'BRIEN & FOWLER
CUMMINGS BRIDGE - ONTARIO

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THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

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is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

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Positions Vacant

Advertisements under this heading two cents per word per insertion.
Minimum charge fifty cents per insertion.

WANTED.

TOWN ENGINEER.

For the Town of Pembroke, Ont., a Civil Engineer, to enter on duty 1st January, 1914, to do Municipal work. Applicants to state salary, experience and reference.

A. J. FORTIER,
Town Clerk.

Positions Wanted

Advertisements under this heading one cent per word per insertion.
Minimum charge fifty cents per insertion.

MECHANICAL ENGINEER—Experienced Designer, Cost Estimator and Salesman, Works Supervision, all kinds of steam engines, boilers, hydraulic pumps, air machinery and mining plants, seeks position with Consulting Engineer, Contractor, Manufacturers or agency business. Highest references, some capital. Box 102, *The Canadian Engineer*, Toronto.

CIVIL ENGINEER (40) with 18 years' experience in railway exploration and location, surveys, construction and maintenance, concrete foundations and bridge erection, at present engaged, will be open for employment about October 1st, Please reply Box 130, *The Canadian Engineer*, Toronto.

ENGINEER desires permanent position along civil engineering lines. University graduate of three years. Various experience with consulting engineer, also on preliminary and location surveys, having been in charge of both. Box 138, *Canadian Engineer*, Toronto.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

STRUCTURAL ENGINEER. Experienced in design; field and shop practice in structural steel and reinforced concrete, seeks technical commercial position. Address Box 132 *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion.
Minimum charge fifty cents per insertion.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian patent No. 135587, granted September 12th, 1911, to John Sorley, of Fielding, New Zealand, for composition for the destruction of insects, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention, and from whom full information may be obtained. Fetherstonhaugh & Smart, 53 Queen Street, Ottawa, Canada; Russel S. Smart, resident.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian patent No. 114335, granted on September 29th, 1908, to S. Vivian, for fluid flow controller, may do so upon application to the undersigned who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh & Smart, 53 Queen Street, Ottawa, Canada; Russel S. Smart, resident.

TAKE NOTICE that the undersigned are prepared to supply at a reasonable price the explosive described in Canadian Letters Patent No. 91254, issued on the 31st day of January, 1905, to Hans Von. Dahmen, or to grant anyone a license to have the same manufactured for him at a manufacturing establishment in the Dominion of Canada. They are also prepared to receive offers for the purchase of the patent or for licenses to manufacture under the same. Ridout and Maybee, 59 Yonge Street, Toronto, attorneys for Hans Von Dahmen.

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Canada.—Chas. H. de Ruset, lubrication of internal combustion motors; George J. Webb, devices for cleaning or removing obstructions in pipes, tubes and the like; Chas. H. de Ruset, control mechanism for internal combustion motors; Chas. H. de Ruset, internal combustion motors; Wm. E. Simpson and Howard Oviatt, furnaces for the direct production of iron and steel from iron ores; Ernest Colegate, the fastening or sealing of boxes, packets, wrappers and the like; Oswald Silberrad, perchlorate explosives; Jesse H. Tromanhauser, constructing cribs, sea-walls and the like.

Belgium.—B. R. Seabrook, improvements in differential railway axles; B. R. Seabrook, method of separating axle couplings; B. R. Seabrook, differential axles.

It has been decided to strengthen the foundations of the piers of the old Val Benoit bridge at Liège, Belgium, over which the international trains from Paris to Cologne cross the Meuse, by injecting cement under pressure into the underlying gravel of the river, so as to form a large monolithic mass at the foot of each pier.

SPIDERS ON THE PANAMA CANAL WORK.

Among the numerous workers who are contributing their little share to the construction of the Panama Canal is a number of spiders at Gorgona Shops. They are kept in the instrument room, and are carefully protected, because from their cocoons the instrument makers procure filament for use in the transits of the surveyors. The instrument repair men at Gorgona have been using the thread taken from the cocoon of a certain variety of spider that has been encouraged to multiply in the instrument shop for the past seven years to replace the platinum thread when it wears out. This use of the filament from the cocoon is not original on the Isthmus; indeed, it has been a common practice for many years.

It has been found that when the instruments so repaired are used early in the morning or during a rain the thread does not remain taut, because the instrument itself contracts. As soon as the instrument warms up, however, the spider web answers its purpose very well. In order that there may be no time of the day in which the transits may not be used, an order has been placed for platinum thread. As soon as it arrives on the Isthmus the use of the spider web will be discontinued, and the Canal force will be reduced by at least half a dozen more workers, for there are at least that many spiders spinning fibre at Gorgona Shops.

NEWCASTLE BRIDGE MERIMICHI RIVER NS

THE FOUNDATION COMPANY
LIMITED

VANCOUVER

NEWCASTLE

PITT RIVER BRIDGE

MARKET CONDITIONS

Montreal, September 20th, 1913

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20, sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base, toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal - $1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight

Chain.—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in., $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1 and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4 ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized

Iron.—Following prices are on dock. No 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian Iron sells here at about $19.25 to $19.50 per ton, on track.

Lath.—See Lumber, etc

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles; seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft. x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths. X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $5 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady: —¼-inch $8.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $8.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. of for galvanized; 3½-inch, $95; 4-inch $1 08.

Toronto, September 24th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—⅜-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1¼-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm

Copper Ingot.—The market is lower at 15¾ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¾ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1¼c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 5c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 5c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $13.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6 50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 50 or 30 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, September 23rd, 1913.

Anvils.—Per pound, 11¾ to 12¾c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26¾c., planished 29¾c.; boiler and T. K. pits, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.40; ¾-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—¼-inch, $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound

Volume 25 Toronto, Oct. 2, 1913

Contents of this issue on page 531

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

KAMINISTIQUIA RIVER BRIDGE, FORT WILLIAM

NEW ELECTRICALLY OPERATED STRAUSS TRUNNION BASCULE BRIDGE FOR THE CANADIAN PACIFIC RAILWAY—CLAIMED TO BE THE LARGEST DOUBLE DECK, DOUBLE TRACK BRIDGE IN USE

THE Canadian Pacific Railway Company are building extensive terminal yards and loading docks on Island No. 1 at Fort William, Ontario. In order to reach this island, it was necessary to build bridges across the Kaministiquia and McKellar Rivers, and, inasmuch as these are both navigable rivers, movable bridges were required, while on account of the rivers being so narrow, it became necessary to use bridges of a bascule type.

The Kaministiquia River, at the point where the railway crosses, has a clear width of channel of 125 feet, but as the railway crosses the river at an angle, a clear span of 180 feet is required. This leaves the channel perfectly clear when the lift is raised into the open position.

The bridge is a single-leaf, double-deck, Strauss trunnion bascule bridge, with the main trunnions at the point of intersection of the bottom chord and the end post of the truss (heel trunnion type), and embraces a 186-foot movable span, giving the required clear channel of 180 feet in the river, and a 40-foot stationary span or tower. The lower deck carries a double track railway and the upper deck two street car tracks in addition to a roadway and sidewalks on each side.

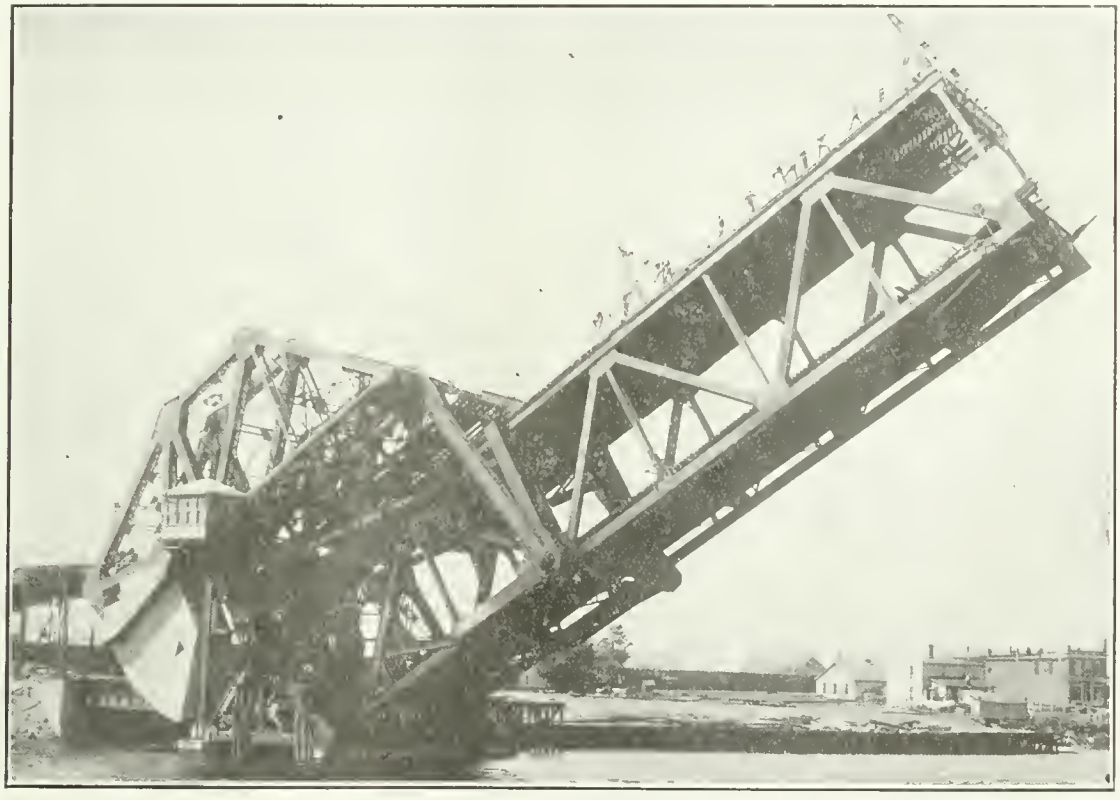

Fig. 1.—The Kaministiquia River Bridge, Fort William, Ont.

The Kaministiquia River bridge is of the Strauss trunnion type, while that across the McKellar River is of the Scherzer rolling lift type. The bridge department of the Canada Foundry Company, Limited, have the contract for the fabrication and erection of both of these bridges, and the bridge across the Kaministiquia River is about completed.

The double-deck feature in bascule bridge construction is said to be out of the ordinary and it is reported that there is no other bridge of the bascule type containing a double deck that is quite as large, although there are a few single-deck bascule bridges under construction that are considerably larger than this one.

There are long approach viaducts on both sides of the river for the electric railway, to enable it to cross the bridge on the upper deck.

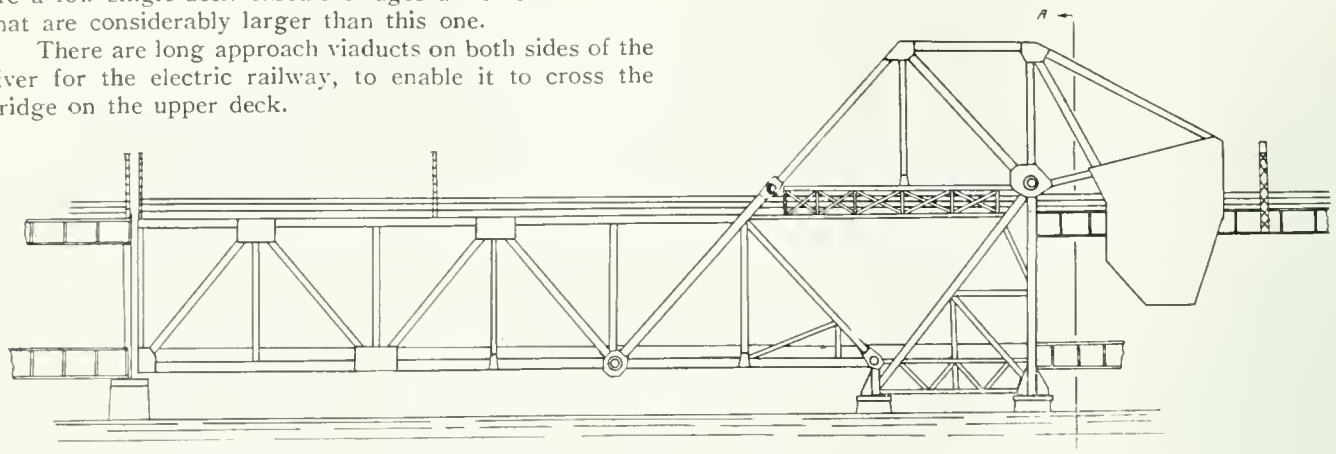

Fig. 2.—Kaministiquia River Bridge, showing General Elevation Diagram.

The construction of the bridge is rather out of the ordinary, as an inspection of the accompanying illustrations will show. The main span is pinioned on a main trunnion at the forward end of the triangular tower. It is for this reason that it is called a heel trunnion type. On the top of the tower a cantilever counterweight arm is trunnioned, the counterweight overhanging the right end of the bridge, the opposite end being connected by a connecting link with pins at both ends to a point along the lower part of the span member, as indicated.

As the main span turns on the main trunnion, the counterweight cantilever at the same time moves through a similar angle, as the pins are so located as to form a parallelogram. The counterweight on the outer end of the counterweight arm is a solid mass of concrete, of such weight as to maintain the main span in equilibrium at all times, the only power required to raise the span being that necessary to overcome the friction of the parts.

The bridge was erected in the open position by means of a wooden erection tower 125 feet high. A derrick on top of this tower took the steel from the cars at the bottom and landed it in place. The placing of the concrete for the counterweight was carried on simultaneously with the erection of the steel, so as to balance the structure at all times. On account of the size of the structure, the available space for the concrete was small, and it was necessary to make concrete weighing as much per cubic foot as possible. Good results were obtained by using iron ore in place of stone in the aggregate, and concrete was obtained weighing about 175 lbs. per cubic foot. This concrete had such great tensile strength that most of the reinforcing ordinarily used in these counterweights was omitted. There was occasion to remove some of this concrete afterward, and it was found to be so tough that the only way it could be removed was by blasting.

Method of Operation.—The operation of the bridge is as follows: Pinned to the front of the triangular towers on each side are operating struts, on the lower end of which are long racks each engaging at the outer end with a pinion. This pinion is connected through gearing to an 85-h.p. motor fitted with solenoid brakes. These two motors are mounted on the towers as indicated in the illustration. The motors, when operating, revolve the pinion, which moves along the rack on the lower face of the operating strut. This action lifts the span. As the bridge moves up, the motors move through the same angle, which in the highest position is 80 degrees.

At the outer end of the span there are two lock motors of 5 h.p. each. These operate the locks through worm gearing. There is also a 3-h.p. motor geared to a crank disc to operate an emergency brake.

When the bridge is closed and ready for traffic, the lock signal switch and the bridge signal switch are both closed, and the contacts in the circuits of the main operating motors and the lock motors are open. To open, the

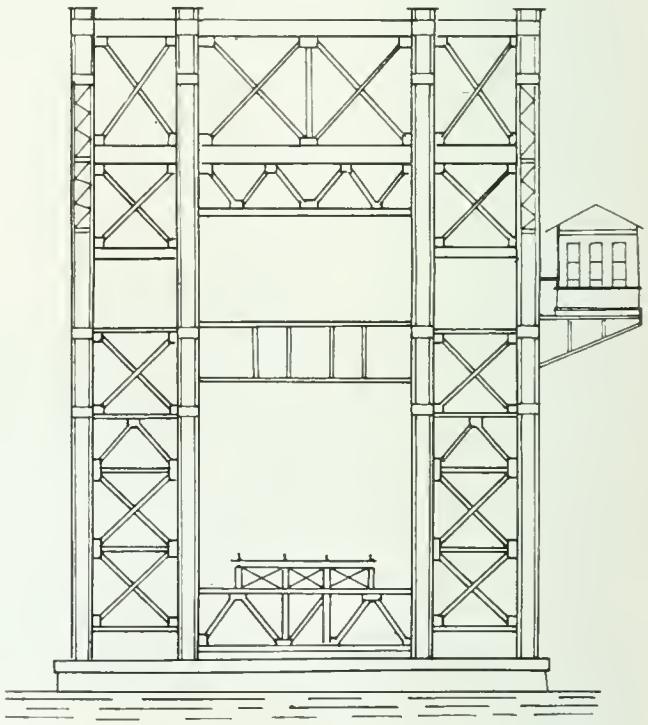

Fig. 3.—Kaministiquia River Bridge—Section A-A (Fig. 2).

danger signal is first set. The action of so doing energizes the contactor points of the lock motor, causing them to close, when, by the closing of the lock motor circuit breaker by the operator, the locks are withdrawn. The lock moving out, automatically changes the light in

the signal tower from white to red, indicating that the bridge is closed to traffic. Similar changes of light occur on the operator's panel.

Until the end locks are withdrawn, the contactors of the operating motors remain open. When withdrawn, these contactors are closed, so that the operator can, as soon as the light signals that the time is proper, energize the main motors through the controllers. The first notch of the controller merely releases the solenoid brake. This position can be used at any time when it is desired to coast. The starting of the span on its upward movement opens the lock motor contactors, so that the latter cannot

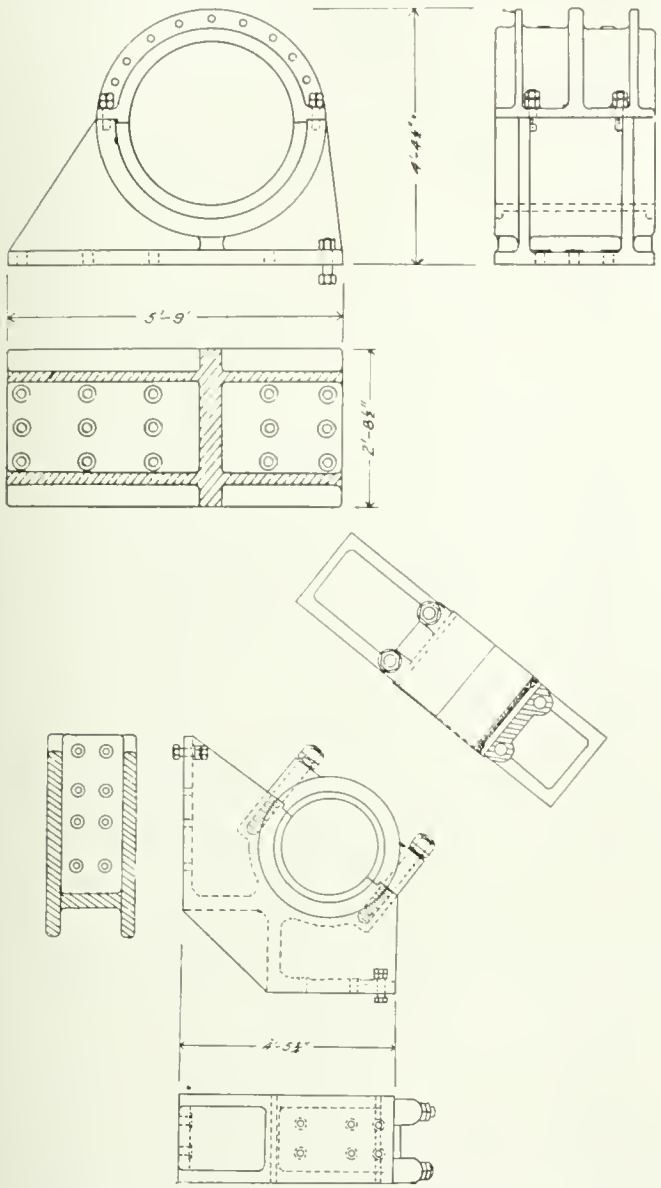

Fig. 4.—Kaministiquia River Bridge—Details of Trunnion Bearings.

operate by accident. The closing of the span is performed by reversing the operations outlined, and the signal lights show up in the same reverse order. Air buffers are provided to take up any shock when the span strikes the abutments. If the bridge is travelling too fast, these air buffers will cause the motors to overload and trip the oil switch, which will automatically put the brakes on. The operating machinery is all interlocked in such a way that every operation must be performed in sequence, and unless the bridge is actually moving up or down, it is held rigidly in position by a brake operated by an independent 5-h.p. motor.

The current for operating this bridge is obtained from the Kaministiquia Power Company and is 2,200 volts, 3-phase, 60-cycle A.C. current. It is stepped down to 550-volt for use on the bridge. The operator's house on top of one of the towers is fitted with a complete electrical control outfit, including switchboard and the necessary attachments.

The bridge is also equipped with a hand-operating mechanism for use in an emergency. It would take four hours to open the bridge with this mechanism.

The total weight of steel in the bridge, exclusive of the approaches, is about 2,500 tons. The counterweight weighs 2,400 tons. The bridge was designed by the Strauss Trunnion Bascule Bridge Company, of Chicago, under the direction of Mr. P. B. Motley, engineer of bridges for the Canadian Pacific Railway. It was fabricated in the Davenport works of the Canada Foundry Company, and all calculations in regard to counterweight were worked out in their engineering department, after the shop drawings were made. The entire electrical equipment was furnished and installed by the Canadian General Electric Company, Limited.

ELECTRIC RAILWAY CONVENTION IN ATLANTIC CITY.

The American Electric Railway Association, whose company members represent over 36,000 miles of track, more than 76 per cent. of the total in the United States, will hold its Thirty-second Annual Convention in Atlantic City, October 13th to 17th. The preliminary announcement of its programme indicates the growing attention which public service corporations are giving to the matter of relations with the public and employees. Technical matters, being left largely to the allied associations, composed of the technical men of the business, the parent association, in which are found the heads of the companies, devotes its attention largely to subjects of general interest to the industry.

Profit-sharing with Employees, The Relation of Carriers to the Development of the Territory They Serve, The Relief of City Congestion, Present Tendency of Public Service Laws and Regulations, Valuation, and Electric Railway Securities from the Investor's Viewpoint, are some of the subjects which will be discussed.

Among the speakers will be Frank Hedley, vice-president of the Interborough Rapid Transit Company, of New York; Paul Shoup, president, Pacific Electric Railway Company, Los Angeles; C. S. Sergeant, vice-president, Boston Elevated Railway Company; J. J. Burleigh, vice-president, Public Service Corporation of New Jersey; W. F. Ham, vice-president of the Washington (D.C.) Railway and Electric Company; C. L. S. Tingley, vice-president of the American Railways Company, Philadelphia; C. N. Duffy, vice-president, the Milwaukee Electric Railway and Light Company; Richard McCulloch, vice-president, United Railways Company, of St. Louis; C. W. Beall, of Harris, Forbes & Company, New York; A. D. B. Van Zandt, Detroit United Railway Company; David W. Ross, vice-president, Interborough Rapid Transit Company, New York; Frank Bergen, general counsel, Public Service Corporation, of New Jersey; C. M. Rosecrantz, general counsel, the Milwaukee Electric Railway and Light Company, and Assistant Surgeon-General W. C. Rucker, of the United States Bureau of Public Health.

NEW JERSEY REGULATIONS FOR THE DESIGN OF SEWERAGE SYSTEMS AND DISPOSAL WORKS.

AT a recent meeting of the Board of Health of the State of New Jersey, a set of rules and regulations governing the submission of designs for waterworks or sewage works were adopted. These rules have been under consideration for about a year, and the necessity for them has increased daily. Plans are submitted at the present time in all sizes up to 6 feet by 10 feet, and on all kinds of paper from the wrapping kind up to tracing cloth. It is also an unfortunate circumstance that some few engineers who have worked along other lines will accept work designing municipal sewage disposal or water purification plants apparently without investigating the underlying principles as thoroughly as is desirable. It then becomes necessary for the authorities to gather detailed data regarding the project, which very often cannot be done as efficiently as would be best because of the small number of engineers which may be employed with the present annual appropriation.

The present rules are therefore intended to prevent loss of time incident to the collection of fundamental data, upon which the design is based, and also to make the plans and reports more uniform in character. Before taking final action they were submitted to several of the leading sanitary engineers, with the request that comments and criticisms be made, so that no unjust provisions should be included which would cause unnecessary hardship or expense upon the part of the engineers. Many helpful suggestions were made by these engineers.

The following is extracted from the adopted rules and regulations:—

Sewerage Systems and Sewage Disposal Works.—The plans for a complete sewerage and sewage disposal system shall include the following:

A general map of the municipality or sewerage district.

Profiles of all sewers proposed.

Details of construction of manholes, flush tanks, and special structures pertaining to the sewers.

General and detailed plans for disposal works.

A comprehensive report upon the proposed system by the designing or consulting engineer. This report to be typewritten upon letter-size paper, and the sheets firmly bound together.

A preliminary report, containing data and information sufficient for the complete understanding of the project may be submitted to the State Board of Health for their consideration, prior to the submission of detailed plans.

Map or General Plan.—The general plan referred to shall be drawn to a scale not greater than 100 nor less than 300 feet to 1 inch, and shall show the entire area of the municipality or district. If the municipality is greater than two miles in length the map may be divided into sections, conforming in size to those mentioned under "Drainage." The sheets shall be bound together and a small index map supplied, showing by number the area covered by the various sheets. A general plan shall accompany each application, in the case of a new sewer system or any extension or modification of any existing sewer system unless such general plan has already been submitted.

The map shall show all existing or proposed streets, the surface elevations at all street intersections, and contour lines at intervals of not more than 10 feet.

If it is intended to defer the construction of sewers in some of the streets, the plan shall show that sewerage facilities are provided for all such sections of the municipality or sewerage district. The plans shall also clearly show the location of all existing sewers, either "separate" or "combined," the location of the disposal works, and the location of existing and proposed sewer outlets or overflows. The true or magnetic meridian, the town or borough lines, title, date, scale, direction of flow and average water elevation of the stream shall also be clearly shown. The elevation of the highest known freshets at the outlets and site of the disposal plant shall be given. Any area from which sewage is to be pumped shall be shown by light shading, coloring or other distinctive marks.

Letters and figures shall be clearly and distinctly made. Sewers to be built at present shall be shown by solid lines, and sewers to be constructed later shall be shown by a line of dashes, as - - - - - - - - -. Existing sanitary sewers shall be shown by the following symbol, ... , and combined sewers by a dot and dash, .—.—.—. All topographical symbols used are to be the same as those of the United States Geological Survey.

Elevations of the surface of the streets should be placed outside the street lines in the upper right angle, or opposite their respective positions in the street. The elevations of sewer inverts should be shown at street intersections, ends of line, and wherever a change of grade occurs. The elevations of the sewer shall be written close to the point to which they refer, parallel with the sewer line and between the street lines. The elevations of surface shall be shown to the nearest 1/10 foot; those of the sewer invert to the nearest 1/100 foot. The sizes and gradients of all proposed and existing sewers shall be marked along the line of the sewer.

All sewer appurtenances and unusual features, such as manholes, lampholes, flush tanks, siphons, pumps, etc., shall be designated on the plans by suitable symbols and referenced by a legend near the title.

Profiles of all sewers over 8 inches in diameter and of all 8-inch sewers, where gradients less than that given below are used, shall accompany the application. Profiles of all sewers must be approved before they are constructed.

Profiles of sewer lines shall be prepared and drawn to such a scale as to clearly show the structural features of the sewer. For ordinary use, the following scales are suggested: Vertically, 10 feet to 1 inch; horizontally, 100 feet to 1 inch. Both scales must be clearly shown upon each sheet. Upon these profiles shall be shown all manholes, flush tanks, lampholes, siphons, and stream crossings, with elevations of stream bed and normal water. Figures showing the sizes and gradients of sewers, surface elevations, sewer inverts, etc., should be shown with the same frequency as required for the map.

Grades, Etc.—The following gradients for sewers flowing half full are suggested as minimum grades for ordinary use, as with careful construction a theoretical velocity of approximately two feet per second can be obtained:—

Size of pipe.	Fall in feet per 100 feet of sewer.
8 inches	0.40 feet
10 inches	0.29 feet
12 inches	0.22 feet
15 inches	0.16 feet
18 inches	0.12 feet
20 inches	0.10 feet
24 inches	0.08 feet

The sewers should have a capacity when flowing half full sufficient to carry twice the future average flow twenty-five years hence, plus a sufficient allowance for ground water infiltration.

When grades lower than those given are used, an explanation and reasons for the use of such grades should be included in the engineer's report. On each sheet of profiles must be given, under the title, an index of the streets appearing on that sheet. Profile sheets shall be numbered consecutively.

Detail drawings of sewer sections except where terra cotta or iron pipe is used, and of all sewer appurtenances, such as manholes, lampholes, flush tanks, inspection chambers, siphons and any special structures, shall accompany the general sewer plans.

The detail plans shall be drawn to such a scale as to show suitably and clearly the nature of the design and all details, such as manhole frames and covers, iron pipes, valves, gates, etc.

Disposal Works.—The plans for the disposal works shall include a general plan upon which reserve areas or future extensions are clearly shown, and detail plans of the various units and structures which comprise the plant.

A weir or other measuring device shall be provided at some convenient point, and the installation of a recording device is recommended, and in particular instances may be required.

The detail plans shall show longitudinal and transverse sections sufficient to explain the construction of each unit. They should also show the distributing and drainage systems, general arrangement of any automatic devices, sizes of stone, gravel, or sand used as filtering material, and such other information as is required for the intelligent understanding of the plans.

Drawings.—All drawings submitted shall be neatly and plainly executed and may be traced directly on tracing cloth, printed on transparent cloth, or printed on any of the various papers which give distinct lines. All prints shall be clear and legible.

With the exception of the map, the following dimensions are suggested for ordinary use: Distance from top to bottom, 20 or 30 inches; length, 24 inches, 32 inches, 40 inches or 48 inches, or thereabouts. By this section it is intended to prevent the use of long profiles and unnecessarily large maps, which are difficult to file or to use.

Each drawing shall have legibly printed thereon the name of the town or persons for whom the drawing is made, the name of the engineer in charge, the date, the scale, and such references in the title as are necessary for the complete understanding of each drawing.

A report, written by the designing or consulting engineer, should accompany all plans for complete sewerage systems, and shall give all data upon which the design is based, such as:

Information Concerning Sewer Systems.—(a) The nature and extent of the area which it is proposed to include within the present system of sewerage, and of the area which it is planned shall ultimately drain into this system.

(b) The population to be served, both present and estimated for twenty-five years hence.

(c) The estimated per capita daily flow of sewage to be cared for.

(d) The total and per capita water consumption of the town at the present time.

(e) The allowance made for leakage into the sewers.

(f) The estimated daily flow of sewage, including leakage.

(g) The character of the sewage (whether domestic or including manufacturing wastes, and in case of the latter, the nature and approximate quantity of the same stated in specific terms).

(h) Method of flushing or periodically cleaning the sewers.

(i) That portion of the sewers to be built at the present time.

(j) The minimum grades of sewers for each size used.

(k) If there are sections which cannot drain into this system, the extent of such sections and the probable future disposition of the sewage from these sections.

(l) Distance of sewer outlet from shore and depth of water at mean tide at outlet, if outfall discharges into ocean or large stream.

A list of bench marks or fixed elevations should be included in this report.

Information Concerning Disposal Plant.—With regard to the disposal plant, the engineer's report shall cover the following subjects:—

(a) The method of disposal to be adopted and a description of the units of the system.

(b) The rate of working of each unit.

(c) If disinfection is to be used, the name of the disinfecting substance, the quantity per million gallons of sewage and the method of application.

(d) The nature of the body of water into which the effluent discharges, with particular reference to the run-off during dry weather.

(e) The disposal of sludge.

(f) All conditions peculiarly characteristic of the locality and which in any way affect the design of the system.

(g) Special devices used in connection with the disposal system.

(h) Special methods of maintenance or operation of the system.

(i) The results expected from the purification system.

(j) Explain any provisions for reserve units in pumping plants, pipe lines, filters, etc.

Specifications and Estimate of Cost.—Specifications for the construction of the system of sewers and sewage disposal works and an estimate of the cost of the same shall accompany all plans for new or original systems. With plans for extensions of existing systems, specifications may be omitted, provided that these extensions are to be constructed in accordance with specifications filed previously with original plans.

If the plans are solely for the extensions of an existing system, then only such information as is necessary for the comprehension of the plans will be required. This information must in general conform to the above requirements for a complete system.

Systems on Separate Plan.—Under ordinary circumstances the board will approve such plans only when designed upon the separate plan, in which all rain water from roofs, streets and other areas and all ground water, other than unavoidable leakage, is to be excluded.

No by-passes which may allow raw or partly purified sewage to be discharged from the sewers or disposal works shall be included in the plans, except by special permission of the board.

Water Supply and Water Purification Systems.—The plans for a complete water supply and water purification system shall consist of the following parts:

A general plan of the municipality or district, showing the proposed system.

Detailed drawings showing construction of any special structures in the distribution system.

General and detailed plans for the water purification works.

A comprehensive report upon the proposed system by the designing or consulting engineer. This report to be typewritten upon letter-size paper, and the sheets firmly bound together. A preliminary report, containing data and information sufficient for the complete understanding of the project may be submitted to the State Board of Health for their consideration, prior to the submission of detailed plans.

General Plan.—The general map referred to in paragraph 2 shall be drawn to a scale not greater than 100 nor less than 300 feet to 1 inch, and covering the entire area of the municipality or district to be supplied with water, and shall accompany each application in the case of a new water system, or any extension or modification of any water supply or water purification system, unless such a general plan of the entire area has been previously submitted.

If the municipality is greater than two miles in length, the map may be divided into sections, conforming in size to those mentioned under "Specifications." The sheets shall be bound together and a small index map supplied, showing by number the area covered by the various sheets.

This map shall show all existing or proposed streets, the surface elevations of all street intersections, and the elevations of the principal parts of the water system, such as water at the intake, in the reservoir or standpipe, etc. The map should show that water supply facilities can be provided for all sections of the municipality or district, even though the construction of pipe lines in some of the streets is to be indefinitely deferred. The location of intakes, valves, hydrants, reservoirs, pumps, standpipes and purification plant, and any special structures, shall be shown and referenced in a legend near the title. The size of pipes shall be written between the street lines and along the pipe. The map shall also show the true or magnetic meridian, title, scale, date, the municipal or district boundaries, the mean, low and high water elevations of water at the intake. If the site of the pumping plant is subject to flooding, the elevation of the highest known flood water must be given.

Letters and figures shall be clearly and distinctly made. Pipe lines to be built at present shall be shown by solid lines and those to be later constructed shown by broken lines. All topographical symbols used are to be the same as those used by the United States Geological Survey.

The elevations of the street intersections shall be placed outside the street lines in the upper right-hand angle or opposite their respective positions in the street.

Detail drawings of all special appurtenances, such as blow-offs, siphons, intakes, conduits, reservoirs, collecting galleries, filters, etc., shall be submitted.

Profiles of long conduits or pipe lines may be plotted to a convenient scale and shown on sheets of the sizes mentioned below.

Purification Works.—The plans for the purification works shall consist of a general plan upon which reserve areas or future extensions must be shown, and also the general layout of the various units of the process, together with the piping system.

The detail drawings shall include longitudinal and transverse sections sufficient to show the construction of each unit and part of the plant. They shall also show the distributing, drainage and cleansing systems, general arrangement of any automatic devices, sizes and depth of stone, gravel or sand used for filtering material, and such other information as is required for the intelligent understanding of the plans.

All drawings submitted shall be neatly and plainly executed and may be traced directly on tracing cloth, printed on transparent cloth or printed on any of the various papers which give distinct lines.

The following dimensions are suggested for ordinary use, with the exception of the general map: Distance from top to bottom, 20 or 30 inches; length, 24 inches, 32 inches, 40 inches or 48 inches or thereabouts. By this section it is intended to prevent the use of unnecessarily long or large maps, which are difficult to file or to use.

Each drawing shall have legibly printed thereon the name of the municipality or persons for whom the drawings are made, the name of the engineer in charge, the date, the scale, and such references in the title as are necessary for the complete understanding of each drawing.

Engineer's Report.—A report, written by the designing or consulting engineer, shall be presented with all plans for complete systems, and shall give all data upon which the design is based or which is required for the complete understanding of the plans.

When a purification or treatment plant is to be constructed, a measuring device shall be provided at some convenient point, and the installation of a recording device is recommended, and in particular instances may be required.

If no purification process is provided, the nature and extent of the watershed, with special reference to its sanitary condition, shall be fully and explicitly discussed, together with proposed methods and regulations for the prevention of accidental or other pollutions.

A small scale map of the watershed, showing the roads and the number and character of buildings, shall be included in the report. Other features which should be discussed in the report are: Storage capacity, average depth, general nature and area of the storage reservoir, liability of odors or tastes in supply, and removal of color, iron, or hardness.

If the water supply is to be taken from wells, describe the number, depth, size and construction of the same;

method of pumping, capacity of pumps, kind of strainer used, nature of ground through which wells will be driven, and probable flow of the wells. If collecting galleries are to be used, describe their construction.

Information Concerning Purification Plant.—The following information is required respecting the purification plant: The method of purification and a description of the units of the system; the rate of operation of each of the systems; the rate of operation of each unit of the plant; if any chemicals are used, the nature and quantity of each with a description of the appliances for adding the same to the water; a description of all conditions peculiarly characteristic of the water or locality which in any manner affect the design or operation of the system; a description of all special appliances used, any special methods of maintenance or operation of the plant, and the extent of purification expected or guaranteed.

If for purposes of fire protection it is necessary to provide by-passes, by which partly treated or raw water can be turned into the mains, they shall have valves upon them of such a character that they may be properly sealed by the State Board of Health.

The report should further include a description of the nature and extent of the area to which it is proposed to supply water, or which will ultimately be supplied from the system, the quantity of water to be supplied daily, and the population to be served, the portion of the system to be constructed at present and the minimum depth of pipe below the surface of the ground. A description of any provision for future units of pumping plants, filters, etc., should be given.

Should there be areas in the municipality or district which, on account of topography or for other reasons cannot be supplied with water, a definite statement to this effect must be made and the probable future supply of this omitted territory should be discussed.

Specifications.—Specifications and an estimate of the cost for the construction of water supply and water purification systems shall accompany all plans for new or original systems. With plans for extensions of existing systems or plants, specifications may be omitted, provided that these extensions are to be constructed in accordance with specifications filed with the original plan.

Extensions of Present Systems.—If the plans are solely for the extension of the existing system, only such information as is necessary for the comprehension of the plans will be required. This information shall, in general, conform to the above requirements for a complete system.

The application for approval of plans shall be made by the proper municipal authorities, persons for whom the work is to be done, or their properly authorized agents, upon blank forms, which will be supplied by the board.

The above regulations were prepared by C. G. Wigley, engineer of the board, under the supervision of R. B. Fitz-Randolph, chief of the Division of Food, Drugs, water and Sewerage, and adopted by the Board of Health of the State of New Jersey, June 23, 1913.

MEETING ON IRON AND STEEL.

A meeting of the American Institute of Mining Engineers under the auspices of the Iron and Steel Committee of the Institute, will be held in New York on October 16 and 17.

THE FINANCING OF ROAD ENGINEERING.

RECENTLY The Surveyor (London) published an article by Reginald Ryves, A.M.I.C.E., containing suggestions as to the policy which should be adopted in the United Kingdom for the raising of funds for road maintenance and improvement, and as to the manner in which these funds should be expended. Highway finance is a very different problem in Canada from what it is in the British Isles, where roads are short and population is dense; but there are many suggestions in the article mentioned which Canadian highway engineers will find practical.

The papers contributed to the Third International Road Congress on the subject of highway finance do not admit of summary in a form conveying correct ideas as to the merits of different methods of raising and applying revenue for road construction and maintenance; the reports are, nevertheless, very illuminating if we study the methods pursued in each country with due consideration for the prevailing circumstances. In nearly all countries the financing of road construction and maintenance is closely bound up with or is greatly influenced by the general principles of taxation adopted, and beyond this the methods followed depend very much upon the stage of development which the road system has reached. In some countries considerable sums are raised by the taxing of vehicles and from tolls, and in some cases payments are exacted from persons who habitually, or occasionally, use the roads in such a manner as to cause unusual wear and tear. In India vehicles are taxed and tolls are collected, and in some parts of that country the sums raised from tolls collected by the district boards are not only sufficient to defray the expenses of maintaining the roads, but leave considerable surpluses for other purposes. Such a tax is not more unreasonable in principle than the tax in this country upon certain classes of users of postal services, who pay much more than the cost of the service for the benefit of the country at large.

The expediency of any system or of particular measures depends upon the relations otherwise established between local and national finances, which may vary greatly, the national treasury being, in some countries, largely replenished by contributions from local taxation.

We have also to consider the extent to which the roads are used by certain groups of traders as well as in general trade and commerce, the manner in which the population is distributed, and the nature of their occupation. The equity of any particular system also depends upon whether the soil and climate, taken together, are much more favorable to road maintenance in some localities than they are in others. In countries in which the climate is much the same in all parts, and where the geological conditions are equally favorable as regards the cost of maintaining roads, and where, further, the population and local resources are fairly evenly distributed, it may be equitable and economical to charge the local authority with the cost of maintaining all roads, even when some of these carry a large proportion of through traffic.

When, however, the main roads traverse varying strata and areas differing considerably in climate, and where the population is unevenly distributed, and is engaged in many different callings, it is not equitable to charge the local authority with the cost of maintaining

*The reader is referred to an article in last week's issue descriptive of the Road Board and its methods of financing.

roads for through traffic, and may even be inequitable to make each authority maintain the roads for local traffic, unless the area of any such authority is fairly large. In an almost purely agricultural country, or one in which the distribution of industries and of the soils is very symmetrical, the consideration that the more costly roads are usually those running through rich soils is of some importance; but it is of very small importance in a country which is complex as regards soils, climates, and the distribution of population and of wealth, more especially when the population of that country includes a large spending element as distinct from the elements of primary economic significance.

The United Kingdom is such a country. In it financial equity can only be secured by defraying a considerable part of the costs of road maintenance out of the King's taxes, and a fair economic distribution of burdens can only be secured by something in the nature of a wheel tax, the whole of which would not necessarily be paid by those upon whom it was imposed, but would naturally be to a great extent, distributed among the persons directly or indirectly benefiting from the carriage of goods over the roads. The customer pays. All classes do not benefit equally from the existence of an efficient highway system, and those who use the roads as a means of rapidly amassing wealth, or as an accessory in the dissipation of wealth, should be taxed to pay for road maintenance, not only because they use the roads for such purposes, but also because they are the strong, active and efficient elements in the community. To a considerable extent roads are maintained by persons who use them and benefit by them less than any other classes of the community. It is desirable that taxes raised from users of the roads should be devoted to road maintenance, not as a punishment for the use of the roads, but because there will be a constant proportion between the amount of wear and tear and the amount of money raised, and it is here suggested that a wheel tax should be imposed on all vehicles, including bicycles, for the purpose of road maintenance. The sums raised from motor and petrol taxes should be included. These sums are at present devoted to a quite distinct purpose—that is, road improvement. This is much better than carrying out such improvements by means of loans (the loans granted by the Road Board* being only such in a secondary sense, and involving no charge upon the community for interest), but this must be regarded as a temporary expedient for rendering the road system as a whole more effective, and the aim should be to establish a state of equilibrium in which all sums raised by taxes on vehicles should be devoted to road maintenance, and to such minor improvements as do not lead to an increase in the cost of maintenance.

So far the improvements carried out with the Road Board funds have largely been, as a Scottish reporter to the Road Congress has expressed it, "quasi-permanent" rather than permanent in the true sense, and no attempt has yet been made to undertake generally such engineering works as are needed in some cases to make roads more efficient, and, in many other cases, to render them less costly in annual maintenance. It should be clearly understood that the policy here advocated—viz., the attainment of an equilibrium, and the allocation of Road Board fund to road maintenance proper—includes as a preliminary the extension of the wheel tax at the earliest possible date, the "hoarding" of Road Board funds until a sufficient sum is in hand and the carrying out once for all in each case, on definite stretches of road, such improvements as are necessary. It is further suggested that the expenditure of the Road Board fund should be to some extent rhythmic, and that, in addition to the annual expenditure on maintenance, there should be a steady hoarding of a surplus to be devoted, from time to time, to works of road improvement. One advantage of this system would be that, while the money was accumulating, there would be time for investigations into the different schemes of road improvement put forward, for the preparation of the plans, and for all preliminary work, so that when the time came to spend the money the whole of the improvements staff could be employed in furthering the executive work. Outside the larger cities, at any rate, the carrying out of road improvements by means of loans on which interest has to be paid is not sound finance. How can it be good finance to pay, say, £1,600 for an improvement which actually cost only £1,000? In the case of a long-term loan the total sum paid may be more than twice that actually expended on the work.

In the United Kingdom the conditions of trade and of business and personal activitity generally are such that a wheel tax on the broadest possible basis is a very fair method of raising revenue for the purpose of maintaining roads. If it can be argued that persons who do not use the roads benefit indirectly as much as those who do use the roads, it may equally well be argued that persons who do not actually use vehicles pay indirectly a full share of the cost of running such vehicles as are used in the dirtribution of goods. With a better organization of road maintenance, including an increase in the sizes of administrative areas, closer relations between one highway authority and another, and some general supervision of finance, procedure and staffs, by a body such as the Road Board, the funds raised at present by local taxation, added to those derived from vehicle and petrol taxes, and increased by an extension of the wheel tax would, it may safely be asserted, be amply sufficient for all purposes of road maintenance for a very long time to come.

CORUNDUM.

In spite of the large increase, in late years, in the manufacture and consumption of artificial abrasives, such as carborundum, alundum, etc., natural corundum is still preferred for certain purposes, and the Canadian deposits of this mineral yield practically the entire supply. In 1912 the production amounted to 1,960 tons, valued at $239,091, according to statistics contained in Economic Minerals and Mining Industries of Canada, by J. McLeish.

The corundum mines are situated in the eastern portion of the province of Ontario, in the townships of Carlow and Raglan, and mining operations have been in progress since 1900. At present, mining is being conducted solely by one corporation—the Manufacturers' Corundum Company—who have acquired the mines and mills formerly operated by the Ontario Corundum Company, in Carlow, and the Canada Corundum Company, in Raglan.

The corundum occurs in the form of crystals of various sizes, disseminated in syenite, and is won by quarrying the matrix, hand-sorting the broken rock, and crushing the richer material, with subsequent wet concentration. The average corundum content of the rock treated does not much exceed 6 per cent., and, as from 1½ to 2 per cent. are lost in concentrating, the recovery represents about 4 per cent. of the crude material.

Corundum-bearing rocks were first recognized in this area in 1897, and the mineral is found sparingly, but widely distributed in the rocks of this district.

MECHANICAL GRAVITY FILTRATION AT SASKATOON

TYPICAL RECORDS OF PLANT OPERATION WITH RESPECT TO QUANTITY OF WATER FILTERED, CHEMICAL TREATMENT, BACTERIAL REMOVAL AND COSTS.*—DESCRIPTION OF THE PLANT

By GEORGE T. CLARK,
City Engineer, Saskatoon.

THE city of Saskatoon obtains its water supply from the south branch of the Saskatchewan River. This river and its tributaries are being polluted by the sewage from a number of towns and cities, including Calgary, McLeod, Lethbridge and Medicine Hat. In addition to being contaminated, the water of this river is very turbid at certain seasons of the year, and it is generally believed that a turbidity in the water such as is presented in this case, consisting to a large extent of fine quartz particles, predisposes to enteric conditions.

For these two reasons, therefore, namely, periods of excessive turbidity and danger of contamination, the civic authorities decided that it was advisable to take the necessary steps to purify the water, and the writer was requested by the city to report on the subject of filtration. Before doing so, some filtration plants of different types were visited, including among others those at Albany, N.Y.; Hackensack, N.Y.; Harrisburg, Pa.; Philadelphia, Pa., and Columbus, Ohio; and the outstanding features of each were noted.

Requirements of Water Being Used for Domestic Purposes.—Water which is required for domestic purposes should possess the following qualities:—

(1) It should be free from disease-producing germs.

(2) It should be free from those allied organic forms, which are not conducive to health, although they may not as yet be recognized as accompanying disease.

(3) It must be uniformly clear and free from turbidity, whether such be produced by mineral or organic matter.

(4) It must be free from color, odor and taste.

The methods adopted by the city of Saskatoon to accomplish these results may be divided into three steps, viz., sedimentation, filtration and sterilization.

Sedimentation.—The sedimentation basin has a capacity sufficient to give the water 8 hours' subsidence, when the filter is working at full capacity, and is divided into two parts by a weir wall across the centre. In the north half of the basin, plain sedimentation takes place, and in the south half, sedimentation and coagulation.

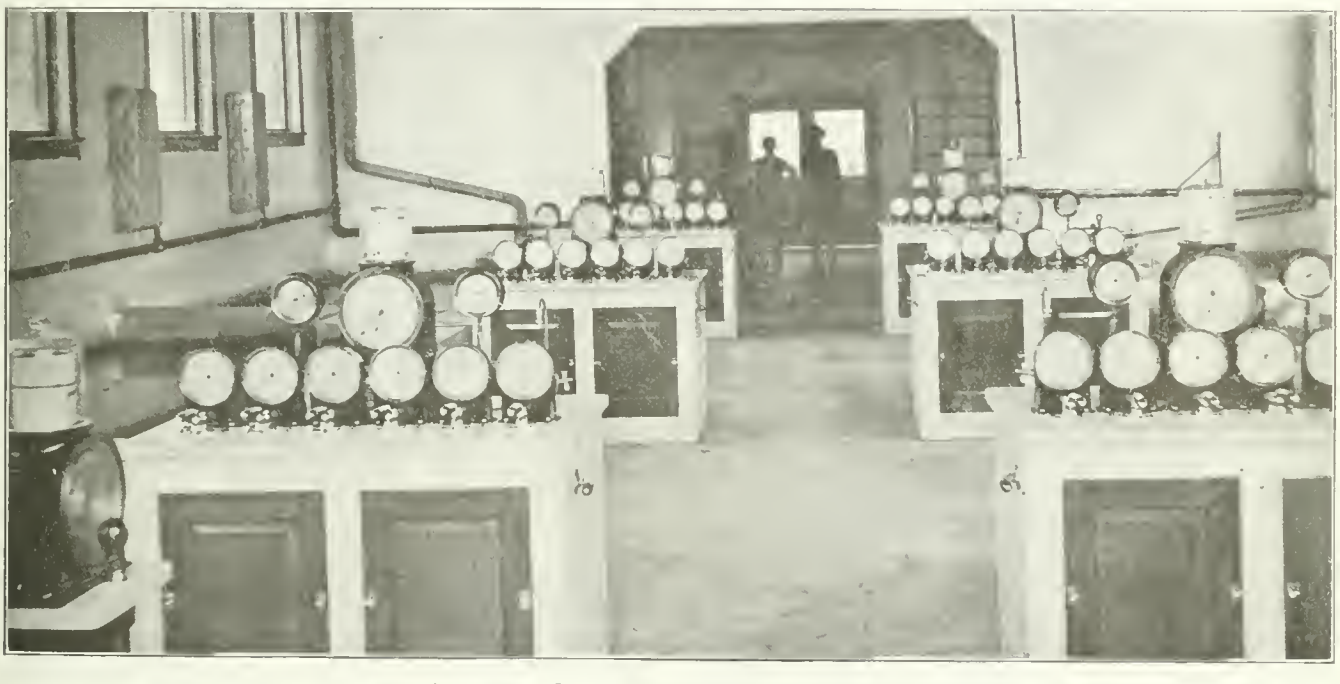

Fig. 1.—Section of Laboratory, Saskatoon Filtration Plant.

The coagulant used is sulphate of alumina, because the water has a sufficient alkalinity content, so that sulphate of alumina presents the necessary reaction to form an alumina hydrate, which, in precipitating, coagulates much of the organic matter, and drags down the finer suspended matter.

Provision has been made for applying the coagulant at three points: (1) When the water enters the basin; (2) when it passes over the weir; (3) just before it enters the filters.

The solution of sulphate of alumina used is 350 lbs. to 1,980 Imperial gallons of water or 1.8% solution.

Filtration.—The three best known types of filters were duly considered before a decision was arrived at, as to which one was best suited to our purpose. A very

* These Tables formed the basis of Mr. Clark's paper to the Canadian Public Health Association in Regina last month.

strong point in favor of the pressure filter was that, with this type of installation one system of pumps would have been all that was necessary to deliver the water from the river direct to the distributing system, whereas, with either of the other two systems a double pumping is necessary. The excessive turbidity of the water, however, made preliminary sedimentation absolutely necessary, and the idea of installing pressure filters had, therefore, to be abandoned. The gravity mechanical filter was chosen over the slow sand type for the following reasons:—

(1) The mechanical filter will handle 50 times more water per unit of area per day than the slow sand filter.

(2) The mechanical filter is, on account of being much smaller in area, much more easily protected from excessive cold.

(3) The initial cost of construction is about one-half.

(4) The cost of operating slow sand filters in the case of highly turbid waters is much in excess of mechanical filters.

(5) Cleaning the surface of slow sand filters requires the dangerous personal contact of workmen.

the form of a .5 per cent solution, and is applied to the water at the point where it enters the filter beds.

The total amount of hypochlorite used by us since the plant was first put in operation in June, 1912, has been only 900 lbs.

Results.—Table I. appended hereto is a typical monthly operating cost sheet. It will be noted that the chief items of expense are salaries of superintendent and operators, and the charge for interest and sinking fund. The cost for filtering for the month of August, 1913, per 1,000 Imperial gallons was 1.93 cents.

Table II. shows in detail the operation of the plant during the month of August. The quantity of water pumped and filtered, the chemicals used, and the turbidity of the water is given for each day.

Table III. illustrates clearly how the amount of coagulant required, and the amount of wash water used, vary directly as the turbidity. The amount of coagulant required varies from about one-quarter to one and one-half grains per gallon with an average for 8 months of ¾ of a grain, while the amount of wash water required

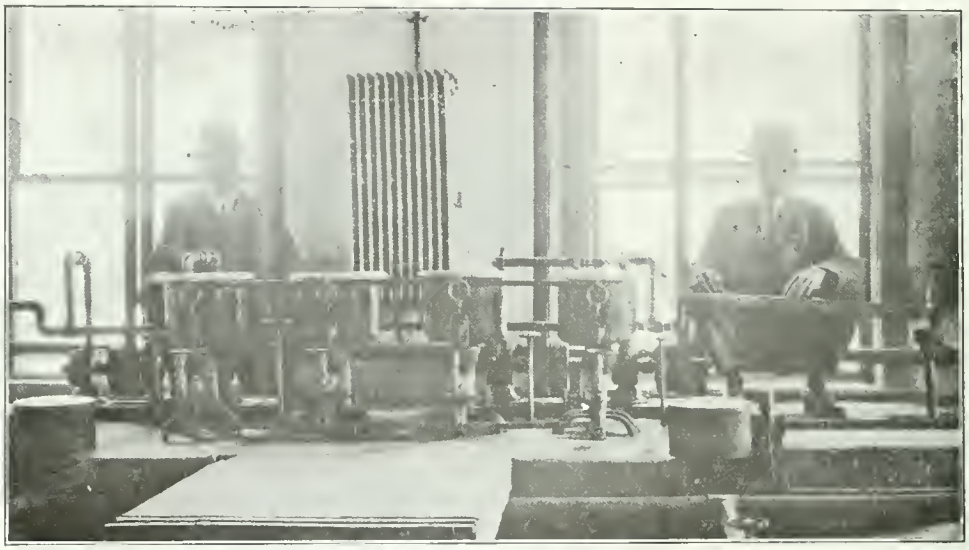

Fig. 2.—Apparatus for the Chemical Treatment, Saskatoon Filtration Plant.

Description of Plant.—The mechanical plant installed consists of the following:—

(1) One filtered water basin, capacity 125,000 Imperial gallons.

(2) Six concrete filter units, each with an effective filtering area of 290 sq. ft. The filtering material consists of an 8-inch layer of gravel, graded in sizes from .2 to .5 of an inch, the larger pebbles being placed on the bottom, and a 30-inch layer of sand graded from .36 of a millimeter to .55 of a millimeter, and consisting of hard silicious material free from vegetable matter or other foreign substance.

(3) A wash water pump and motor.

(4) An air compressor.

(5) A complete apparatus for preparing and feeding sulphate of alumina and hypochlorite of lime.

(6) Hydraulically operated valves for controlling the operations of the filter units.

Sterilization.—This is the third operation, which is sometimes required to be performed in cases where harmful bacteria are still present in the filtered water. It consists in our case of the addition of hypochlorite of lime in

varies from two and one-half to five per cent., with an average for 8 months of 3½%.

Table IV. shows that although the superintendence and interest and sinking fund remain constant, the turbidity is of sufficient range to vary the cost of filtering from a minimum of 1.4 cents per 1,000 Imperial gallons to a maximum of 2.16 cents, or an average for the eight months of 1.77 cents.

It is of interest here to note that the turbidity of the South Saskatchewan River water varies from 30 to 3,750 parts per million.

Table V. shows the bacterial removal efficiency for 8 months. For 6 months the removal has been 97%. For the month of February the removal was only 80%, but the bacterial count in the raw water was very small. The high count in the raw water in March is accounted for by the melting of the snow during that month, and the consequent depositing in the river of the filth collected in the snow during the winter months, and also by the increased volume of water underneath the ice scouring the river bottom.

A study of these records shows that the plant has, in respect to wash water required and bacterial removal, ful-

Table II.—Summary of Water Filtered and Chemical Distribution for Month of August.

Date.	Venturi, gallons per day.	Wash-water, gallons per day.	Alum used, grains per day.	Alum used, grains per gal.	Chloride, grains per day.	Chloride, grains per gal.	Turbidity, raw.	Turbidity, treated.
August 1st ...	2,043,000	72,000	1,208,644	0.57	123,600	0.058	130 p.p.m.	100 p.p.m.
" 2nd ...	2,027,000	72,000	938,304	0.45	185,380	0.089	130 "	100 "
" 3rd ...	1,468,000	72,000	982,584	0.64	77,250	0.05	130 "	100 "
" 4th ...	2,082,000	72,000	1,009,152	0.45	47,628	0.06	110 "	65 "
" 5th ...	2,081,000	72,000	1,009,152	0.45	126,908	0.059	120 "	65 "
" 6th ...	1,856,000	72,000	912,744	0.47	63,504	0.060	120 "	100 "
" 7th ...	1,827,000	72,000	623,520	0.33	0	0	100 "	90 "
" 8th ...	1,772,000	72,000	752,084	0.41	0	0	100 "	90 "
" 9th ...	1,643,000	72,000	623,520	0.36	0	0	100 "	85 "
" 10th ...	1,464,000	.....	623,520	0.43	0	0	75 "	55 "
" 11th ...	1,706,000	72,000	703,860	0.4	0	0	75 "	55 "
" 12th ...	1,737,000	60,000	623,520	0.35	0	0	75 "	55 "
" 13th ...	1,817,000	60,000	691,584	0.35	0	0	95 "	75 "
" 14th ...	1,688,000	60,000	665,860	0.38	0	0	75 "	55 "
" 15th ...	1,748,000	60,000	666,060	0.36	0	0	65 "	50 "
" 16th ...	1,793,000	60,000	666,060	0.36	0	0	65 "	45 "
" 17th ...	1,487,000	.....	623,520	0.40	0	0	65 "	45 "
" 18th ...	1,750,000	60,000	623,520	0.34	0	0	80 "	55 "
" 19th ...	1,660,000	60,000	768,132	0.45	0	0	130 "	80 "
" 20th ...	1,842,000	60,000	1,328,863	0.7	0	0	180 "	70 "
" 21st ...	1,701,000	60,000	1,238,823	0.7	74,088	0.07	150 "	45 "
" 22nd ...	1,869,000	60,000	1,210,000	0.63	127,008	0.066	180 "	45 "
" 23rd ...	1,893,000	50,000	1,210,008	0.62	127,008	0.065	250 "	65 "
" 24th ...	1,559,000	60,000	1,067,728	0.66	127,008	0.078	200 "	70 "
" 25th ...	1,937,000	60,000	1,158,203	0.58	68,790	0.06	180 "	70 "
" 26th ...	1,917,000	72,000	1,702,913	0.8	108,528	0.09	250 "	70 "
" 27th ...	1,920,000	72,000	1,953,542	0.98	186,048	0.093	350 "	65 "
" 28th ...	1,856,000	72,000	1,869,999	0.96	186,048	0.096	400 "	45 "
" 29th ...	1,910,000	72,000	1,524,839	0.76	54,264	0.094	300 "	30 "
" 30th ...	2,061,000	72,000	1,438,727	0.69	0	0	300 "	35 "
" 31st ...	1,347,000	72,000	1,451,200	1.plus	0	0	500 "	100 "
	55,361,000	1,922,000	31,870,204	0.556	1,683,060	0.063		

Water pumped to city mains.....55,361,000 gallons
Wash-water used ..... 1,922,000 "

Total water filtered .....57,283,000 gallons

Pounds of sulphate of alumina 4,552.8
Pounds of hypochlorite of lime used 240
Average turbidity of raw water .....167 p.p.m.
Average turbidity of treated water ..... 67 p.p.m.
Per cent. reduction turbidity by sedimentation 60 p.p.m.

filled the guarantee given by the Roberts Filter Manufacturing Company who installed it.

Table I.—Monthly Expense Report for the Month of August, 1913.—Filtration Plant.

Salaries of operators and superintendent .....$	315.00
Bacteriologist	58.33
Additional labor, none	
Alum, 4,550 lbs. at $2.25 per cwt.....	102.37
Hypochlorite, 240 lbs., at $2.74 per cwt.	6.58
Wash water, 1,922,000 gallons at 6 cents per 1,000 gallons	115.32
Stores, none	
Power, 1,077 kw.h. at 6 cents per kw.h.	64.62
Light, 235 kw.h. at 6 cents per kw.h.	14.10
Heat, none	
Repairs, none	
Laboratory, fixed charge of	25.00
Interest and sinking fund	400.00
Total cost for the month .....$	1,101.32

Water filtered for month, 57,283,000 gallons.
Cost of filtering, per 100,000 gallons, $1.93.

Table III.—Summary Showing Average for Eight Months' Operation.

	Alum.	Wash-water.	Filtered water.	Cost per 1,000 gals.
Jan.	None	1,300,000	78,095,704	1.23 cents
Feb.	None	1,213,968	75,631,738	1.19 "
Mar.	1,900	2,323,000	82,321,140	1.27 "
Apr.	19,380	4,388,880	79,591,588	2.04 "
May	11,580	2,800,000	61,919,060	2.13 "
June	12,675	2,842,800	59,416,800	2.30 "
July	7,475	2,316,000	58,541,000	2.04 "
Aug.	4,550	1,922,000	57,083,000	1.93 "
	57,560	19,610,640	552,600,030	14.13 cents

Average grains of alum per gallon for period of excessive turbidity 1.52
Average grains of alum per gallon for period of normal turbidity 0.28
Average grains of alum per gallon for period of eight months 0.73
Average amount of wash-water for period of excessive turbidity .....4.9 %
Average amount of wash-water for period of normal turbidity 2.58%

Average amount of wash-water for period of eight months 3.45%

Table IV.—Average Cost of Operation.

Average cost of filtering 1,000 Imperial gallons during period of excessive turbidity	2.16 cents
Average cost of filtering 1,000 Imperial gallons during period of normal turbidity	1.4 "
Average cost of filtering 1,000 Imperial gallons during period of eight months	1.77 "

Table V.—Bacterial Removal.

Month.	Bacteria. Raw water.	Bacteria. Filtered water.	Efficiency. Per cent. removal.
January, 1913	27.0	1.4	95.5
February	2.5	0.5	80.0
March	11,144.0	16.0	99.8
April	4,644.0	20.0	99.6
May	4,172.0	37.0	96.7
June	2,553.0	28.0	99.0
July	7,358.0	21.0	99.7
August	2,199.0	42.0	98.1

THE LINCOLN HIGHWAY.

Thirteen States will be traversed by the Lincoln Highway, the route of which has been definitely announced. They are New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Iowa, Nebraska, Wyoming, Colorado, Utah, Nevada and California.

Starting in New York City, the Highway passes through Jersey City, Newark and Trenton to Philadelphia, then west to Pittsburg, through the north central section of Ohio, over to Fort Wayne and South Bend, skirts Chicago, enters Joliet, Rochelle, Sterling and other Illinois cities, reaches Iowa at Clinton and leaves at Council Bluffs, passes through Omaha, goes to Denver and north to Cheyenne, west through Green River and Evanston to Salt Lake City, finds its way into Nevado by way of Tippet's ranch, and after reaching Reno, goes to Lake Tahoe, California, finally ending on the Pacific seaboard at Oakland and San Francisco. The directors of the Association have endeavored to select a route of easy grades, yet combining the scenic splendors of the country.

Makers of carbon black at Wilsonburg, W. Va., obtain free power in a novel manner. The product is deposited from the flames of natural gas, and power was originally supplied by a steam boiler and engine. The gas issued at a pressure of 950 pounds from a well 3,000 feet deep. It was suggested that this pressure might be utilized, and accordingly the gas was led in place of steam to the engine, which was thus driven, and acted as a reducing valve, delivering the gas at low pressure to a discharge tank feeding the carbon buildings. The engine, requiring no attendant, continues to give uniform and satisfactory service.

The Canadian General Electric Company, Limited, have just acquired by purchase all the plant and assets of the Stratford Mill Building Company, at which plant in future will be manufactured not only the flour mill machinery heretofore manufactured by the Stratford Mill Building Company, but also the wider range of machinery and equipment as produced by the Allis-Chalmers Company. Mr. William Preston, who has been the president of the Stratford Mill Building Company, will now act as manager of the flour mill machinery department of the Canadian Allis-Chalmers Company.

BELT CONVEYERS.

By Reginald Trautschold, M.E.

(PART II.)

(Continued from page 480, Sept. 18th issue.)

THE operation that presents the greatest difficulty in any belt conveyer system, if wear and tear are to be kept at a minimum, is that of loading the conveyer, for it is at the instant that the load comes in contact with the conveyer belt that the main wear occurs and greatest depreciation of equipment takes place. Loading should always—when practicable—be accomplished through chutes discharging in the direction of conveyer travel, and it is in the design of these chutes that one of the greatest problems of an efficient installation is presented. The slope of the chute should be such that the velocity of the material as it leaves the chute is as nearly as possible the same as that at which the conveyer belt is running. The bottom of the chute should also be provided with an adjustable curved lip, conforming to the trough of the belt and turning upward sufficiently to throw its discharge forward in a plane approaching that of the conveyer belt, thus minimizing the shock of impact as the load strikes the belt and is carried forward by it. The loading chute should always be located slightly in advance of a troughing idler and should be provided with parallel skirt boards extending along the conveyer and parallel to the belt, an inch or so above it, for a distance equal to about twice the distance between troughing idlers—i.e., a troughing idler should be located just back of the chute, one not quite midway along the skirt boards, and one just before the load leaves the confines of the guides. These skirt boards should be separated by a space a few inches less than the width of the belt—less than the section of belt covered with load—and should advisably have triangular cleats attached to their inner sides for the section lying in the path of the material descending the chute—such cleats tend to throw the load towards the centre of the conveyer belt and thus minimize necessary rearrangement of load as it passes from between the skirt boards.

One drawback to what would otherwise be probably about the most efficient and economical mechanical conveying system that could be devised is that belt conveyers are limited as to the inclination at which they can be efficiently operated, necessitating considerable space if any considerable elevation is to be attained; that is, the height through which a load can be raised in a given distance. This limitation is governed to considerable extent by the angle of repose of the material conveyed—particularly the angle of repose of the material on the belt—for just as soon as the inclination of the conveyer is great enough to cause a slippage of the load on the belt disastrous wear occurs and depreciation more than offsets any possible gain of simplicity and convenience of system, etc. The tendency towards agitation of load by oscillation of the loaded conveyer belt as it passes over troughing idlers also augments the harm of excessive inclination of conveyer, so that, with the average class of material handled on such systems, it is dangerous to have the inclination of the conveyer from the horizontal greatly exceed 21 or 22 degrees—equivalent to a rise of about 36 to 37 feet per 100 feet of conveyer. With this one limitation and, of course, the disadvantage that belt conveyers cannot turn corners and must be run, therefore, in one general direc-

tion, a belt conveyer may be installed in almost any position, including horizontal, inclined, inclined with horizontal stretches of conveyer and with the belt rising in a gradual curve from a horizontal to an inclined plane. The latter arrangement is theoretically limited to the curve that would be assumed by a fully loaded belt supported only at points of tangency with the horizontal and inclined planes of the conveyer when the tension in the belt is that necessary for the satisfactory operation of the conveyer—the pull required to draw the loaded belt along at the proper speed. This curve would be a parabola, but in practice such extreme refinement of curve is not practicable and the troughing idlers for the curved section of conveyer are usually mounted so that the conveyer belt resting on them will follow the arc of a circle of about 300-foot radius. This proportion is usually satisfactory for belts of any ordinary width and the conveyer fully loaded with the average class of material usually handled by belt conveyers—the fully loaded belt will then rest on the troughing idlers, though the belt of an empty conveyer will frequently not touch them.

It is in the consumption of power that the belt conveyer has a decided advantage over the types of conveyers already discussed, and with its comparatively large carrying capacity, due to the high speed at which it can be run, when handling ordinary classes of material in bulk, it becomes one of the most valuable and economical of labor-saving devices. As in the case of any mechanical type of conveyer, power is required for three distinct operations when operating the system: 1st, for running the conveyer itself, i.e., the power required to operate the driving machinery, pull the belt over the idlers—neglecting all load other than the weight of the moving parts—etc.; 2nd, for conveying the load itself; and 3rd, for elevating the load, should the conveyer be an inclined one. The power required to pull the belt over the idlers varies with the construction of the troughing and return idlers and is naturally considerably less in conveyers with ball-bearing idlers than in conveyers employing less economical mechanisms, but this item of power is in reality but a comparatively small percentage of the total power required and when the inefficiencies and loss of power in the driving mechanisms—usually consisting of a train of gears—is taken into consideration the power requirements for running an empty conveyer really have comparatively little effect upon the total amount of power that must be supplied and may be considered with safety as bearing some definite relation to the width of the belt and the weight of the moving parts. The second demand for power, that for moving the load itself, is not so much effected by the refinements of idler construction and varies practically with the speed of the conveyer and the load handled, irrespective of size of conveyer, etc. Power necessary to elevate the load is very nearly that theoretical amount that would be required to raise the specified load through a vertical distance equal to the difference in elevation between the point at which the conveyer is loaded and the highest elevation to which the load is carried—for practical purposes, the difference in elevation between the two ends of the conveyer—as no appreciable increase in resistance to the movement of load takes place in an inclined conveyer other than the overcoming of the force of gravity. In the derivation of the following formula (Formula XIV.) conservative values for all variable factors—values obtained from numerous experiments and examination of data from a large number of efficient installations of belt conveyers—are employed and the results from its use agree very closely with the power demands for the ordinary efficient installation. Exceptional installations are found that discount this formula but the inefficiencies of the ordinary driving mechanisms make dependence on other formulæ for ascertaining horsepower requirements that give smaller results dangerous. Formula XIV. gives the total horsepower required to drive the average efficient belt conveyer when continuously and uniformly loaded to its capacity, but does not allow for the additional power requirement for trippers or fixed dumps. Such discharging devices all consume approximately the same amount of power, irrespective of load carried, and Formula XIV.-a gives values that should be allowed for each discharging device of such type for conveyers from 12 to 36 inches in width, the average range of sizes found in practice. For conveyers narrower than 12 inches, an allowance equal to that for a 12-inch conveyer should be made for each discharging device and for conveyers of over 36 inches in width the allowance for 36-inch conveyers is usually ample, unless the conveyer should be one of exceptional size. Chart III. gives the same data as Formula XIV. in a convenient form for rapid calculations and sufficiently accurate results are attainable from its use for all practical purposes.

Horsepower:

W = Weight of load handled in tons per hour (capacity).
V = Velocity (speed) of Conveyer in feet per minute.
L = Length of Conveyer in feet—distance between end pulleys.
H = Height to which load is elevated in feet (incl. Conv.)
= Difference in elevation in length of Conveyer.
w = Width of belt (Conveyer) in inches.
W′ = Weight of load handled per minute per foot of Conveyer in lbs.
= 2000 W ÷ 60 V.
W_b = Weight of moving parts of Conveyer (belt) per foot in lbs.
= 0.7425 w.
f_s = Speed factor.
= 0.004 w—from experiment.
f_l = Load factor.
= 0.080—from experiment.

Horsepower required to run Conveyer empty :—

$$= \frac{W_b \times f_s \times V \times L}{33{,}000} = \frac{0.00009\ w^2 V L}{1000}$$

Horsepower required to convey load :—

$$= \frac{W' \times f_l \times V \times L}{33{,}000} = \frac{0.08\ WL}{1000}$$

Horsepower required to elevate load :—(Inclined Conveyer)

$$= \frac{2000\ W \times V \times H}{60\ V \times 33{,}000} = \frac{WH}{1000}$$

Then, total horsepower required :—

$$HP = \frac{(0.00009\ w^2 V + 0.08\ W)L + WH}{1000} \qquad \text{Formula XIV.}$$

Additional horsepower required for each tripper or fixed dump :—

$$HP = \frac{(w-10)}{8} \qquad \text{Formula XIV-a.}$$

(Conveyers 12″ to 36″ inclusive)

Though exceedingly economical in the consumption of power, belt conveyers are expensive as far as first cost is concerned if satisfactory wear and freedom from the annoyance of break-downs are to be obtained and the true economic value of the equipment realized. That is, all apparatus should be of the highest grade; particularly the belt, which should be, as previously stated, of duck-rubber construction with a suitably thick resilient cover of rubber to withstand the abrasive wear of the load moving on its carrying surface—a certain readjustment in position of load on the belt being unavoidable in even the best designed and most carefully installed conveyers. Owing to the extreme simplicity of construction, the cost of the various component parts of a belt conveyer vary closely either with the width of the belt, as for conveyer

pulleys, drive, etc.; or with both the width and length of conveyer, as for idlers, belt, etc., and a conservatively accurate equation can be derived for ascertaining the approximate cost of any belt conveyer of given size. Such an equation follows, Formula XV., which gives the total average cost of a conveyer equipped with a high-grade rubber belt and machinery of a high class. A similar conveyer, equipped with a good grade of stitched canvas conveyer belt, would cost but about half as much and systems may be purchased for any price between these two limits, depending upon the character and quality of the conveyer belt. The best grade of belt is really the most economical, however, as a conveyer so equipped will have a much longer life than one where false economy is attempted by the purchase of an inferior belt whose depreciation is bound to be rapid. In fact, it is only with the highest grade of all equipment that the full economic value of a belt conveyer system can be realized—this point cannot be too strongly emphasized. Table VII. gives equations for ascertaining the approximate cost of the various discharging devices which are customarily employed with belt conveyer systems, all of which vary approximately directly with the width of the conveyer (belt) rather than with the capacity of the system when handling any particular class and weight of material.

Initial Cost:

C = Cost of equipment in dollars.
w = Width of Conveyer (belt) in inches.
L = Length of Conveyer in feet—distance between end pulleys.

Cost of idlers per foot of Conveyer = $0.184\ w - 0.899$
" belt " " = $0.303\ w - 1.261$
" other machinery = $4.633\ w$

$$C = (0.487\ w - 2.16)L + 4.633\ w \qquad \text{Formula XV.}$$

Table VII.—Approximate Cost of Discharging Devices for Belt Conveyers.

Apparatus	Cost in dollars
Automatic Tripper - -	$15.7833\ w + 189 + 1.13L_t$
Hand-propelled Tripper -	$9.0\ w + 106.28 + 1.13\ L_t$
Fixed Dump - - - -	$2.8\ w + 16.4$

w = width of Conveyer (belt) in inches.
L_t = Length of Tripper Track—total travel of Tripper.

Although the carrying capacity of a belt conveyer varies with the square of the width of the conveyer belt, the necessity of loading devices, discharging apparatus, etc., that varies in cost with the size of conveyer, permits the expression of the average cost of a belt conveyer system in terms of the carrying capacity of the conveyer—i.e., average carrying capacity. Such classification is not as accurate for ascertaining the approximate cost of such a system as the formula based on the width of the belt, but for purposes of arriving at the average net cost of operation of a system, where only relatively small percentages of the initial cost enter into the question, an equation for approximating the cost of equipment, expressed in terms of the average tonnage per hour capacity, is sufficiently accurate for forming a conservative calculation of the average net operating cost of the ordinary belt conveyer installation. Particularly is this so for installations where the material handled is particularly heavy and where the initial cost ascertained by such an equation would be correspondingly low, the depreciation charge is apt to be very much greater than in an ordinary installation—the two inaccuracies, as to formula, thus tend to compensate for one another and the results obtained by the use of the formula for arriving at the measure of economic value of the system is approximately correct in any case. Depreciation on all component parts of a belt conveyer are not equal, of course, but a fairly reliable average value—one for the relatively expensive belt and the other for the balance of the machinery or equipment—does exist, provided for in the derivation of Formula XVI., which permits a close calculation of the true economic value of any belt conveyer system if the cost of power is known and the system is kept in good working condition and subject to efficient operation—i.e., is used frequently, for no conveying installation can be a really efficient one if allowed to remain idle much of the time.

Net Operating Cost (N.O.C.) of Belt Conveyers:—
L = Length of Conveyer in feet—maximum distance load is carried
H = Height (distance) through which load is elevated.
W = Weight of load conveyed in tons per hour (capacity).
N = Number of hours (total) Conveyer is in use per year.

Average Cost of Equipment:—
$= 0.0904\ WL + 1.07\ W.$

Fixed Charges:—

Interest	6% total cost	$= 0.00768\ WL + 0.091\ W$
Insurance....	1%	
Taxes	2%—¾ cost	

Depreciation, renewals, etc.:—

On belt	$0.01990\ WL$
machinery	$0.00317\ WL + 0.107\ W$
Depreciation account..	$0.00025\ WL + 0.011\ W$
Total Depreciation, etc.	$0.02332\ WL + 0.118\ W$

Yearly Burden:
$= 0.031\ WL + 0.209\ W$

Horsepower, attendance, supplies, etc.:—
P_c = Price (cost) of a horsepower per hour.
Average consumption of power $= 0.00021\ WL + 0.001\ WH$

	Horizontal Conveyer	Inclined Conveyer
Cost of Power	$0.00021\ WLNP_c$	$0.001\ WHNP_c$
Attendance, etc.	$0.0000122\ WLN$	negligible
Supplies, etc. ..	$0.0000128\ WLN$	negligible

Burden depending upon use of Conveyer:—
$= (0.00021\ WP_c + 0.000025\ W)LN + 0.001\ WHNP_c$

Then:

Net Operating Cost (N.O.C.) per ton:—

$$N.O.C. = \frac{31000\ L + 209000 + (210\ P_c + 25)LN + 1000\ HNP_c}{1{,}000{,}000\ N} \qquad \text{Formula XVI.}$$

Examples.

1. Conditions:—

Length of Conveyer	100′—0″	= L
Material Elevated..	20′—0″	= H
Service.....	2400 hours per year	= N
Cost of Power	$0.02 per horsepower per hour	= P_c

$$N.O.C. = \frac{3100000 + 209000 + 7008000 + 960000}{2{,}400{,}000{,}000} = \$0.00470 \text{ per ton conv'd}$$

2. Conditions:—
The same as in the preceding example except that service is but 1200 hours per year.

$$N.O.C. = \frac{3100000 + 209000 + 3504000 + 480000}{1{,}200{,}000{,}000} = \$0.00608 \text{ per ton conv'd}$$

The typical examples cited well indicate the real value of the belt conveyer as a means of transferring material from place to place, as the conditions assumed are very frequently found in practice. An interesting point is brought out by these examples, namely, that a belt conveyer is much more economical if in continual use than if used only occasionally. This is due to the facts that the system is very economical in the consumption of power, that the expense for attendance or labor is low when charged to actual tonnage handled, and that supplies, such as waste, lubricants, etc., are also low, while the burden of interest on investment, taxes, insurance, etc., is relatively high and is constant, no matter how frequently the conveyer is used. The burden of depreciation which is charged as the same in the two examples and so proportioned in Formula XVI., does not depend upon the hours of operation—provided, of course, that the conveyer

is in use a fair number of hours each year—as depreciation is almost as rapid in an idle conveyer as in one that is in continual use, for proper attention and care is rarely accorded the equipment unless it is in actual service. In fact, unless the conveyer belt is carefully cleaned, removed from the conveyer and stored in a place of even temperature, free from acid, hydro-carbonaceous fumes,

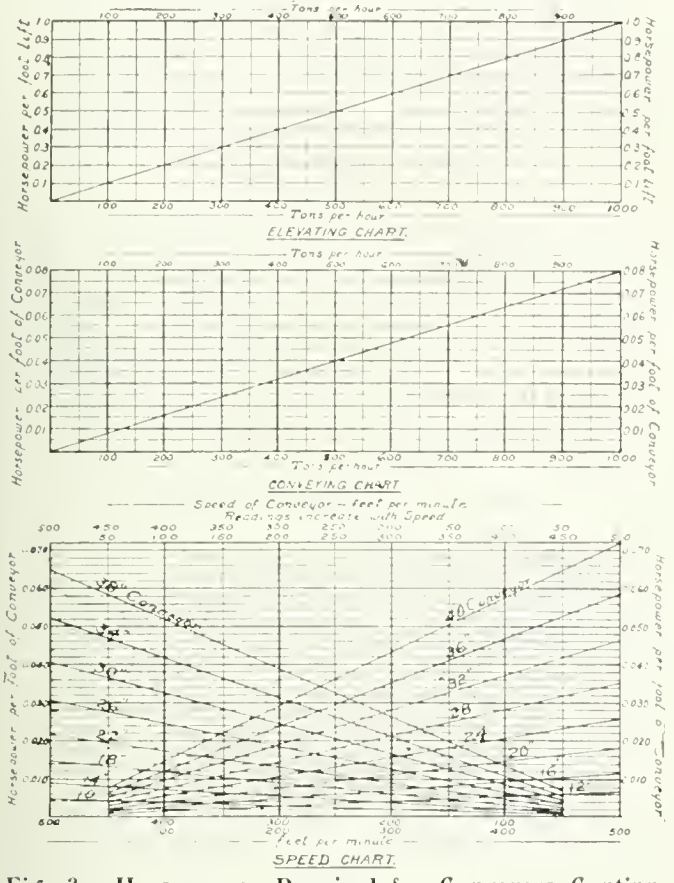

Fig. 3.—Horse-power Required for Conveyers Continuously and Uniformly Loaded.

Note.—To ascertain total horsepower required, multiply the sum of Speed Chart and Conveying Chart readings by total length of Conveyer in feet and add the Elevating Chart reading multiplied by total lift in feet. For each discharging device add an additional 1/8 horsepower for each inch of Conveyer (belt) in excess of 10 inches.

moisture, etc., etc., its deterioration may be even more rapid than if actually used for carrying material for, in use, particles of the load have a tendency to stick to the belt and to protect it from the injurious effects of many agents. This all emphasizes the economic fact that the more economic a piece of apparatus the greater the necessity of its continual use in order to realize the maximum benefits.

In this discussion, no attempt has been made to indicate the wide use to which belt conveyers may be put, such as picking conveyers for the sorting of ores, etc., the handling of mail in post offices, packages in department shops, cements in bags, etc., etc., but the discussion has been limited rather to one of conveyers for handling material in bulk. The laws and rules that have been laid down, however, can easily be modified to meet almost any condition of service, for the power consumption of belt conveyers depends almost entirely upon the load carried, distance of transfer, and inclination of conveyer. The question of width of conveyer (size) has little effect upon the consumption of power. Initial cost, on the other hand, really depends almost entirely upon the size of the conveyer so that only a modification of the various formulæ that have been given need be made to fit almost any special use of belt conveyers. Reference will also be made to this class of conveyer when describing certain special installations and operations, for such equipment is found in almost any modern enterprise.

THE CANADIAN LOCOMOTIVE COMPANY'S NEW PLANT.

An idea of the radically different layout of shops at the Canadian Locomotive Company's plant, at Kingston, Ont., as at present being changed, may be gathered from the accompanying plan. On the completion of the buildings there shown, the whole plant will be essentially new, as while three of the buildings are shown as being old, the only one of these three that goes back ten years is the machine shop to the right, completed some few years ago. The power house has only been in operation about eight years, and the boiler shop is less than two years old, so that with the new shops, the plant will be almost entirely new throughout, replacing the antiquated buildings with which the company has heretofore been compelled to do business.

The whole area shown in the plan has been more or less covered with a miscellaneous collection of old stone buildings, scarcely adapted to the work done, except under adverse conditions of operation. The problem presented was that of removing these old buildings, and re-

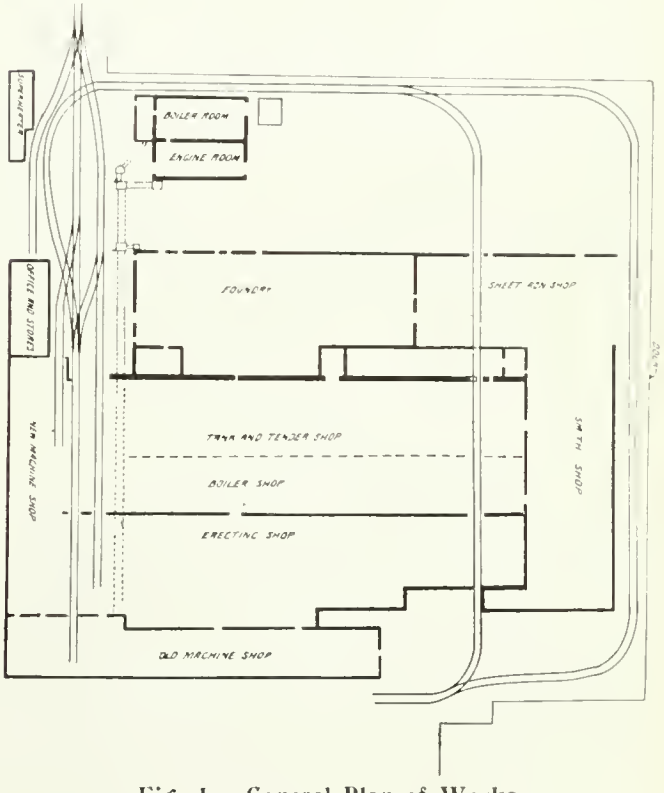

Fig. 1.—General Plan of Works.

placing them with newer ones without interfering with the locomotive construction work. This is being accomplished by razing the old buildings one at a time, and on the cleared site, erecting the new ones.

The work of reconstruction was first commenced on the buildings to the north of the old boiler shop, erecting the new tank and tender shop on ground unoccupied, and then tearing down the old tender shop for the erection of

the new foundry and yard runways on the site of same. Following this, the old foundry has been torn down, and on its site a portion of the new erection shop is now being erected.

Fig. 2 shows an interior view of the centre bay of the foundry, which is used for moulding all heavy parts. The building has a high monitor with continuous sash operating the whole length, so that all smoke and gases can find an easy exit.

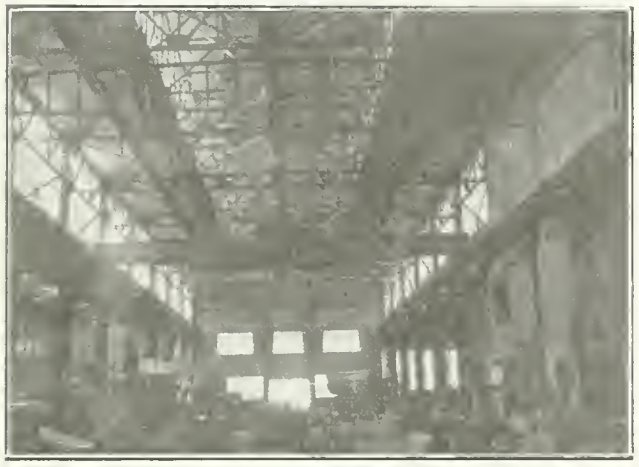

Fig. 2.—View of Centre Bay of Foundry.

A cross-section of the new erecting shop is shown in Fig. 3. This has a centre bay 80 feet wide with a 200-ton travelling crane for lifting locomotives and a 20-ton travelling crane below it. There will be fifteen erecting pits running crosswise, spaced at 17-foot centres, in this shop when completed. This shop has two side bays with galleries in which will be located pipe shop, superheater shop, paint shop and electrical departments. The main bay opens directly into the new machine shop, and runs at right angles to same, while the 20-ton crane in the erecting shop runs 20 feet into the machine shop, so as to deliver heavy material directly to engines there being erected. The new machine shop will also be served by a 20-ton travelling crane.

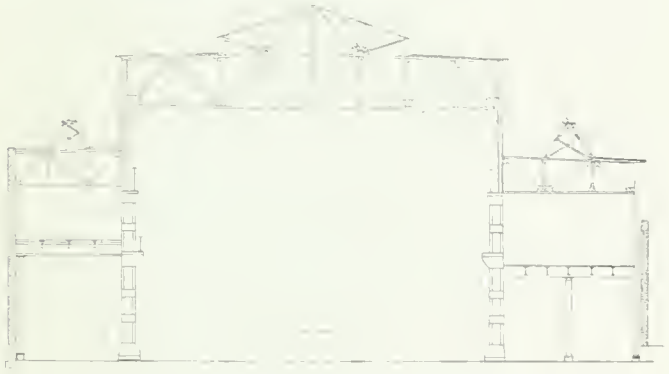

Fig. 3.—Cross-Section Through Erecting Shop.

A carpenter and pattern shop with pattern storage is being erected on a new site. As soon as these are completed the present carpenter shop, located at the south end of the old boiler shop and new tank and tender shop, will be torn down to provide space for a new blacksmith and hammer shop to be erected on this site. Following this, the old blacksmith shop will be razed and an addition to the new erecting shop and the old boiler shop will be built.

After these buildings are completed the old erecting shop and stores and office building running on Ontario Street will be demolished, and on this site a new four-story reinforced concrete store and office building, and a new machine shop will be built.

The convenience of the layout is at once apparent. Every building will be in open communication with all the others. In addition, it will be noted that the focal point of construction is the erecting shop, about which every building in the plant is arranged, all the parts feeding directly into that final point.

The total area of the plant covers about 9.5 acres and 7.5 acres of this will be covered by buildings.

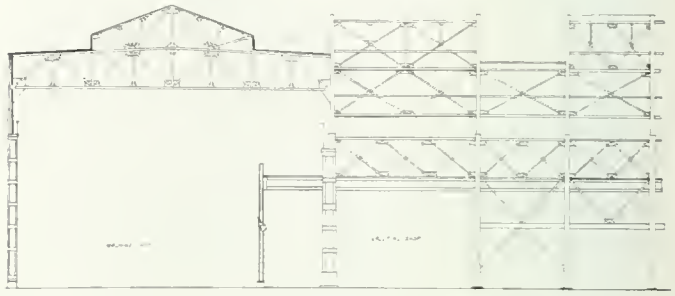

Fig. 4.—Cross-Section Through Machine Shop.

The general design of these buildings has been worked out by the firm of Henry Goldmark, consulting engineers, New York; all details regarding buildings and their equipment, and the construction work, have been carried out under the personal supervision of C. J. Goldmark, of that firm.

RAILWAY CARS OF STEEL.

Apparently acting upon the idea that collisions cannot be avoided, the different railroad companies are considering the advantages that will follow the introducing of all-steel cars in their rolling stock equipment. While one might suppose that this change would add largely to the element of cost, it is a fact that the outlay per passenger carried for the two styles of cars is about the same.

This practical identity of cost is due to the fact that although steel cars cost $17,000 each and wooden cars only $9,000 each, the former cars are seventy feet long and the latter only fifty-four feet, and there is a further advantage in favor of the steel construction by reason of greater durability. Of course, the two main points in favor of steel cars are that they do not crumple up after the shock of a collision and they do not burn in the event of the always possible and usually probable fire.

It is now generally recognized that if the Bar Harbor Express had been made up of steel cars exclusively at the time of the North Haven disaster, there would have been no lives lost. Just how steel cars behave under such conditions is shown by the experience of a collision in Pennsylvania early in the present year, when a passenger train going thirty-five miles an hour crashed into another standing still and no one was injured.

Of course, from the railroad point of view, the main question is, How does the steel construction affect the question of cost? At first it was thought that the saving in maintenance on the new style cars over the wooden ones would take care of interest on the larger investment. This has not yet been achieved, but it is being closely approached as the railroads discover and remedy the faults of the first steel cars delivered.

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CONTENTS OF THIS ISSUE.

	PAGE
Editorial:	
The Value of Engineering Training	531
Canadian Engineers and Road Conventions	532
Re Proposed Canadian Institution of Municipal Engineers	532
Leading Articles:	
Kaministiquia River Bridge, Fort William	515
New Jersey Regulations for the Design of Sewerage Systems and Disposal Works	518
The Financing of Road Engineering	521
Mechanical Gravity Filtration at Saskatoon	523
Belt Conveyers (Part II.)	526
The Canadian Locomotive Company's New Plant	529
The Chemical and Biological Effects of Water Filtration	533
Programme of American Good Roads Congress	537
Tunneling	538
Waterwheel Generators	540
Coast to Coast	542
Personals	544
Coming Meetings	544
Railway Orders	73
Construction News	76

THE VALUE OF ENGINEERING TRAINING.

The resumption of technical instruction in the universities this week brings into touch with engineering courses a large and increasing number of men, among whom will be engineers of the future. The fact that engineering, although one of the oldest of the arts, has only within the past generation or two become generally recognized among the learned professions, makes it somewhat difficult for the student in engineering to choose between the courses which the calendar presents. There are no regulations existing such as are common to the oldest and most widely recognized professions, the scope and prospects of which are generally well defined. The field of engineering has broadened so much during the past twenty-five years that it is no longer possible to say just what it includes or excludes. It has no hard and fast lines of limitation, nor yet are the lines of division between its various branches quite distinct.

In the case of the three more important branches, viz., civil, mechanical and electrical, into which it has been frequently found convenient to roughly sub-divide the scope of the profession, there is often a considerable amount of overlapping, especially in the case with mechanical and electrical engineering. The boundary line is very indistinct, and it is difficult to say to which branch of the science many phases of development work belong. For instance, the mere replacement of a steam engine by an electric motor to drive the main shafting of a plant can hardly be called a piece of electrical engineering; but if special electric appliances are introduced to perform duties which cannot be done, or not done as well, by purely mechanical machinery, we have electrical engineering in the true sense of the term. The two branches are in many respects, upon the same general footing, nevertheless, and the majority of principles upon which the university courses are based, apply equally to both branches.

It will be readily noted, however, that while mechanical and electrical engineering have much in common they differ entirely from civil engineering. In this branch every new undertaking of any magnitude involves entirely new conditions, and introduces unforeseen problems, each of which may have to be approached with little precedent for guidance.

Opinion in the past has been very divided as to the best lines on which engineering training should be carried out. Formerly a purely practical training was preferred, leaving the young engineer to pick for himself such knowledge as he was able, of the science underlying his profession. With its expansion, and the rapid application of technical science, theoretical training has been brought to the fore, more or less at the expense of practical training. At the present time engineering authorities are fairly well in unison concerning the advisability of alternate periods of technical and practical training, although opinions differ as to arrangement of the courses

This policy also applies with force to the other branches of the engineering profession. Its importance is such that a man who is beginning a course in engineering should be conversant with the general evolution of the nature of the training which he hopes to acquire. From a knowledge of its history the necessity will present itself to him of keeping always in mind the fact that the university course does not turn him out an engineer; but that by the practical application of the principles which he acquires thereby he may be better enabled to become an engineer.

CANADIAN ENGINEERS AND ROAD CONVENTIONS.

That for years to come highway problems will occupy a most prominent place in Canadian municipal affairs is a potent reason why our road engineers should take cognizance of the road conventions that are being held within attending distance. The American Road Congress in Detroit this week has gathered from far and near the pioneers of scientific road construction in America, and their views and experiences as related in the discussions following the numerous papers presented, cannot be surpassed in value as enlightenment on the many factors upon which such work is contingent.

Another convention that should receive the attention of our men in highway engineering is that of the American Road Builders' Association, to be held in Philadelphia in December. A tentative programme of this Good Roads Congress appears in another column, and further information respecting the plans for it will be published shortly.

The Ontario Good Roads Association passed a resolution worthy of note last week, deciding to extend to the American Road Builders' Association an invitation to hold its 1914 convention in Toronto. The invitation will be delivered in person by the president and secretary at the coming convention in Philadelphia.

If it meets with acceptance, Canada should at once prepare to show the American Road Builders' Association the immensity of the Canadian road problem, coupling with it a well-defined policy showing how its many difficulties are to be overcome.

Canada's road problem is merely a revised version of the same questions that have been before the highway officials of other countries, and that, in many instances, are still pending solution. Chief among the influences retarding a settlement by standardization of road construction has been the introduction of faster and heavier vehicles. Practically all countries are of an opinion concerning the certainty of the change which methods of road construction must shortly undergo, to meet the motor-driven vehicle as a successor to the steel-tired horse-drawn vehicle. More up-to-date systems of road engineering must be adopted if the expense of maintenance is not to become excessive.

But until the battle for supremacy between the new and the old has been fought to such a stage that the engineer may be justified in practically eliminating one of them from consideration, there will be no standard road or pavement. Before the advent of the automobile there was a single class of traffic, varying only in intensity. Since then motor-driven vehicles equipped with rubber tires have destroyed the old standard construction to such an extent that ordinary macadam is not likely to regain the place it held as a satisfactory type of road for general use.

Thus the problem has resolved itself into a selection, for each particular piece of road, of the type that will serve local conditions best. This requires a highway engineer to have a very comprehensive knowledge of the characteristics of all pavements in use, since there is no standard for his guidance.

Such considerations as these should emphasize the advantages to be derived from a participation in the proceedings of the road conventions.

RE PROPOSED CANADIAN INSTITUTION OF MUNICIPAL ENGINEERS.

An informal meeting of the engineers attending the Canadian Public Health Convention at Regina was held on Friday, September 19th, to discuss the question of forming a Canadian Institution of Municipal Engineers.

Mr. Wynne-Roberts (Regina), the convenor, submitted the correspondence which he had with several engineers, the great majority of whom approved of the idea. Letters had been received from city engineers located in many parts of the Dominion. Those from Toronto and Winnipeg were not favorable, but those from Edmonton, Regina, Battleford, Vancouver, London, New Westminster, Calgary, St. John, N.B., Halifax, Ottawa, Fort William, St. Catharines, Glace Bay, C.B., Peterborough, Guelph, Sydney, N.B., and Hamilton were favorable. Some desired more information. Representatives from Battleford, Saskatoon, Prince Albert, Swift Current and Toronto, who had not already written expressing their views, were present and verbally stated their opinions.

After fully discussing the matter from various viewpoints, it was unanimously resolved: "That this meeting of the engineers present at the Annual Convention of the Canadian Public Health Association, held in Regina, after considering the question and perusing the letters received from city engineers in various parts of Canada, is of the opinion that it is desirable to form a Canadian Institution of Municipal Engineers, and that a Provisional Committee be appointed to enquire into and adopt the most advisable steps for its formation." The names of the committee members will be published later on, after their individual consent to act has been obtained.

EDITORIAL COMMENT.

If properly carried out, Calgary's intention of planning street grading to meet requirements of several years to come, so as to keep well ahead of civic improvements, will save the city a lot of money. This desirable policy will enable the laying of water-mains, sewers and street paving to be executed without apprehension of early subsequent disturbance, and it will also obviate alterations to residential property occasioned by the cutting down of grades, in connection with pavement work. The city requires much grading work to be done in places, and the step which the City Commissioners are taking is a matter of great permanent importance to property holders in particular, and the citizens generally.

Especially in the case of street pavements, we hear so much of their disturbance for the laying of water-mains, etc., that the plan which Calgary purposes to follow should be considered by every city and town in Canada, and it seems practicable enough to be continued if once established.

CORRECTION.

In Mr. V. J. Elmont's paper in last week's issue, the table on page 486 is not explicit without further explanation. The bending moment values are arranged vertically under the different values of $\frac{x}{l}$ and horizontally opposite the different values of $\frac{y}{l}$. In the table also, "o.x" simply means "o."

THE CHEMICAL AND BIOLOGICAL EFFECT OF WATER FILTRATION

ORGANISMS IN EARTH AND WATER AND THEIR FUNCTIONS—EFFORTS TO ELIMINATE PATHOGENIC BACTERIA IN WATER BY FILTRATION—THE FILTER FILM AND ITS WORK—AUXILIARY CHEMICAL TREATMENT—EXTREME PURIFICATION DANGEROUS

By H. W. COWAN,
Chief Engineer, Bell Filtration Co. of Canada, Limited.

MUCH argument has taken place as to whether bacteria are a form of plant or animal life. One of the lowest forms of plant life, known to the botanical microscopist as oscillariae, possesses similar characteristics to the types of organisms called bacteria.

The chief difference is the presence of chlorophyll in oscillariae, or the green coloring matter which enables the plant to derive nourishment from such simple foods as it can procure from the air and soil, in which it is present. It is the absence of chlorophyll in bacteria which forces them to live on more complex foods. Both have the power of motility, the same form, the same method of thread and spore formation, and may both be considered as true plants.

The simplest forms are typical of bacteria, spherical, cylindrical or spiral. They are so minute that their diameters range from 0.000012 to 0.0003 inches. A coating of some gelatinous membrane seems to envelop most species, serving as a cement to keep them together. Their internal structure of protoplasm has never been definitely decided on, and is still much a matter of conjecture.

When massed into clusters bacteria are known as zoogloea, which differ from a colony in that the latter is formed when a single bacterium is cultivated in some mass which presents too much resistance for the separation of the bacteria to any distance. Varying species form different characteristics in their colonies, which serve as a means of identification when under examination.

Bacteria multiply very rapidly, unless in unsuitable conditions, by the simple process of dividing in two, a process which can go on indefinitely until as many as 16,000,000 are produced in twenty-four hours. In addition to this simple method of propagation, some species produce spores. These are round or oval pieces of bacteria protoplasm, which develop until they finally break out of the original organism. When the original germ cannot exist, the spores are still to be found resisting very adverse conditions, and acting as a means of perpetuating the species.

A means of motility is supplied to many species, which have stringy membranes attached to them, sometimes one, two, or many, sometimes at one end, and sometimes at both. By lashing these membranes back and forward, a means of propulsion is supplied, which is very active when the germs are immersed in liquids.

The food of bacterial organisms is secured from the dead bodies of animals or plants, and their excretions, which they rapidly decompose in their operations for assimilation. Probably the rapidity of multiplication is due to not having to manufacture food, as in the case of other plants. In effecting the decomposition of substances, many chemical and physical changes are wrought, extensively made use of in the maceration industries.

The manufacture of linen, jute, hemp, fibre, leather, sponges, and the products of fermentation, is chiefly dependent on the action of various forms of bacterial life. In still more important functions are bacteria necessary for the continuity of life, and the preservation of mankind. For the purpose of showing this some digression is allowable for consideration of other plants and their mode of existence.

No life could exist if the earth were littered with dead matter, but bacteria, acting as scavengers, and putrefactive changes prevent such a happening. The earth's surface has been the producer of the countless years of life. Plant life has extracted food from its soil and air without apparently diminishing the food supply.

The animal kingdom breathes oxygen and exhales it as carbon dioxide, which the vegetable kingdom inhales and returns as free oxygen to complete the cycle. Plants also consume nitrogenous food from the soil, in the form of nitrates, in combination with gaseous products of the air and other elements. These solar energy transforms into starches, proteids, sugars, fats, etc., to supply animal life with nutrition.

Carbonic acid and water are returned by the animal in the assimilation of its food, to be again absorbed by plant life, but nitrogenous food is not returned in total. Most of the nitrogen consumed by animal life is turned into albumens and the balance excreted. Even when the animal dies, the nitrogen is too complex in its compounds to form plant food, when recovered by disintegration.

The bacteria of decomposition and putrefaction now set to work to reduce most of the nitrogen compounds into suitable feeding material for the plant, leaving the balance as nitrites, which in turn are too simple for plant food.

The soil abounds with organisms called nitrifying bacteria which unite these nitrites with oxygen and transpose them into the nitrates necessary for the existence of the vegetable world. In decomposing, dead animal life frees a proportion of nitrogen which passes into the air, thus reducing the supply of nitrogenous food returned to the soil. More is lost in excretions taken direct to the sea in the form of sewage, while many of the chemicals used in the manufacture of explosives and other articles of commerce consume a large amount.

The farmer makes up this deficiency by the application of chemical fertilizers to the ground, but were the same soil freed from all plant life, and exposed to the air

for a period, nitrogen fixation would be secured through the activity of bacteria in the earth. Not only in this way is dispersed nitrogen recovered, but also by an active co-operation of germ life with certain leguminous plants. These organisms attach themselves in globules or clusters to the roots of the vegetables, and with both agencies at work some nitrogen is fixed in the fibrous structure of the legume. Disintegration and rotting of the plant enables the stored-up nitrogen to be fixed in the soil.

In the scheme of life, therefore, bacteria have very important and definite functions to perform. Without them the recovery of nitrogen for plant food would be impossible, and the circle of life created by the energy of heat would cease. Were it possible to destroy germ life as a whole, the result would be the total extinction of all forms of life.

There are, however, other types of bacteria which are pathogenic, and have the power of reproduction in the human body, causing many diseases to which humanity is subject. The proportion of these to the harmless bacteria is fortunately small, but as they give rise to such sickness as typhoid, cholera, diphtheria, tuberculosis, lock-jaw, anthrax, influenza, etc., they must be kept down. These germs produce by-products which act as virulent poisons to the human system, causing the diseases enumerated together with many others. They gain access through the mouth, nostrils, cuts and breaks in the skin, and set about reproduction by incubation until the disease gets a hold on the body. If the powers of resistance of the body are very great, the organisms are disposed of, and the sickness is warded off. These resistive forces are not yet fully known, but science has established the presence of certain products in the body termed alexines which kill non-pathogenic germs. To combat the alexines the pathogenic bacteria create lysines to neutralize their action, and make the way clear for their depredations.

The invading bacteria are then attacked by the white corpuscles of the blood, which leave their usual habitation in the blood vessels and surround the attacking germs. The evidence of this is generally given by the appearance of inflammations, either internal or external, which break out and give off pus should the corpuscles be vanquished. With such contending influences in the body, disease is warded off by those in robust health, and the importance of maintaining these resistive powers cannot be over-estimated, otherwise they will become useless through dissuetude.

The chief means of conveying the harmful bacteria to the body is by means of liquids which act as carrying agents in a greater degree than any other source. In consequence, our drinking water supplies are of national importance, and the elimination of harmful or pathogenic germs from them is the first essential to disease prevention.

Methods of Filtration.—The methods of filtration generally employed are to filter all water used for drinking purposes by means of sand filters, of which there are three distinct types—slow sand, gravity mechanical, and pressure mechanical. Of these the first and last are most commonly used in the older countries, while on the American continent the first and second are favored. In the slow sand filter the water is allowed to flow through beds of sand and gravel, into collecting pipes placed under the filtering material, at rates varying from one to six million gallons per day. They are generally constructed of brick and concrete, or both, and occupy a large area. Gravity mechanical filters are frequently constructed of the same materials, or of wood or steel, containing sand overlying gravel, while pressure filters are entirely composed of steel. Both of these latter types operate at rates up to one hundred and seventy-five million gallons per day. The ratings given are for an area of one acre.

Before the sand in all types of filters performs effective work, it must be coated with a film which retains the bacteria in the passage of the water through the filter. The slow sand filter forms this filter naturally by the growth of vegetation, the deposit of fine clay particles, and the agglomeration of organisms. In the mechanical type the film is deposited by the addition of alum to the water, before it is applied to the sand bed. The alum reacts with the lime in the water, or with added lime if the water is deficient, and forms a gel or albuminous coagulant which is insoluble, and deposits on the sand bed.

In course of time this film becomes too impervious, and it is necessary to clean the surface of the filter to allow the water to find its way through. In the slow sand filter this is performed by scraping off the surface to a depth of about ⅞ of an inch, and passing through a sand washer to make it ready for replacing when the sand bed gets too shallow to work satisfactorily. In the gravity mechanical and the pressure mechanical filters cleaning is carried out by the operation of valves to force the water back through the sand bed, where it is run to waste. Agitation is performed by means of compressed air or mechanical means to break up the sand, so that the reverse flow of water may do its work.

In the slow sand and gravity mechanical types of filters, water flows in by gravity or is raised by a pump, and allowed to flow through the filter under atmospheric pressure only, into a clear water reservoir from which the filtered water is pumped to the service pipes. In the pressure type of filter the water is forced through by means of a pump, or sufficient height of water to supply an equivalent pressure. The pressure filter is totally enclosed, while the other types are open.

It does not fall within the scope of this paper to enlarge on the merits of any particular type, beyond saying that with a properly designed plant and proper operation, they should all give equally high bacterial reduction. On leaving the filters it is common practice on this continent to treat the effluent with chlorine to further reduce the bacteria content, and approach as nearly as possible a sterile water. With this practice the writer is not at all inclined to agree.

Chemistry of Filtration.—It is well known that the work performed by sand filters is to remove suspended solids, and to act in such a way that both chemical and biological changes are wrought in the treated water. In considering the presence of dissolved substances in the water, it is found that chlorides do not vary much, neither increasing or diminishing in passing through the filters. Nitrates vary either to a greater or lesser extent, and sulphates and carbonates remain pretty much the same. In both slow sand and mechanical filters, the chlorine content, as indicated by the presence of chlorides, seldom varies, while in both cases the carbonates are reduced about one grain per gallon. Albuminoid ammonia is reduced by mechanical filters from 15 to 90%, according to the water treated, and an average of about 60% in the case of slow sand filters.

Free or saline ammonia is reduced from 33 to 50%, and sometimes as high as 95%, in mechanical and slow sand filters respectively. The oxygen absorbed varies

from 50 to 90% reduction with mechanical filters, as against 40 to 50% with slow sand filters.

Mechanical filters reduce nitrates and nitrites from 5 to 60%, while the slow sand filter ranges from 10 to 30%. Before discussing how these changes may be brought about by filtration, it is interesting to note that mechanical filters are much more uniform in their results than slow sand filters in the reduction of albuminoid ammonia. In three months' observation of tests made every third day, while the raw water content varied from .002 to .0067 grains per gallon, the effluent only varied in its quantity from .002 to .00265 in one series of tests. Another series during the same period, showed the variation from .003 to .0039, with the raw water containing from .0046 to .0067 grains per gallon. At the same time tests were made with slow sand filters treating the same water, in which albuminoid ammonia was present in quantities of .0063 to .0064 grains per gallon, the effluent varied from .0035 to .0059 grains per gallon. The mechanical filters, therefore, while treating water with considerable variation in quantity of albuminoid ammonia, contained practically the same amount in the effluent. In the slow sand tests the results were just the reverse, and laboratory practice further accentuates the difference.

In mechanical filters, sulphates increase from one-half to one grain per gallon, due to the addition of alum which dissociates sulphuric acid in hydration.

The presence of chlorides, unless they can be accounted for by proximity to the sea, or natural salt deposits, gives an indication of sewage pollution of the water supply. Before the advent of bacteriology, nitrates were used to determine the standard of purity, but their presence is no longer considered except to call for confirmation of sewage pollution by bacterial tests. Water high in nitrites, however, should be condemned, until exhaustive tests have been made and their source accounted for. More free ammonia than albuminoid ammonia is a sure indication of the presence of polluting matters, as in normal waters the albuminoid at least equals free ammonia. If such oxygen is consumed in testing, the probability is that pollution has occurred unless with waters high in color, where the original oxygen has been depleted in oxidizing the vegetation.

Bacterial reduction in all filters of the types mentioned, operated on the same water with the same care, and with suitable rates of filtration, with suitable water for all types, should be much the same, ranging from 85 to 100%, according to the count of bacteria in the untreated water.

The Filter Film.—In performing these changes consideration must be given to the nature of the film on the sand, and its action, so that we may be able to judge what is most likely to give constant results when dealing with any particular type of water. The film on the slow sand filter is composed of fine particles of clay and mud, of green and blue algae, fungus, bacteria, etc., which very soon propagate under favorable conditions when the water contains the original propagators. The bacterial bodies present mass themselves in zoogloea, or into colonies, and putrefactive changes in many of the diatoms produce slimy brownish masses of matter. These form a net-work over the surface of the sand, which is bound together by the active diatoms, and the whole mass coheres and feeds on other organisms, or the same placed thereon in the act of filtering. At the same time there is constant destruction going on in the film, between opposing plants, which is the primary cause of the expert attention required in the care of slow sand filters, so that the film may be guarded against rupture. Algae has quite a purifying action in the removal of bacteria, without the assistance of other diatoms, and performs useful functions in the purification of stored waters.

The whole of this mass is of a gelatinous, viscid, and sticky nature, eminently suitable for adhesion of particles coming in contact with it. Each particle of sand on the upper layers of the filter becomes wrapped in a coating of the sticky substance, and a drop of water flowing around that particle will leave any minute organisms sticking to the coating on the sand, to be sucked in and retained, if not disturbed by vibration or variations of flow in the passage of the water.

The vegetation in this film is suited to the action of nitrifying bacteria, which transform the ammonia content of the raw water into nitrates and nitrites, reducing the ammonia and increasing the nitrogen. Where a reduction of one is shown, without an increase of the other, the ammonia content has been very small, in other cases there may be sufficient ammonia present in organic matters in the water for the nitrogen to show an increase not wholly due to transformation of ammonia products into nitrogenous from the water.

Albuminoid ammonia, on the other hand, forms food for many forms of bacteria, which transform it into various fatty compounds, gases, and water. Decomposition again sets in, and nitrates, ammonia, carbonic acid and water are the final products. Thus we can readily see that the feeding stuffs necessary to the life of bacteria on the sand bed, are drawn from the water, with the consequent reduction of these food stuffs after the water is filtered.

In the film formed in mechanical filters the work performed appears to be mostly of an absorptive nature, the deposit being more like a membrane full of minute cells, which are closed, and present a very large surface when wrapping round the particles of sand on the upper layers of the filter. These minute cells of the gel are continuously opening and closing, giving up the necessary amount of water each time to equalize the vapor pressure with the surrounding fluid. It has been found that by removing the water from colloidal substances, various chemical compounds holding varying amounts of water are not formed in cycles, but that the water content changes continuously. Thus the coagulation of a hydrate makes a kind of tissue, neither solid or liquid, which encloses liquid. With this construction it may readily be understood that the enclosed water in the cells may, in being replaced by other water containing a minute organism, leave the organism in the sticky cell, when it opens to allow of the absorption of a fresh quantity of liquid.

Heat is destructive of the adsorptive properties of the gel membrane, probably by contracting or stretching the formation until the cells collapse into a flat plane. The great surface tension of the culloid and the pulsation movement of the innumerable cells, in the opening and closing, explain the suction-like action of the firm in drawing in gelatinous or minute substances, while its viscosity and stickiness aid in the retention of these foreign matters.

Every weathering process in nature is productive of some form of gel in regard to its minerals, stalactitic, botryoidal, or glassy in form, with fibrous fractures, sometimes being found even in a gelatinous state. The filtering action of nature in well waters and successful infiltrations is probably due to the action of these gels. Their absence in some vicinities certainly accounts for the

failure of similar constructions, when these are apparently exactly the same, but in a locality with a totally different mineral deposit.

Biological and Aesthetic Considerations.—In common with the changes caused chemically and bacterially, there are many other biological changes desirable for the securing of the more aesthetic qualities of a water supply, such as color, taste, and odor. The mechanical filter is highly successful in treating waters which have to be dealt with in regard to these qualities. The slow sand filter rarely removes more than 20% of the color, while with the mechanical filter total elimination is possible. Odors which are caused by decomposition of vegetable matter are rarely disagreeable, but living organisms, or vegetation may also cause them. Many forms of bacterial or organic growth give off matters of an oily nature, which have a smell peculiar to the species from which they are exuded, in a way analogous to the poisons given off in the body by pathogenic bacteria.

Agitation may break up these bubbles of oil and spread them through the water until the odor is accentuated. In the same way heat, when applied, scatters the oily products and exaggerates the odor until it can be definitely compared with others known to the physical sense. The number of such organisms present in the raw water determine the intensity of the odor, and the various intensities may make the smells appear different, while they are really produced by the same organism.

It is possible that the substances producing the aforementioned qualities may have a poisonous effect on the human system, but unfortunately science has not yet been successful in demonstrating this.

Odors of decomposition are usually set up in the water pipes of a system, by the action of the filaments of plant life attaching themselves to the inside of the walls, propagating there, then becoming detached when in a state of partial decomposition. This is the frequent cause of pitted pipes, as the preservative coating is detached along with the organism, allowing rust to set in. Every system should be flushed out completely and thoroughly, periodically, as a safeguard to the preserving of the pipes against such action, and the maintaining of the physical qualities of the water at the highest standard.

Color is entirely the result of dissolved vegetable matter, and is, therefore, generally associated with taste or odor produced by the same substances. The oxygen used in the oxidizing of the vegetation in solution sometimes gives an insipid taste to the water, which is simply removed by aeration, to replace the occluded oxygen.

In the removal of odors due to organisms, filtration is effective, while the absorptive tendencies of coagulants collect the globules of oil, together with the organisms producing them. Products of decomposition are retained in the same manner, and those growths which attach themselves to the piping in the water system are prevented from passing into the supply. They cannot then become nauseating by detachment.

Nature has been copied as closely as possible in the filtration of public water supplies, and the results of slow sand and mechanical filters are practically the same as those performed naturally.

Auxiliary Chemical Treatment.—When water is too soft, it frequently sets up an acid reaction, particularly in the case of peat discolored supplies, which has the effect of dissolving the piping through which it is conveyed. This brings about lead poisoning to the consumer. The absence of mineral salts is a plausible cause of rickets and bone weakness.

Waters which are very hard may also be productive of plumbo solvency when they give an acid reaction, and are frequent causes of constipation and troubles of the digestive organs.

Extreme hardness leads to a stunted and ossified growth in individuals, as is well instanced in the Cretins, a race of dwarfed people who live near the Swiss borders, and use very hard waters.

The commercial side is also important, as the extra cost of fuel with hard waters, and the high cost of soap to a community is very burdensome.

With such waters hardening should take place prior to filtration, or softening where necessary, by the addition of lime water to increase hardness, or an excess to reduce the same trouble.

Danger in Extreme Purification.—A note of warning might well be sounded before attempting to exceed the results produced by natural means, as in the tendency in Canada at the present time.

The exigencies of modern civilization demand the collection of human beings in congested sites for the pursuit of industry. The consequent polluting of water supplies, with the subsequent necessity for treating them follows.

In the old tribal times there were no large communities gathered together for a long period of time. The people were constantly moving from one camping ground to another, and oxidation had time to effect purification after a site had been deserted. The spread of disease was to a great extent safeguarded by the absence of a means of conveyance in the shape of water systems, public vehicles, etc., and the water supply was carefully guarded from pollution by those in the camp using them. The dread intestinal diseases of bacterial origin were not much heard of until the commencement of the industrial era, and most of the scourges which attacked communities were of a zymotic nature rather than an intestinal.

Is there not a possibility that attempts to purify our drinking supplies are being carried too far? Would it not be wise to determine what is the maximum extent to which it is safe to go?

The healthiest communities are those with natural water supplies, often carrying a large bacteria count of harmless germs, with a small proportion of mineral salts. Yet, modern demands cry out for sterilized drinking water. Even distilled water, devoid of all natural salts, is being largely consumed, while recent investigations into the large number of tubercular patients in navies using distilled water exclusively, point to the demineralization of the human system as conducive to the inroads of the tubercular germ. Much interest will be shown in the experiments now being conducted by French scientists to prove that the absence of mineral salts in drinking waters is a forerunner of the wasting disease.

An attempt has been made to show the vast importance of bacteria in the great scheme of existence. Are we not eliminating some of the bacteria which an all-seeing Providence has provided for the performance of vital functions in the body?

Professor Metchinkoff, in one of the most interesting and masterly treatises of modern times, in summing up the results of his investigations into the longevity of a certain European race, demonstrates clearly that the scouring action of bacteria present in their national beverage of sour milk is probably the reason for the felicity obtained by that people.

In our food and drinking supplies, water conveys bacteria directly from the soil, other bacteria are deposit-

ed after cooking by touch, from the air, and by contact, while fruit is mostly removed from its peel or skin, and therefore from the greater part of its bacterial life. Useful bacteria can therefore have drinking water as a possible conveyer only.

It is not known what action harmless germs have on the human body, and the body's curative agents have power to combat the inroads of harmful bacteria, when their numbers are not too great. As the proportion of harmful bacteria to harmless is small, an efficient filter removing about 98% of the total bacteria count in drinking water can leave few, if any, pathogenic germs to play havoc with the consumer. Even the few which might escape will perform good work in providing exercise for the resistive forces of the body, and preventing their becoming defunct through dissuetude.

Potable waters in Canada after filtration are invariably treated by chlorine as an additional preventive, with the tendency to produce bacterial sterility. This has been brought about by the use of filters whose operation is not all that can be desired, and is a slur on the engineering profession generally, which may have very far-reaching consequences. There are filters which can be relied on, without the use of sterilizing agents, and the sooner engineers make use of them, or design others to perform first-class work, the sooner will doubtful practice be removed.

Any of the types of filters described can be made to give such results if they are not hampered by considerations of cutting down cost.

The greatest evil is facing modern times in resorting to practice of whose effect we are ignorant, when natural means of treatment will give a margin of certain safety.

As has been pointed out, water may be the only source of organisms necessary for the proper performance of bio-chemical functions in the body. The removal of these germs would make the functions of the body entirely chemical, a position which might lead to the destruction of the body's tissues until it could be adjusted to the new order of things.

Chlorination, sterilization by ozone, distillation, and other means of securing final sterilization, are being carried on at the present time in entire ignorance of all the uses of the body of those very properties which are being destroyed.

The whole tendency of modern therapeuthy is towards prevention of disease by sanitation, or the use of antitoxines, or its retardation by small doses of reactionary drugs to stay the progress of the disease, until the recuperative powers can reassert themselves.

Why, then, should these very recuperative powers be weakened by extreme preventive measures?

A census of operative cases, such as appendicitis, in cities using chlorination, or other sterilization treatment, might produce interesting results. In cases of strangers succumbing to disease when in strange cities, a census might also be taken and consideration given as to whether their resistive powers had not been weakened by the water treatment in their home town.

Would it not be wise to withhold drastic treatment until the need for it has been scientifically demonstrated, and its effect on the body placed beyond doubt

The importance of this point is too great to be neglected and affords excuse for the somewhat lengthy discussion of bacterial life at the beginning of this paper.

PROGRAMME OF AMERICAN GOOD ROADS CONGRESS, PHILADELPHIA.

Plans for the Fourth American Good Roads Congress, to be held under the auspices of the American Road Builders' Association in the First Regiment Armory, Philadelphia, Pa., are being worked out in detail by the Convention Committee and officials having the matter in charge.

The following outline of programme shows the subjects to be discussed at this convention:—

Subject A—Organization:

1. Highway Officials—Their Duties and Powers.

2. Division of Expense, of Responsibility and of Authority Between the Various Municipal and Other Units Participating in a Road or Street Improvement.

3. The Relation to Each Other of the Contractor, the Chief Engineer, the Resident Engineer and the Inspector.

4. Details of Arrangements for the Use of Convict Labor.

Subject B.—Construction:

1. The Proper Determination of the Amount of Re-Alignment and of Grading to be Done.

2. The Factors Governing a Proper Selection of a Road or Street Pavement or Surfacing.

3. Materials and Methods Suitable for Road Surfaces.

4. Unit Price vs. Lump Sum Contracts.

5. Plant Equipment.

6. Preliminary Traffic Census.

7. Efficiency and Economy of Using One Size Crusher Run Stone Bituminous Concrete Pavements as a Substitute for Bituminous Pavements Constructed by Penetration Methods.

8. Dirt Roads.

Subject C—Maintenance:

1. Sub-organization for Securing Efficient Maintenance.

2. General Methods of Repairs and Renewals.

3. Methods of Dust Prevention.

4. Maintenance of Different Road Surfaces.

The general plan of providing for discussion of subjects, rather than long papers, which has been so successful in the past, will be adopted at this meeting. The speakers are being selected with reference to their fitness to discuss the various questions, and announcement of these assignments will shortly be made. The list of speakers will include the men who are recognized as the leading authorities in the United States and Canada.

In connection with the Congress and Convention, there will, as usual, be held an exhibition of road machinery, materials and appliances. This exhibition will be known as the Fifth Annual Good Roads Exhibition, and will include everything that enters into the construction, repair and maintenance of roads and pavements. This exhibition will also be held in the First Regiment Armory.

This association was the first to inaugurate these exhibitions and they have uniformly been successful, each having been larger and more complete than the one previous.

TUNNELING.

By Robert B. Sinclair,
Assistant Engineer, Jennings and Ross, Toronto.

TUNNELING is by no means a modern feat of engineering. In the early times the ancients resorted to it as a means of obtaining passage for their thoroughfares under their rivers, and also as a means toward drainage; but on the whole the operation was rather a crude piece of manipulating. That science has made great strides since those days, the instruments by which the great engineering obstacles can now be very quickly overcome, is but one of many illustrations. In the following paragraphs a few of the methods that are being followed in tunneling are briefly described.

Preliminary Surveys.—When it has been decided to tunnel in order to obtain a passage-way for railroads, electricity, waterpower, or whatever the case in question may be, we must have some idea of the obstacles which are to be overcome, such as the amount of material to be excavated; the nature of the material, whether loose gravel, rock or quick-sand, and also an idea of the surrounding country, as regards the necessary depth to rock, etc. A great many other data, which will be barely mentioned, must be gathered, and in order to obtain this a geological survey party is sent on to the field of operation. The information is obtained from the geologist's knowledge of the rock formation, and also from diamond drill borings, which are taken at intervals in the vicinity. Upon the rock formation depends the nature of the blasting, as it will be more efficient if the rock is attached perpendicularly to the stratification.

Generally speaking, a horizontal strata is very much weaker than a vertical strata, and, as a result, it needs heavier supports in the shape of tunnel lining, bracing, etc. Upon the geologist's report the character of the construction is to be based.

Centre Line of Tunnel.—Tunnels are divided into two classes—curvilinear and rectilinear. We will not follow the detail of curvilinear tunneling here, but will touch upon the rectilinear, as it affords a better discussion for a general treatise.

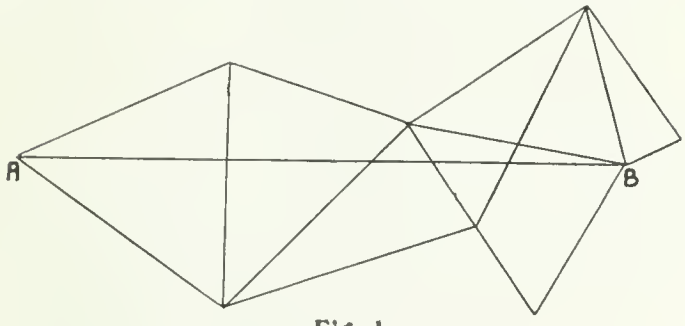

Fig. 1.

The centre line of a rectilinear tunnel is obtained by means of a triangulation survey. This must be carried on with the utmost accuracy. The angles and chainages must be read a number of times, and the results obtained by the method of least squares.

The triangulation method is illustrated very well by the above diagram shown in Fig. 1. It can be seen that the utmost accuracy can be obtained in this method of procedure. The line is staked out preliminary to the beginning of construction.

It might be said here that nearly all tunnels of any length are not worked completely from end to end, but have intermediate shafts by which the tunneling is carried on to much greater advantage.

The method of obtaining the line underground is illustrated in Fig. 2.

The depth is calculated from the profile of the tunnel. A-B is on the offset tunnel line. The plumb-bobs C and D give the direction of the line beneath the surface. A small tunnel is run to the main tunnel in question, giving a means by which the tunneling can be operated at this point.

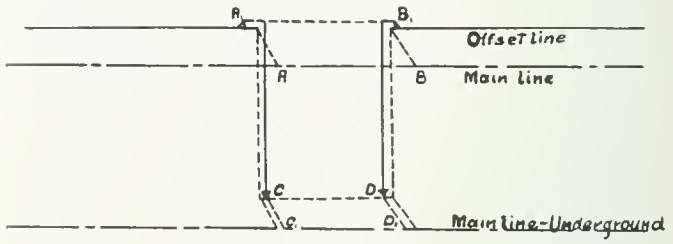

Fig. 2.

Different Methods of Tunneling.—The different methods of tunneling are in no way a small study by themselves. If we ponder for one moment over the subject we shall see the difficulty of preventing "cave-in" while the tunnel is under construction. This difficulty is off-set in a number of ways. Engineers of different nations have ways and means of their own, and from them are developed the methods by which every kind and condition of material may be encountered and successfully overcome.

We will see by the following how cleverly the methods are developed, and yet, after all, common sense is the one fundamental of them all. In fact, the basis of engineering is common sense and surveying.

Rock Tunnels.—Rock tunnels are carried through by the drift and the heading methods. The drift method is shown in the design by Fig. 3.

The parts 1, 2 and 3 are excavated, leaving supports 4 and 5, upon which is built the arch of the tunnel. At intervals along the side transverse cuts are made and filled in with the masonry. These support the arch after 4 and 5 have been cut away.

By Headings.—The more common method of rock tunneling is by the heading method.

Section 1 in the diagram (Fig. 4) is drilled through perhaps 200 feet to 300 feet in advance. Parts 2 are drilled into until finally we arrive at the point of constructing the arch structure. It is built up on the unexcavated rock below and is supported by 4 and 5, while fissure 3 is opened up. Parts 4 and 5 come next, and the lining is then inserted.

It might be interesting to mention the fact that rock tunnels do not require the heavy lining that is used in ground tunnels. This is very well understood on account of the fact that the rock walls are self-supporting, except where some crack or fissure allows the side to break off. These cracks and weakenings are caused by heavy blasting and also by the rock structure. If the strata is perpendicular to the side of the tunnel it will have greater tendency to cave-in than if the strata is parallel to the side. The St. Gothard tunnel is a very good example of the heading method of excavation. The tunnel was constructed in 1872-82, and is one of the longest tunnels at

the present time. It connects France and Italy under the Alps Mountains, and is 9¼ miles in length.

Passing from rock to earth formation in connection with tunneling, the earth formation is much more difficult to successfully tunnel. Although it might not appear so on first consideration, the blasting and removing of rock is a very simple operation in comparison to the removing of soft material, in the face of a cave-in, quick-sand and a great many other obstacles, which cannot be gone into here.

A Good Method of Blasting.—The explosives used in the blasting operation consist principally of gun-powder, nitroglycerine and dynamite. The methods used are various, but one which is used a great deal and which seems most efficient is the American centre cut method.

In this method seven or eight holes are bored in the facing in the form of a polygon, the holes tending to terminate at the point. The holes are charged and fired, extricating the conical, or pyramidal structure. Another circle of holes is forced in a cylindrical form round about this opening. These are charged and fired, and a cylindrical shaped fissure is opened. In this way the blasting operation is carried on until the opening is brought to the required size and shape.

The distinguishing feature of the method is the way in which the opening is begun. The futility of making a blast without first weakening the substance by extricating the cone section can easily be understood. When this is done, the rest of the operation may be manipulated with comparatively little difficulty.

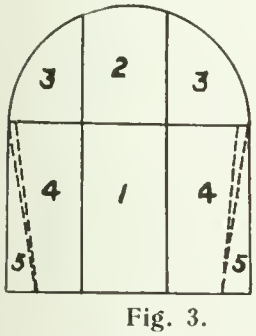

Fig. 3.

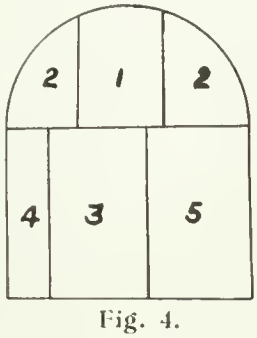

Fig. 4.

Tunneling Through Soil.—The engineers of different countries seem to have contrived methods by which every kind of loose structure may be successfully treated. In most respects the following methods are very much the same; the Belgian, English, German, Austrian and Italian differing only in the order in which the drifts and headings are excavated, and also in the different frame structure employed. The Belgian method consists of putting forward the arch before the walls are built; while in the German method the perimeter is excavated and lined before the core is removed. In types such as the English and the Austrian the whole fissure is excavated before the lining is placed, although, however, the excavation is never far in advance of the masonry work. The Italian method consists of excavating the lower half, lining it and filling it in again, followed by the work of excavating the upper half.

Submarine tunneling is perhaps the most expensive, and seems much more difficult than any of the other soft-ground tunnels, particularly in the case of tunnels which are constructed at small depths below the water bed. There is always a danger of flooding, and the materials encountered are extremely difficult to handle. Various methods are used, some of the most important being the shield method, the compressed air method, and when we come very close to river bed we use the cofferdam method, and pneumatic caissons.

The shield method is very interesting from a historical point of view. It was invented by Isambardt Brunel, a French engineer, in the early part of the 18th century. The Frenchman was gifted with a keen sense of observation. While cruising, he happened to observe the ingenious method of the ship worms in working their way into the wood. He noticed that as the animal bored its way in it applied a secretion which lined the opening and rendered the lining waterproof. Being an engineer, the idea intimated itself very strongly to his mind in connection with submarine tunneling. He immediately set to work to contrive a mechanical device which would give the same result as the boring of the small insect, and finally succeeded by inventing his universally known boring machine.

The invention consists of a circular boring disc placed immediately in front, which might be termed to represent the head of the insect, while the body is cylindrical in shape and constructed of steel in the form of a shell. In operation the earth is conveyed out and the tunnel is lined with steel tubing immediately in the wake of the boring machine. In this way it is kept perfectly water-tight, eliminating the possibility of cave-in, and making the otherwise difficult task into a comparatively simple operation.

HEWN OUT OF ROCK.

A peculiarity of the New South Wales Government dockyard on Cockatoo Island, in Sydney Harbor, is that it is hewn out of solid rock Historically, Cockatoo Island is of much interest, as it was the site of a large prison in the days when British convicts were deported to Australia. The present offices on the island are in the old prison buildings, the stone walls, barred windows, and iron-doored cells being still in evidence.

The formation of the island was originally quite unsuitable for a dockyard, as the solid rock rose sheer from the water to a height of 60 to 70 feet. By using convict labor, however, the rock was gradually cut back, first, to permit the building of graving docks, and later to make room for building slips and shops near water level. The work has been continued until at present two-thirds of the total area of thirty-three acres has been brought to a practically uniform level of about 15 feet above high tide.

When a beam of X-rays is passed through thin, rolled metal sheets to a photographic plate placed parallel to the sheet, H. B. Keene, of the University of Birmingham, finds that these patterns are of two classes, in one of which the central spot produced by the direct beam is surrounded by an irregular halo of smaller spots, while in the other the patches around the central spot are extended and form a faint but perfectly symmetrical design. The figures vary with the metal. Markings of the first kind are produced by metal sheets that are either well aged or recently annealed, and the symmetrical patterns are given by newly-rolled sheets. The spots are due to reflections from the micro-crystals within the metal; the symmetrical patterns are formed by the structure imparted to the metal by the rolling. Annealing a newly-rolled sheet changes the pattern from the second to the first class, and rolling an annealed sheet gives the reverse change.

WATERWHEEL GENERATORS

WATERWHEEL generators have recently been built to conform with the rapid development of hydraulic power for driving electric generators. The increased demands for such service require almost infinite combinations of capacity and speed range. Refinement in the design of both generators and waterwheels has made these changes possible; the successful operation of many high-voltage transmission lines and

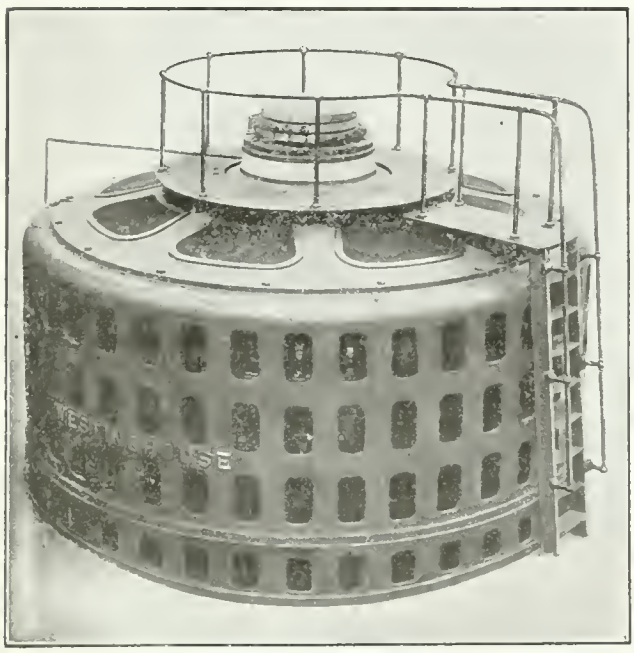

Fig. 1.—A 12,500-Kva., 6,600-Volt, 50-Cycle Generator Complete.

the ever-increasing demand for power, all aid materially in the utilization of many water powers heretofore considered either impracticable or inaccessible.

Two types of waterwheel generators are built—horizontal and vertical—depending upon the local conditions in each case.

Horizontal Type.—The standard horizontal unit is of the two-bearing, coupled type construction; that is, the generator includes shaft, two bearings, and a bedplate usually designed to allow for sliding the stator to one side in case ready access to either the stationary or rotating winding is desired. The stationary frame is made of a strong, rigid iron casting, into which soft steel laminations are dove-tailed and securely fastened.

Ventilating ducts are spaced at frequent intervals across the face of the armature punchings, allowing for perfect ventilation to all parts of the active material.

Form-wound, interchangeable armature coils fit into parallel open slots punched in these laminations, and these coils are held firmly in place by means of fibre wedges. The coils are insulated and impregnated with fabrics and compounds of high insulating qualities.

No single type of construction will meet the varied requirements in rotor design, therefore several well-tested methods are employed. When comparatively low peripheral speeds are encountered a cast-iron spider with bolted-on, or dove-tailed poles, is usually employed. For higher speeds cast steel, or steel plate construction may be used. In the case of very large relatively high-speed machines, the difficulty of securing perfect castings may lead to the well-proven laminated rim structure.

All field poles are made of thin steel laminations riveted together with overhanging pole tips provided to support the field windings.

Field coils are wound of heavy copper strap on edge, insulated in such a way that each individual turn is exposed to the ventilating air, and thus perfect radiation results. The coil is securely fastened between the rotating spider and the tips of the field poles by heavy coil supports.

All parts are carefully inspected during each step in the process of manufacture, and before the succeeding operation is started. When completed, the machine is carefully tested under conditions as nearly identical as possible to those which its future service will demand.

Vertical Type.—Westinghouse standard practice recommends that the generator be fitted with two guide bearings which are supported by brackets fastened to the stator frame. Also, a bedplate or pad on which the stationary part rests.

The roller, or thrust bearing, which supports the weight of the revolving part, may be mounted on top of the generator frame, between generator and turbine, or

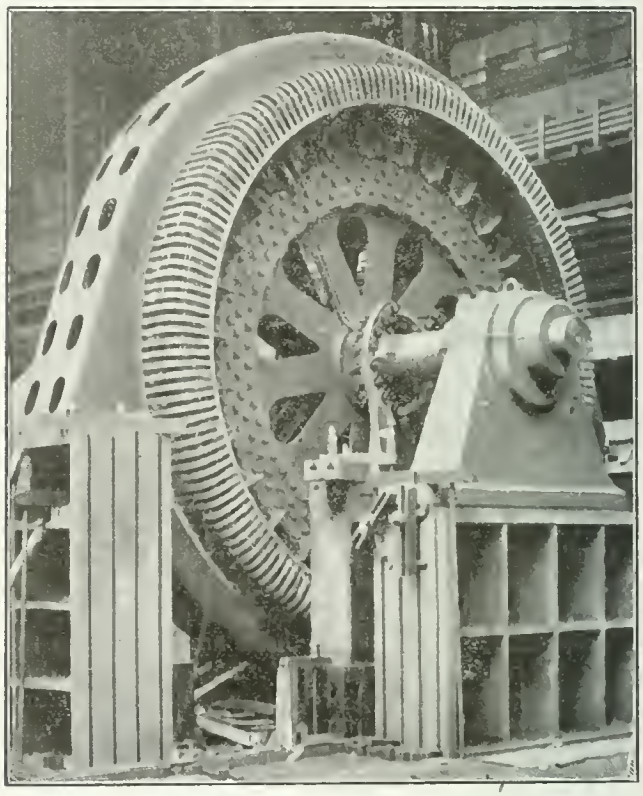

Fig. 2.—A 9,375-Kva., 6,600-Volt Unit, in Shop Testing Rig.

underneath the turbine. In case it is mounted on top of the generator frame, this frame must, of course, be made heavier and more expensive than in cases where it has only to support the stator punchings, winding and guide bearings. Wherever placed, this bearing usually supports not only the rotor of the generator, but also the turbine runner, and in addition takes care of any unbalanced water thrust.

A rigid cast iron frame, into which soft steel laminations are securely dove-tailed, forms the basis of the stator.

Form-wound, interchangeable armature coils are held in open slots by means of fibre wedges. The coils are vacuum dried and impregnated before the outside insulation is applied. This outside insulation consists of wrappings of paper and mica on the straight portions of the coils which lie in the slots, and servings of treated cloth over the V-shaped coil ends. After the outside insulation is applied the coils are treated with an insulating varnish which renders them moisture and oil-proof. An insulating coil is provided in each armature slot to prevent abrasion of the coil and a fibre wedge holds coil and cell firmly in position.

In case of failure of a waterwheel governor to act, the rotating part of both waterwheel and generator are subjected to unusual stresses, due to the overspeeding of these parts. The rotors here illustrated are designed for the maximum obtainable speeds which result in such instances. These overspeeds vary from 50 to 100 per cent. Due to the wide range of speeds encountered, no one type of rotor construction will give ideal results.

There are several designs of rotors, each one particularly well adapted for the requirements for which it is used. Comparatively low peripheral speeds may permit the use of a cast-iron spider with either bolted-on or dovetailed poles. A higher speed generator may demand an entirely different construction. For such work cast steel or rolled steel plates are often employed. In case of very large machines, it may be difficult to obtain perfect castings, and here the well-proven laminated rim may be employed.

Field coils are ordinarily wound with heavy copper strap on edge and insulated between turns with asbestos. This construction is particularly well adapted to give perfect radiating qualities, and because of the heavy strap used is practically indestructible. The coils are securely fastened between the rotating spider and projecting tips of the field poles by heavy coil supports.

Waterwheel generators of almost any practical capacity or speed for installation in the smallest isolated plant or the largest hydro-electric generating station have been furnished by the Westinghouse Electric and Manufacturing Company.

It is noticeable that the value and conservation of cheap fuel and power in the United States are being more fully appreciated each year. When it is borne in mind that coal in the States of Illinois, Ohio, Pennsylvania, Virginia and Alabama during the year 1910 averaged in price $1.08 per short ton at the mines, it will be better understood why these States occupy such prominent positions in the industrial world. The cost of transport in these States is not a serious item, for the cost of bituminous coal, according to quality purchased, ranges from $1.50 to $3.00 per ton, f.o.b. New York harbor. Coal in large quantities can be had in Pittsburg for $1.00 a ton, but even in remote parts of the above-named States the cost averages under $3 per ton. The supply of natural gas was at one time abundant and cheap, but extravagant waste has led to serious depletion and increase in price. Water power has been developed in some of these States, with the result that the cheap electrical power which is available, has contributed considerably to the development of the country around. As already stated, the movement in the United States towards the utilization of poor fuel is becoming stronger each year, and the result is the establishment of power plants where formerly it was not thought possible, and this is opening out new industrial centres to the advantage of all concerned.

NEW METHOD OF COOLING GAS ENGINES.

ORDINARILY about 30 per cent. of the heat value of the fuel passes from the hot gases to the cylinder walls and pistons, states Prof. Bertram Hopkinson, in a paper read before the Institute of Mechanical Engineers, at Cambridge, describing a new method of cooling the cylinder and piston of gas engines. In order to prevent the overheating of these parts under test conditions, it is necessary to provide a water jacket around the cylinder, and, in the case of large engines, to circulate water through the pistons and around the exhaust valves. Most of the disadvantages under which the gas engines labor are due directly or indirectly to this fact. The complicated and thick-walled castings required for the cylinders are apt to crack under the influence of the wide variations of temperature, and overheating of deposits on the internal walls of the combustion chamber causes pre-ignition, so that it is not always practicable to work a gas engine continuously at its maximum output.

The idea of introducing water into an internal-combustion engine is not new. It is a common practice in oil engines to introduce water along with the oil in order to permit the compression to be raised, and water has been injected into gas engines for the purpose of preventing pre-ignition. Proposals have also been made to introduce water for the purpose of cooling parts of the metal. None of the latter, however, have been practical, if indeed they have ever been more than just proposals on paper, apparently because their originators did not appreciate the conditions which must be satisfied with the injected water to act as an effective cooling agent. If the water be turned into steam before reaching the metal it will not exert any cooling effect, except indirectly by lowering the temperature of the flame, and such lowered temperature is accompanied by a considerable loss of efficiency. On the other hand, water which reaches the walls in liquid form and is there evaporated, absorbs out of the heat given to the walls by the gas the whole of its own heat of evaporation, and there is no loss of thermodynamic efficiency, because the heat used is waste heat, which, in a jacketed engine, would go to warm the cooling water.

The author claims that it is of no use to inject the water in a fine spray, or to introduce it into the gas or air pipe, so that it is carried in suspension in the incoming charge, or, as is often done in oil engines, to spray it in along with the oil. Although some of these devices have proved useful for the prevention of pre-ignition and for the softening of the explosion, none are effective for the purpose of cooling.

The author found, however, that by injecting water in comparatively coarse jets against the internal surface of the cylinder, and the head of the piston, the metal can be kept cool without materially cooling the gases, with the result that there is no loss of efficiency. The temperature of the parts can be perfectly controlled, and simple single-walled castings can be used for the cylinders.

Experiments of Dugald Clerk, the author, and others have shown that the rate of heat-flow from the gas into the metal is far more rapid at and soon after the instant of ignition than at any other time. It seems likely from these experiments that for practical purposes the heat flow into the barrel of the cylinder during the last three-fourths of the expansion stroke might be so small compared with that in the first period that direct cooling of this portion of the cylinder could be dispensed with altogether. This anticipation has been found correct, and

it has been found necessary only to direct the spray against the walls in the combustion chamber, and the piston, the rest of the cylinder being kept cool by conduction. Cold water is injected through a hollow casting projecting into the combustion chamber and provided with a number of nozzles or holes about 1/32 in. in diameter, from which the jets are projected against the metal surfaces.

For the purpose of experiment, an 11½ x 21-in. Crossley engine, rated at 40 h.p., was fitted with a new cylinder consisting of a plain barrel without a water jacket. The injection rose is a hollow casting projecting into the combustion chamber and provided with 25 holes. The drip from the rose suffices to cool the exhaust valve. A simple plunger pump driven by a cam injects a charge of water once in a cycle, lasting from about 30 deg. before to 30 deg. after the point of the sliding surface of the barrel is covered by the piston. The quantity of water used was about 2.4 lb. per brake horse-power-hour, and the temperature of the engine ranged from 150 to 180 deg. C. The engine consumed about 15 cu. ft. of coal gas per brake horse-power-hour, both when it was water-jacketed and after being fitted with the new cylinder.

Tests at other loads showed that with a weak mixture the gas consumption is slightly increased by the water injection, but with very rich mixtures it is a trifle less. The difference, however, does not exceed 5 per cent. either way, and on the average it may be said that the economy is unaffected by the use of this method of cooling.

This engine was set to work driving a dynamo, and its speed was increased from 180 to 195 r.p.m., when it was found capable of developing 50 b.h.p. for many hours, an increase of 25 per cent. on its original maximum safe load. It has now been running for a total period of 5,000 hours on regular work, giving no trouble at all, and the combined wear on both cylinder and piston is less than 0.01 in.

To regulate the water supply in accordance with the load the pump is connected to the governor, which is of the hit-and-miss type, so that the pump only takes a stroke when the engine takes gas.

With a throttle governor a corresponding regulation is easily provided. A simple thermostat has also been devised, which automatically controls the supply of water during starting, and when the engine is running, quite satisfactorily.

In case of failure of the water supply, nothing happens except that the engine slowly heats up, and after ten minutes or so, pre-ignitions occur, bringing the engine to a standstill. No damage results from this, but to guard against any possible danger a fusible safety plug is screwed into the combustion chamber, which melts if the cylinder gets too hot, and the noise of the escaping gases warns the attendant.

The system has also been applied to an engine of 105 h.p., and to one of 1,000 h.p.; in each case the original cylinder was used, without water in the jacket. The large engine was run under load 30 hours without a stop; after a short stop for adjustments, it ran for 70 hours without a stop, driving a factory, and developing an average of 800 h.p. The whole of the injection apparatus for the 1,000-h.p. engine cost only $100, and within a few hours of putting it on the engine it was doing all the work of the cooling tower, centrifugal pumps, etc., previously used. An 18 x 24-in. two-stroke-cycle single-acting engine has been built for use with the new system, and is now undergoing trials.

COAST TO COAST.

Calgary, Alta.—The G.T.P. is erecting a temporary station, pending the conclusion of negotiations for permanent terminals.

St. John, N.B.—Two of the longest branches of the branch railways projected are now in operation, while the other three are in process of construction.

Toronto, Ont.—The date of the completion of the Dominion Government's harbor contracts has been set at four years hence.

Victoria, B.C.—The Daily Times contains an editorial calling attention to the uncertain suspension in the plans for the terminals on the reserve and magnificent bridge that was to span the harbor from Johnson Street. The government announced this construction about a year ago.

Vancouver, B.C.—Eighty miles of double track have been completed from Vancouver west to Ruby Creek, and have been inspected by the Railway Commission Engineer. Formal approval for the operation of the second track is expected shortly.

Toronto, Ont.—It will be requested before the Ontario Railway Board that the Toronto Railway Company be compelled to extend their line west along Bloor Street from Dundas Street to Quebec Avenue, instead of constructing the projected Toronto suburban line along Annette Street and Pacific Avenue.

Ottawa, Ont.—The question of pollution of navigable streams and their tributaries, upon which a special committee of the House of Commons heard last season a great deal of evidence and gave a report, will likely furnish food for a conference between the provincial and federal authorities this autumn. The report recommended the calling of an interprovincial conference, and it is understood that all provincial governments will be called upon to send delegates to a gathering of experts to be held in Ottawa in November.

Winnipeg, Man.—Mr. George Bury, vice-president of the C.P.R., has stated that the program mapped out by the company for 1913 will be completed to the last detail, and that all the grading and steel work planned to be done will be finished this year. Concerning the double tracking, he said that more of it would be in operation before the close of the year.

Edmonton, Alta.—It was stated by Sir William Mackenzie on his return trip from inspecting the western progress of the C.N.R., that construction was now 74 miles beyond the British Columbia border, and that the company hoped to have the road to the coast completed by the end of 1914. He added that 300 miles of branch lines have been laid through the prairie provinces this year, and that, taken in all, the C.N.R. has laid 840 miles of new track since the beginning of the year.

Toronto, Ont.—Hydro power has enabled the farmer of Western Ontario to chop ensilage, thresh grain, and stock his barns by electrical energy. This revolution of the system which handles the annual harvest will, according to present indications, branch out beyond Ontario boundaries. Negotiations are now under way, it is understood, between Detroit and Windsor for the sale of power to the American city for like industrial purposes. The Hon. Adam Beck has stated that, though this is the first instance where power has been sought in this way, all municipalities agree that such disposal of power could be arranged under certain restrictions. A town could sell of its surplus to the extent of 7,500 horse-

power, and anything in advance of that should be returnable from time to time as required, on a year's notice. Thus, municipalities might be aided by the payment of fixed charges until they require the full voltage for their own industries. Where a permanent disposal of power would be desired, the matter would have to come before the commission.

Calgary, Alta.—Sir William Mackenzie made the statement on September 17th that he expected to see the C.N.R. in operation in Calgary within sixty days. It is the opinion of shippers that though the line is somewhat rough, it is in good enough condition for freight traffic.

Moose Jaw, Sask.—The shortage of the supply of cement throughout western cities is not being felt in this city. Owing to the renewed building activity of late, the supply on hand in city warehouses was taxed to keep up with the demand, but no serious hold-up in business operations was caused.

Ottawa, Ont.—At the instigation of the Canadian Manufacturers' Association and the Ottawa and other Boards of Trade, the railway board has asked the railways to extend their cartage system until January 1st. So far negotiations have been without result, but it is hoped that transportation interests will be strong enough to provide a reasonable agreement until the whole matter is finally settled.

Ottawa, Ont.—This is the first fall that the two conservation dams of the Upper Ottawa have been working to their full capacity and consequently there will be a great deal of interest particularly among power owners concerning the effect these dams will have on the volume of water available at the Chaudiere. So far it would seem that these dams are very effective in holding back the water for the low water seasons. This has been a very dry season and consequently the amount of water coming down to the Chaudiere would be expected to be very much reduced. However, it has held up remarkably well. At the very low water period a few years ago there were only 7,000 cubic feet of water per second flowing at the Chaudiere, while now the flow is about 24,000 cubic feet, or over three times as much. The two dams, at Kippewa and at Temiskaming, are both in operation this year. They hold back the water in the wet seasons and let it out in the dry seasons in order to keep the level of the river more nearly uniform all year. Then they begin about November to store up water again from the fall rains and let it out during the winter. The government is now building a third dam at Lake Quinze, which is farther up and will increase the storage capacity considerably. To give an idea of the vast amount of water these dams conserve, it is equal to a body of water with an area of 4,000 square miles and a depth of one foot. Besides making the water higher in the low water periods it will to a certain extent relieve the floods of the spring by holding back the water. The work has been conducted by the Dominion government and will cost about $1,000,000.

Saskatoon, Sask.—The Canadian Pacific Railway is contemplating the building of a direct line from Calgary to this city, which will make the second direct line of communication between the two cities. The Grand Trunk Pacific has already chosen its right-of-way into the city.

Toronto, Ont.—Prof. A. T. Laing, of the University of Toronto, has returned from his travels through Italy, Switzerland, France and Great Britain. During the four months of his absence he devoted most of his time to the study of roadway conditions. Prof. Laing stated that one, after travelling abroad, and particularly in Scotland, is impressed with the fact that there is still much to be learned or put into practice in Canada in order to keep pace with other countries, or to meet even in a remote way the economic requirements essential to development. The time has come, said he, when the older and more densely populated districts much have better transportation facilities. Prof. Laing remarked that, as Toronto was surrounded by the best of agricultural land, he could see no reason why she should not be served by the district within a radius of thirty or forty miles. But this he believed to be impossible with the present conditions of the roads. By the use of the motor truck produce can be carried fifty miles in the Old Land.

Kerrisdale, Point Grey.—A lighting experiment is being tried in Point Grey, which, it is said, has already been favored by delegations of ratepayers from Wards Two and Three who have examined it. Point Grey is the first municipality in the district to endeavor to determine what can be accomplished by a municipal lighting and heating plant, and other municipalities are stated to be keenly watching the progress of events. The light, which is very brilliant, and yet soft to the eyes, is obtained from gas manufactured from petrol, and is declared to be produced at a very low rate, the trial working out at a cost of about 60 cents per thousand cubic feet of gas. The plant works on an automatic principle, it being said to only require attendance about once in six months. The illuminant is now on trial, and if successful a proposal may be made for the municipality to undertake the lighting of the district. The gas can be used for a variety of purposes, street and house lighting, house heating and cooking purposes. If this principle is adopted, small plants will be erected in various parts of the municipality, this being a better method than having one large central plant, as it will not be necessary then to have large gas mains throughout the area, the small plants being able to supply each section through small pipes. No scheme, however, has yet been outlined, the matter still being in a tentative stage.

Montreal, Que.—The Harbor Commissioners, at a conference held recently with the Hon. J. D. Hazen, Minister of Marine and Fisheries, obtained an additional grant of $18,000 for the purpose of completing the new addition to the grain elevator, the original grant of $50,000 being found insufficient. The Commissioners hope that the only works contemplated in the harbor for the immediate future will be finished this year. On their return they expressed extreme gratitude for the liberality the Minister had shown in granting their requests. The question of a free port, which has been agitated here for some time, was also briefly discussed. In the opinion of Commissioner Robertson, Montreal was already a free port, and the Board of Trade and other commercial bodies were, therefore, asking for something they already had. Mr. Robertson stated that he was unaware where any port existed at which there were no tolls to correspond to all the harbor charges in Montreal. The report of the Royal Commission on Transportation in its last sitting, urged that Montreal be established as a free port; but this Mr. Robertson held had already been done, though without any special sanction from Parliament.

Montreal, Que.—An additional $20,984 for sidewalks is the request of the Board of Control from the City Council as a result of Superintendent Barlow's report, submitted at a recent meeting. It is found that more sidewalks than it was expected can be laid this year before cold weather sets in, and the supplementary amount of money is requested that as much work as possible can be done, especially on streets which have been paved, but on which sidewalks are not yet laid.

Ottawa, Ont.—About 1,000 tons of peat from the plant at Alfred, Ont., will be sold in Ottawa this winter. The price of this commodity to Ottawa people will probably be $5 per ton. The Government three years ago, as an experiment, installed a plant there that had proved most successful in Europe, and turned out thirty tons a day. Later, the Govern-

ment sold their portion of the bog to private interests, who have installed improved machinery. Two years ago peat from this bog was sold here, and found a ready market. By analysis one ton of hard coal goes as far as one ton and three-quarters of peat, but by actual practice this is not the case; for much is lost in the coal by combustion and in the escaping of half-burned clinkers, whereas in peat the combustion is almost complete, and the substance is burned away to a fine ash. Canada has 37,000 square miles of known peat bogs, constituting a potential national asset of enormous value. Four bogs, within five miles of Ottawa, examined by Government experts, are estimated to contain over 25,000,000 tons of fuel.

Toronto, Ont.—The Toronto Hydro-Electric system made a profit of 13.19 per cent., or $71,000 during the first six months, ending July 1.

Fort William, Ont.—The Board of Railway Commissioners for Canada, at a sitting in Ottawa, September 16th, granted permission for the Grand Trunk Pacific Railway Company to construct a double track branch line from its main line at Empire Avenue, Fort William, northward on what was formerly known as James Street, thence easterly along the city limits to Thunder Bay. The new spur track will be over three miles in length and will open up and serve a large industrial area as well as giving the Grand Trunk Pacific Railway access to the new Government elevator.

Winnipeg, Man.—Track laying on the main line of the G.T.P. Railway is progressing towards Prince George at a rapid rate. Steel is at mile 1,200 from Winnipeg. While the steel bridge across the Fraser River was being completed, a short check was experienced at mile 1,197, where the railway for the second time crosses the Fraser River. This obstacle has now been successfully passed, and the track laying machines are steadily pushing their way forward. The Fraser River is crossed for the third time about 40 miles west of the second crossing, but the bridge here will not be allowed to delay track laying, and a temporary trestle will be erected to get the steel across the river. The steel bridge will be put in place shortly after, and towards the end of November the track should reach Prince George. One hundred and four miles of branch line in the province of Saskatchewan have just been opened for traffic by the G.T.P Railway, with the inauguration of a mixed train service on a part of the Biggar-Calgary branch. This line has been completed to Loverna, on the boundary line between Saskatchewan and Alberta, 104 miles from Biggar. Track laying on the Regina-Moose Jaw and north-westerly branch of the G.T.P. Railway has just been completed to mile 91, a short distance beyond Mawer, Sask., and within a couple of miles of the Saskatchewan River. Permission has just been granted by the Board of Railway Commissioners for operation of this line, and it is probable that a considerable amount of wheat will be shipped over it this year.

Montreal, Que.—Mr. H. S. Holt, president of the Royal Bank, and of the Montreal Light, Heat and Power Company, made some interesting observations on the progress of the work of the C.P.R., throughout the past year. He states that the company is spending in the west on extensions, terminals, and double-tracking, as much as, if not more than, it spent on the original system; that 1,100 miles of new trackage are under way at present and thousands of men at work on their construction; that over $30,000,000 is being expended this year in the west, and in no part of the system is finality disclosed; and concerning the Windsor and Place Viger stations, that before the company has finished their construction with the offices and the slow and tedious system of trackage involved, there will have been an expenditure of about $8,000,000.

PERSONAL.

A. P. LOW, Deputy Minister of Mines, Ottawa, will retire shortly.

H. C. QUAIL, B.A.Sc., has received an appointment to the staff of the Midland Construction Co., at Healey Falls, Ont., and assumes his duties this week.

CHAS. B. GORDON, of Montreal, was elected president of the Canadian Manufacturers' Association at its recent convention in Halifax.

FRANK S. STREETER, one of the United States members of the International Joint Commission has resigned and OBADIAH GARDNER, ex-Senator, Maine, has been appointed in his stead.

CHARLES T. MILLER is a name which we inadvertently omitted from the list of directors of the Maritime Bridge Co., published in our issue of September 11th. Mr. Miller is secretary of the Canadian Bridge Co., Limited, Walkerville, Ont.

W. A. EVANS, recently Public Health Commissioner of Chicago, has been touring the cities of the Canadian West, and has delivered a number of instructive addresses on the subject of public health. Winnipeg, Regina, Moose Jaw, Medicine Hat and Saskatoon were among the places visited by Dr. Evans on his trip.

H. F. MEURLING, C.E., of the Columbia River Hydrographic Survey, is in charge of work near Burton, B.C. The river is undergoing measurement and soundings to find out whether a dam and locks can be built below the narrows at Caribou Point, to raise the water sufficiently for navigability throughout the entire year.

OBITUARY.

DONALD J. McLACHLAN, a well-known contractor of Calgary, died on September 22nd.

AUSTIN BARRETT, in charge of a survey party in British Columbia, was accidentally shot and killed last week. Mr. Barrett was a native of Puslinch, Ont.

E. GRAHAME-JONES, a young engineer connected with a construction party of the Canadian Northern Pacific Railway, was drowned in the Fraser River, near Lytton, B.C., by the upsetting of a small boat. Mr. Grahame-Jones' home was at Stanstead, Surrey, Eng.

COMING MEETINGS.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth annual meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS
OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20324—September 11—Authorizing C.N.O. Ry. to construct spur for Point Anne Quarries, Limited, from main line of Toronto-Ottawa line, at about mileage 126.08, through Lots 21 and 20, Point Anne Concession, Tp. Thurlow, to join spur to be constructed by Point Anne Quarries, Limited.

20325—September 11—Approving revised location and station grounds between mileage 57 and 58, Melville-Regina Branch of G.T.P. Branch Lines Company, in Sec. 12-20-15, W. 2 M., Dist., Assiniboia, Sask.

20326—September 12—Authorizing Lake Erie and Northern Ry. to construct two (2) highways in Tp. Townsend, Ont.—namely, Con. Road from Station 1118-88 to Station 1119-52.1 and Con. Road from Station 1163-95.5 to Station 1164-65.7.

20327—September 15—Extending, until September 30th, 1913, time within which London St. Ry. Co., complete half-interlocking plant at crossing of Adelaide St.; and authorizing London St. Ry. Co. and C.P.R. to operate their cars and trains over said crossing; same to be flagged across by means of a day and a night watchman, employed by C.P.R. at expense of London St. Ry. Co.

20328—September 12—Relieving G.T.R. from providing further protection at first crossing east of Ste. Madeline Station, Co. of St. Hyacinthe, Que.

20329—September 13—Requiring that Michigan Central R.R., T.H. and B. Ry. and C.P.R. Cos., jointly reduce their rate on coal, in carloads, from Suspension Bridge, New York, Black Rock, New York and Buffalo, New York to Islington, Ont., and Lambton, Ont., from 75 cents to 70 cents per ton of 2,000 lbs., said reduced rate to become effective not later than the 27th October, 1913, and rescinding Order No. 20047, dated August 8th, 1913, made herein.

20330—September 5—Authorizing Can. Nor. Alta., Ry. to construct spur from a point on its authorized line, in N.E. ¼ Sec. 30-54-1, W. 5 M., thence across Sec. 30 and Secs. 29 and 32, said Tp. and Rge., to Wellman Gravel and Supply Company, Limited; spur to be completed within three months from date of this Order.

20331—September 16—Approving location C.L.O. & W. Ry. (C.P.R.) station building, known as Brighton, at mileage 91.1: Provided whenever traffic on highway is blocked for more than 5 minutes at any one time by reason of location hereby approved, Board be at liberty to relocate said station; also approving change or alteration in location approved by Orders Nos. 16325 and 16912, so as to include extra land required for station grounds.

20332—September 16—Authorizing G.T.P. Branch Lines Co. to carry traffic over portion of Moose Jaw Northwest Branch from Moose Jaw, mileage 40.1, Regina-Moose Jaw Branch, to Mawer, mileage 44.9, Moose Jaw Northwest Branch, a distance of 47.3 miles. Trains limited to a speed not exceeding 15 miles an hour.

20333—September 17—Approving location Edmonton, Dunvegan & B.C. Ry., from east boundary of Sec.25-72-5, W. 5 M., mileage 156.11, to west boundary of Sec. 30-74-17, W. 5 M., mileage 238.80, Alberta.

20334—September 16—Directing C.N.R. to grade approaches to crossing of road allowance between Secs. 13 and 14-54-5, W. 5 M., Alta.; that south approach to crossing of public road between Secs. 17 and 18-54-4, W. 5 M., be raised 2 ft. and made at least 20 ft. wide, and cattleguards properly adjusted: work be completed within 30 days from date of this Order.

20335—September 17—Authorizing Dominion Atlantic Ry. to use and operate drawbridge at south end of its bridge over Shubenacadie River at South Maitland, Nova Scotia.

20336—September 15—Authorizing Can. Nor. Western Ry. to construct its Red Deer Calgary Branch across G.T.P. Ry. Co.'s Tofield Branch, in N.E. ¼ Sec. 4-25-28, W. 4 M., Alta., subject to and upon certain terms and conditions.

20337—September 16—Approving location C.N.R., Alsask Branch, through Twps. 26-28, Rgs. 26-29, W. 3 M., Sask., mileage 125.45 to mileage 148.34.

20338—September 15—Authorizing C.N.Q.R. to construct across 9 highways, Twps. Lussier, Rawdon, Chertsey and Chilton, Co. Montcalm, P.Q.

20339—September 16—Relieving G.T.P. Ry. from erecting and maintaining fences on its line of railway east of Prince Rupert, to mileage 164. That operation of this Order and all relief given hereunder, in so far as any one or all of said portions of right-of-way are concerned, shall cease when and as soon as any land on either side, or in vicinity of any such portion or portions, becomes settled or improved.

20340—September 15—Approving C.N.R. Co.'s third-class station at Webster, Saskatchewan.

20341—September 15—Approving G.T.P. Branch Lines station site and station at Dorenlee, Sec. 11-43-21, W. 4 M., on its Tofield-Calgary Branch, Alta.

20342—September 15—Removing speed limitation of 15 miles an hour over C.P.R. Co.'s Bassano to Irricana Branch, between Bassano and Standard.

20343—September 17—Approving location C.P.R. Stations on Weyburn Westerly Branch, namely, Melaval, W. ½ Sec. 35-8-4, W. 3 M. Readlyn, S.E. ¼ Sec. 30-7-27, W. 2 M., Woodrow, N.W. ¼ of Sec. 35-8-6, W. 3 M., and Lafleche, E. ¼ Sec. 2-9-5, W. 3 M., all in Province of Saskatchewan.

20344—September 16—Authorizing C.P.R. to construct road diversion in Sec. 25-14-19, W. 4 M., Alta.; and to construct, by means of a grade crossing, its Suffield-Blackie Branch across said road diversion.

20345—September 15—Authorizing C.P.R., subject to and in accordance with terms and conditions contained in agreement, entered into between Municipality of Elcapo, Sask., Town of Broadview, and C.P.R. Co., dated July 2nd, 1913, after diversion of Front St. is made, to close portion of road allowance, within limits of right-of-way of main line, Sask. Div., between Sec. 26 and 27-16-5, W. 2 M., at Broadview, Sask.; and authorizing opening of streets in said City.

20346—September 17—Extending, until Nov. 15th, 1913, time within which C.P.R. complete spur for Canada Wire & Cable Co., Ltd., authorized to be constructed under Order No. 19471.

20347—September 16—Approving location C.N.R., Grosse Isle Branch, through Twp. 25, Rgs. 1 and 2, W.P.M., Manitoba, mileage 74.47 to mileage 80.88.

20348—September 17—Directing that C.P.R., within 60 days from date of this Order, install improved type of automatic electric bell at crossing of Port Burwell Road, at mileage 32.7, Port Burwell Branch; 20% of cost of installing bell be paid out of "The Railway Grade-Crossing Fund," and remainder by Rly. Co.

20349—September 11—Authorizing C.L.O. & W. Ry. (C.P.R.) to cross (a) Prospect St., at grade; crossing be protected by gates installed and maintained by Rly. Co. (b) Albert St., by diverting said St. and carrying it over Rly.; and authorizing Rly. Co. to take whatever additional land may be required for purposes of said overhead crossing. (c) Simcoe St., by means of bridge carrying street over railway, and (d) Divert Centre St., by extending Hall St., easterly to a connection with Simcoe St., and to close existing crossing on Centre St. 2. Approving location of Rly. Co.'s station.

20350—September 17—Approving G.T.P. Co.'s station and station site at mileage 1179.2, Cariboo District, B.C.

20351—September 18—Amending Order No. 20148, dated August 20th, 1913, by adding words "and maintain" after word "construct," in second line of operative part of said Order.

20352—September 17—Authorizing C.P.R. to open for traffic portion of second main line of Cascade Sub. Div., between mileage 86.8 and mileage 47.8, a distance of 39.0 miles

20353—September 18—Amending Order No. 19832, dated July 18th, 1913, to provide that expense of constructing and maintaining crossings authorized under said Order, be borne and paid by the Railway Company.

20354—September 17—Authorizing G.T.R. to construct siding into premises of Dominion Textile Co., Ltd., Montreal, Que.

20355—September 17—Authorizing G.T.R. to construct siding into the premises of Grasselli Chemical Co., Ltd., Montreal, Que., subject to and upon certain conditions.

20356—September 17—Authorizing C.P.R. to construct spur into premises of Ogilvie Flour Mills Co., Ltd., on Lot 11, Block E, at Calgary, Alberta.

20357—September 17—Authorizing C.P.R. (1) to construct diversion of road allowance in Sec. 14-16-20, W. 4 M., Alta.; (2) to construct, by means of a grade crossing, Suffield-Blackie Branch across said diversion, at mileage 83.97.

20358—September 17—Authorizing Dominion Atlantic Ry. to construct bridge over Cambridge Brook, situated 77.9 miles from Halifax and about 300 ft. east of Cambridge Station, Co. Kings, N.S.

20359—September 17—Authorizing Can. Nor. Alta. Ry., to construct spur for Jasper Park Collieries, Ltd., through Sec. 7-49-27, W. 5 M., and Sec. 12-49-28, W. 5 M., mileage 0 to mileage 0.76.

20360—September 19—Relieving G.T.R. from providing further protection at crossing of Tecumseth Road, one mile east of Stoney Point Station, Ontario.

20361—September 19—Approving amended location of G.T.P. Ry. station at Smithers, mileage 226.5, Prince Rupert East, Lot 5289, Rge. 5, Coast district, B.C.; and rescinding approval of station at mileage 227, Rge. 5, Coast District, under Order No. 16278, dated April 9th, 1912.

General Order, No. 111—September 18—Amending second paragraph of mandatory portion of General Order No. 111, dated August 20th, 1913, by inserting following words after word "That," in first line of said paragraph—namely, "the present tariff rates be reduced by five cents per can by making them exclusive of delivery, and that." This amendment be operative from date of said General Order No. 111.

20362—September 19—Authorizing C.P.R. to construct five (5) bridges—namely:—1. At mileage 78.4, Moose Jaw, to be extended for double track, Sask. Div., Indian Head, Regina. 2. At mileage 3.2, Moose Jaw Subdivision, for double track. 3. At mileage 87.0, Rush Lake, Swift Current Section, Western Div., for double tracking. 4. At mileage 92.1 over Antelope Creek, Swift Current Section, Western Div., to provide for double tracking, and 5. Bridge No. 101.2, for double tracking, Swift Current Subdivision, Western Div.

20363—September 19—Amending Order No. 18931, dated March 27th, 1913, by striking out words, "and freight shed facilities," in fourth line and words "and freight," in sixth line of operative part of said Order.

20364—September 19—Directing that C.N.R. provide and install a standard one-pen, two-car capacity, stock yard, with platform and chute, at Sturgis, Sask.; work to be completed not later than October 10th, 1913.

20365—September 20—Authorizing C.P.R. to construct spur into premises of Canadian Concrete Products Co., Limited, Chatham, Ontario.

20366—September 20—Authorizing C.P.R. to construct two (2) bridges—namely, bridge at mileage 52.5, between Secs. 22 and 21-13-18, W. 2 M., Moose Jaw, Subdivision, Sask.; and proposed extension of bridge at Rush Lake, mileage 73.4, Swift Current Section, Western Div., both in Province of Saskatchewan.

20367—September 20—Authorizing G.T.P. Ry. to carry traffic over that portion of main line east of Prince Rupert, B.C., between Morricetown, mileage 205 and mileage 301; operation of trains over said line to be limited to a speed not exceeding 25 miles an hour between mileages 205 and 245; 15 miles an hour between mileages 245 and 301; and six miles an hour over uncompleted bridges and temporary crossing of Bulkely River at mileage 263.

20368—September 20—Authorizing G.T.R. to construct two (2) bridges in Province of Ontario—namely, bridge No. 59, mileage 147.53, from Black Rock, over Bevfield Creek, 20th Dist., London Div. and Bridge No. 202, mileage 150.75, near Huntsville, over Big East River, 12th Dist., Barrie Div.

20369—September 22—Extending for a period of 30 days from date of this order, time within which G.T.R. construct and complete certain spurs into premises of Pilkington Brothers, Limited, Tp. Thorold, Co. Welland, authorized to be constructed by Order No. 19601, dated June 17th, 1913.

20370—September 20—Approving location C.P.R. stations, in Prov. Sask.—namely, 1. At Lemsford, S.W. ¼ of Sec. 10-22-23, W. 3 M., at mileage 69.00, Swift Current Northwesterly Branch. 2. At Abbey, S.E. ¼ Sec. 31-20-20, W. 3 M., at mileage 50.66, Swift Current Northwesterly Branch and 3. at Prelate, in S.E. ¼ of Sec. 9-22-25, W. 3 M., at mileage 81.70, Swift Current Northwesterly Branch.

20371—September 2—Directing that G.T.R. employ watchman at crossing of Edinburgh St., Guelph, Ont., between the hours of 7 a.m. and 7 p.m.; railway company to pay expense of said watchman.

20372—September 22—Approving plan and specifications of drain known as John Beck Drain, to be constructed under G.T.R., at mileage 20.14, Tp. South Norwich, Co. Oxford, Ontario.

20373—September 20—Authorizing C.P.R. to open for traffic portion of double track of its Broadview Subdivision, from Kemnay, mileage 8.2, to Griswold, mileage 24.8, Manitoba.

20374—September 22—Authorizing C.P.R. to construct two (2) bridges—namely, 1. Bridge No. 9.3, near Red Deer, Edmonton Subdivision, Alta. Div., Alta.; and 2. Bridge No. 113.1, near West Shefford Station, Sherbrooke Subdivision, Eastern Div., Quebec; and rescinding Order No. 20092, authorizing the construction of said bridge No. 113.1.

20375—September 20—Authorizing C.N.Q.R. to construct across public road in Lot 15a, Tp. Rawdon, Co. Montcalm, Que.

20376—September 20—Authorizing C.N.R. to construct a bridge to carry its railway across C.P.R. main line and Moose Jaw Creek (third crossing), at mileage 86.1, Sask.

20377—September 22—Authorizing C.P.R. to construct spur for Whitlock and Riddell, city of Moose Jaw, Sask.

20378—September 22—Authorizing C.P.R. to construct spur from station grounds at Camrose in northerly direction across North Railway Ave., across portions of Lots 6 and 7, Block 48, and lane in rear of said lots, thence along lane through said Block 48, across Edgell Ave., and along portion of lane in Block 1; to construct a second track across North Railway Ave., to premises of Vernon Fruit Co., Limited, in Lot 8, Block 48, and third track across portion of lane in Block 1, into premises of Provincial Telephone Co., on Lot 8 to 16, inclusive, Block 1, town of Camrose, Alta.

20379—September 22—Exempting C.P.R. from complying with requirements of Section 364 as to publication of notice of application; and recommending to the Governor in Council for sanction Agreement, dated August 15th, 1913, entered into between his Majesty the King, represented and acting by the Honorable the Minister of Railways and Canals and C.P.R.

20380—September 22—Authorizing C.P.R. to construct extension to spur already constructed for Western Coal Co., from a point on existing spur into premises of Western Coal Co., Limited, situate on Lot 6, Block 21, D.G.S., 35, parish St. John, Winnipeg, Man.

20381—September 22—Authorizing Montreal and Southern Counties Ry. Co., to operate trains over crossing of G.T.R., on Lot 264, parish St. Antoine de Longueuil, at a point 7.45 miles from Montreal, without their being brought to a stop.

20382—September 23—Authorizing C.N.O.R. to construct across St. Denis St. (now Albert St.), Montreal, by means of a structure carrying railway over highway.

20383—September 23—Authorizing C.P.R. to divert road along southwesterly side of right of way, from road allowance along northerly side of N.E. ¼ Sec. 35-39-23, W. 4 M., Alta., to Leon St., village of Alix, Alta.

20384—September 19—Amending Order No. 20230, dated August 30th, 1913, by adding following clause:—"It is further ordered that this order by without prejudice to the rights of Napanee River Improvement Co., to recover from Applicant company, such damages as it may legally be entitled to by reason of the diversion of the river or the construction of the said bridge; and that if the parties are unable to agree, the question of whether any such damages have arisen by reason of such works, and the amount thereof, if any, shall be decided by arbitration under the provision of the Arbitration Act (Ontario)."

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Last Longest—Cost Least

THE proper unit in comparing the values of roofings is the cost-per-foot-per-year-of-service.

To have a low unit cost a roofing must be—

1st. Inexpensive to build,
2d. Inexpensive to maintain, and
3d. Of great durability.

Barrett Specification Roofs are—

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.

+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Fort William, Ont., examining warehouse	Oct. 7.	Sept. 18.	82
Gull Harbor, Man., extension to wharf	Oct. 7.	Sept. 18.	80
Halifax, N.S., railway terminals.	Oct. 15.	Sept. 18.	88
Kaslo, B.C., construction of wharf	Oct. 7.	Sept. 18.	80
Little Dipper Harbor, N.B., breakwater	Oct. 15.	Sept. 25.	80
Mace's Bay, N.B., breakwater.	Oct. 14.	Sept. 25.	80
McAulay's Shore, P.E.I., wharf	Oct. 7.	Sept. 25.	80
Newcastle, Ont., repairs to pier	Oct. 15.	Sept. 25.	80
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., asphalt pavements	Oct. 2.	Sept. 25.	86
Petite Riviere, Est. Quebec, construction of a breakwater	Oct. 7.	Sept. 11.	82
Roy's Beach, B.C., wharf	Oct. 9.	Sept. 25.	82
Regina, Sask., power house equipment	Oct 1.	Aug. 28.	86
Regina, Sask., power house equipment	Oct. 25.	Sept. 11.	86
Taghum, B.C., bridge	Oct. 14.	Sept. 18.	78
Toronto, Ont. sewer	Oct. 4.	Sept. 25.	86
Welland, Ont., section No. 2, ship canal	Oct 15.	Sept. 25.	86

RAILWAYS—STEAM AND ELECTRIC.

Calgary, Alta.—Athabasca citizens are agitating a change in the route of the Alberta and Great Waterways Railway. As planned, the line will miss Athabasca Landing, would run about 30 miles east of the town and strike the river at a point where the river, after running easterly from Athabasca, turns northward, and thence proceed directly to Fort McMurray. The importance of Athabasca Landing, as a northern trade centre, would thus be minimized, and the inhabitants contend that the logical route is to continue the line from Athabasca Landing to Fort McMurray.

Edmonton, Alta.—The vexed question of the Alberta and Great Waterways Railway case has been settled in a manner satisfactory to the government and all interested. Mr. J. D. McArthur and his associates, owners of the Edmonton, Dunvegan and British Columbia Railway now being completed to Peace River, builders of a large section of G.T.P. Railway and at present of the Hudson's Bay Railway, have taken over the charter, and will complete the road and assume all existing liabilities.

Edmonton, Alta.—Though several portions of the G.T.P. road, under construction, have still to be completed, there is every prospect that steel will be laid as far as Fort George by January 1st. At mile 226, there is approximately 400,000 feet of earth and rock to be removed and a large fill-in made: but with a seventy-ton steam shovel at work, this should be completed before the track-laying crews arrive. These are expected in about three months.

Fort William, Ont.—The C.P.R. has completed the subway, and the company which held the contract has moved its outfit to Saskatoon. The road, however, to be used by the public is still unfinished. Whether this is the work of the company or of the city is apparently undecided.

Hamilton, Ont.—The application of Chadwick Brothers for permission to construct a spur line from the G.T.R., will not be granted owing to the objection of residents.

+—Ottawa, Ont.—The contract has been awarded MESSRS. ELBERT SOPER and A. L. McDOUGALL, of Ottawa, for constructing four miles of new track for the Intercolonial Railway, from St. Romuald to Chandière Curve, in Quebec.

Ottawa, Ont.—Reports of engineers indicate good progress on the Hudson Bay railroad. Before the coming year a straight stretch of 150 miles grading will have been completed. Thus, with the exception of a few cuts, the line will be graded from Pas to Thicket Portage, a distance of about 200 miles. About sixty miles of rails have been laid, and before frost sets in to stop the work, it is expected that the rail mileage will pass the seventy mile mark.

Victoria, B.C.—As a result of the investigations carried on by Mr. F. H. Burrall, a New York mining engineer, in accordance with instructions from the president of the White Pass and Yukon Railway, Mr. O. Dickeson, with a view to a possible extension of the line, the company have been so favorably impressed as to contemplate commencing work on an extension of their line next year.

Winnipeg, Man.—An order has been issued from the Public Utility Commissioners' office for the construction, in accordance with the order of the Railway Board for Canada, and in the manner designed therein, of the necessary appurtenances and equipment for crossing the C.P.R. tracks on Selkirk Avenue by the Winnipeg Street Railway, and for the construction of an extension of the company's tracks along Selkirk Avenue to McPhillips Street. The whole construction is to be completed by November 15, 1913.

GARBAGE, SEWAGE AND WATER.

Calgary, Alta.—Commissioner Graves states that the new pumping plant will be in operation in every part of the city early in November, and in most of the city with the exception of East Calgary within a shorter space of time. The line of pipe cannot be run across the river until the water in the Elbow is at its lowest.

Hamilton, Ont.—The proposition of doing away with the filtering basins at the Beach will be opposed by Controller Cooper, representative for the Board of Control on the committee in charge of the Beach waterworks plant, until it has been shown that the good water enjoyed by Hamilton for years and the lack of typhoid epidemics are not the outcome of the filtration system.

London, Ont.—The Board of Works have provided a secondary by-law to be placed before the people in addition to the by-law for storm-sewers, to the effect that the East end be furnished with a new sanitary sewage outlet system at an estimated cost of $50,000.

Montreal, Que.—Tenders will be received up till October 3rd, 1913, for the construction of sewers in eleven of the city's streets. Plans and specifications may be obtained from Board of Commissioners. L. N. Senecal, Secretary.

Regina, Sask.—The six different sewer contracts let this year in as many sections of the city, under the general supervision of the city engineer, are being rapidly and satisfac-

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4.—Saving in freight, etc., is considerable, as a steel tube weighs one-third to one-half as much as a cast iron pipe of the same length. And there are other convincing reasons and illustrations in our booklets.

BOOKLETS ON REQUEST

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torily carried towards completion. The policy of the letting of contracts this year has been fully justified by the progress made.

▲—**Toronto, Ont.**—Tenders will be received up till October 4th, 1913, for the construction of a sewer on Wychwood Avenue, in the Township of York. Plans and specifications may be obtained from office of Frank Barber, C.E., 57 Adelaide Street East, Toronto. Frank Barber, Township Engineer.

Victoria, B.C.—The municipal council of Oak Bay is directing its attention to the necessity for the extension of its sewage and water systems to the entire area within the municipal bounds, and to this end a by-law is soon to be drafted to secure the authority of the ratepayers.

Victoria, B.C.—Tenders will be received up till October 6th, 1913, for 10,000 feet of 3-inch fibre conduit. Plans and specifications may be obtained from W. Galt, Purchasing Agent, Victoria, B.C.

Washington, D.C.—The committee of the International Joint Commission, which will present a report to the entire commission in Ottawa next month, are emphasizing the necessity for immediate measures to protect the health of the Great Lake cities against sewage pollution of water. The report holds that the principal sewage pollution comes from the sewage disposal at Buffalo and recommends that the method of disposal be changed there in the near future. Conditions of sewage pollution along the Detroit River is a more difficult problem, and is to be further investigated by sanitary experts. In a supplementary report, Mr. Frank A. Streeter, of the commission, holds the opinion that only federal control of sewage pollution can furnish effective remedies where the pollution of an interstate stream by one state menaces the health of citizens of another, and that "Congressional action may wisely be taken to provide federal control in the interests of public health."

+—**Winnipeg, Man.**—The contract has been awarded by the Board of Control to the DOMINION CONSTRUCTION CO., for the construction of a sewer on Martin Avenue, from Kelvin Street to Brazier Street.

LIGHT, HEAT AND POWER.

Belleville, Ont.—Tenders will be received up till October 6th, 1913, for heating, plumbing and electric wiring of the boys' dormitory at the Institution for the Deaf and Dumb, Belleville, and the Institution for the Blind, Brantford. Plans and specifications may be obtained from the institutions named. Signed, H. F. McNaughton, Secretary, Public Works Department.

+—**Calgary, Alta.**—The city of Calgary has recently placed an order with the IMPERIAL WIRE AND CABLE COMPANY, LIMITED, Montreal, for lead covered paper insulated underground cable. Approximately 40,000 feet will be installed by the city under the supervision of Mr. R. A. Brown, City Electrical Engineer.

London, Ont.—On October 16th, 1913, the same day upon which the citizens of London will vote upon expenditure of $400,000, for storm sewers, a by-law asking the ratepayers to vote $700,000 for the electrification of the London and Port Stanley railroad will also be submitted.

Medicine Hat, Alta.—The gas committee's report in which the council was requested to authorize an additional 50 lights in the city's streets, was unanimously adopted.

Nelson, B.C.—The City Council has been petitioned by residents of Vernon Street, between Josephine and Hall Streets, that the Tungsten standard system be extended to that district. Extension to Rosemont and Vancouver Street districts has been granted.

Nelson, B.C.—Terms have been agreed upon between Mr. Fred Burnett, of the Toronto Economical Gas Apparatus Construction Company and the city council for the Nelson gas plant at an estimate of $50,000, payable in 50-year bonds, bearing interest at 6 per cent. per annum. A by-law will be submitted to the people when the necessary legal steps have been taken.

+ **Ottawa, Ont.**—The city of Ottawa has placed an order with the IMPERIAL WIRE AND CABLE COMPANY, LIMITED, Montreal, for the supply and installation of 47,000 feet 3 conductor No. 2/0 B. & S. paper insulated lead covered cable, and 1,100 feet 3 conductor No. 2/0 B. & S. steel taped cable, both insulated for 3,300 volts.

Regina, Sask.—A "cheap power" deal, which bids fair to be satisfactory to all concerned, is being negotiated between the city council and Mr. A. S. Porter, acting for the Estevan Gas Power and Development Company.

+—**Toronto, Ont.**—A contract has been awarded the IMPERIAL WIRE AND CABLE COMPANY, LIMITED, Montreal, by the Toronto Hydro-Electric system for approximately 22,000 feet of 2 and 3 conductor paper insulated lead covered underground cable, conductors ranging from No. 6 B. & S. to 500,000 C.M.

+—**Winnipeg, Man.**—The IMPERIAL WIRE AND CABLE COMPANY, Montreal, received an order recently from the city of Winnipeg for 12,000 feet of paper insulated lead covered underground cable.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—It is expected that an understanding with the International Milling Company making it possible to construct the long-contemplated subway on Fourth Street West, will soon be reached. The company will be requested to fix the amount of damage it considers it will suffer if the city goes ahead with the building of an ordinary subway. The company will be left to negotiate with the C.P.R. for a new site to build its own elevator. It is thought that this can be arranged since the milling company has shown itself willing to make the change, and the C.P.R. has indicated that it is prepared to deal for a site.

Canora, Sask.—The next important improvement to be urged before the attention of local property owners, is the matter of good roads for Canora and four municipalities bordering on the town.

Chateauguay, Que.—Since the incorporation of the town of Chateauguay, its rapid progress has made urgent the construction of a new bridge for passengers and vehicles over the Chateauguay River near the N.Y. Central Railway's bridge at Chateauguay Basin. An engineer from the Quebec government was sent recently to survey the proposed location. In addition, the town council will make many improvements upon roads and walks in the municipality during the coming year.

Fort William, Ont.—A public highway, which will form a direct route between Fort William and Duluth, will be completed, according to present indications, in 1914. Mr. F. W. Fraser, vice-president of the Fort William board of trade, states that he has been informed that most of the road on the Ontario side has been completed, but that the gravelling cannot be completed until next spring. Mr. R. J. Burdett, the secretary of the board, reports through the statement of the editor of the Duluth Herald, that much of the road has been finished between Duluth and the boundary, that it is proposed to boulevard the road for a considerable distance from Two Harbors and that, it is reported, the Commercial Club of Detroit are making good progress in its endeavor to have the State and the United States Governments appropriate $50,000 each for the improvement of this road as well as for the construction of others.

Fort William, Ont.—The board of trade have taken into consideration the improvement of the subway leading to the public dock. The tunnel is in need of new walls, a roof, lights, and a new pavement.

Halifax, N.S.—Tenders will be received up till October 11th, 1913, for the construction of the substructure of and embankment to Lennox Passage bridge in the County of Richmond, N.S. Plans and specifications may be obtained from the Commissioner of Public Works and Mines, Hon. E. H. Armstrong, Halifax, N.S.

Kingston, Ont.—Satisfactory progress is reported on the pavement under construction in this city by the Ontario Asphalt Block Co., of Windsor

London, Ont.—The city engineer and two of the city's aldermen were sent to the American Good Roads' Congress in Detroit, to report upon the advocacy of storm sewers. Should they be favored by the electors a programme for paving streets of the city will be undertaken.

+—**Montreal, Que.**—The contract has been awarded MR. JOHN ROSS, of the firm ROSS AND McCOMB, for build-

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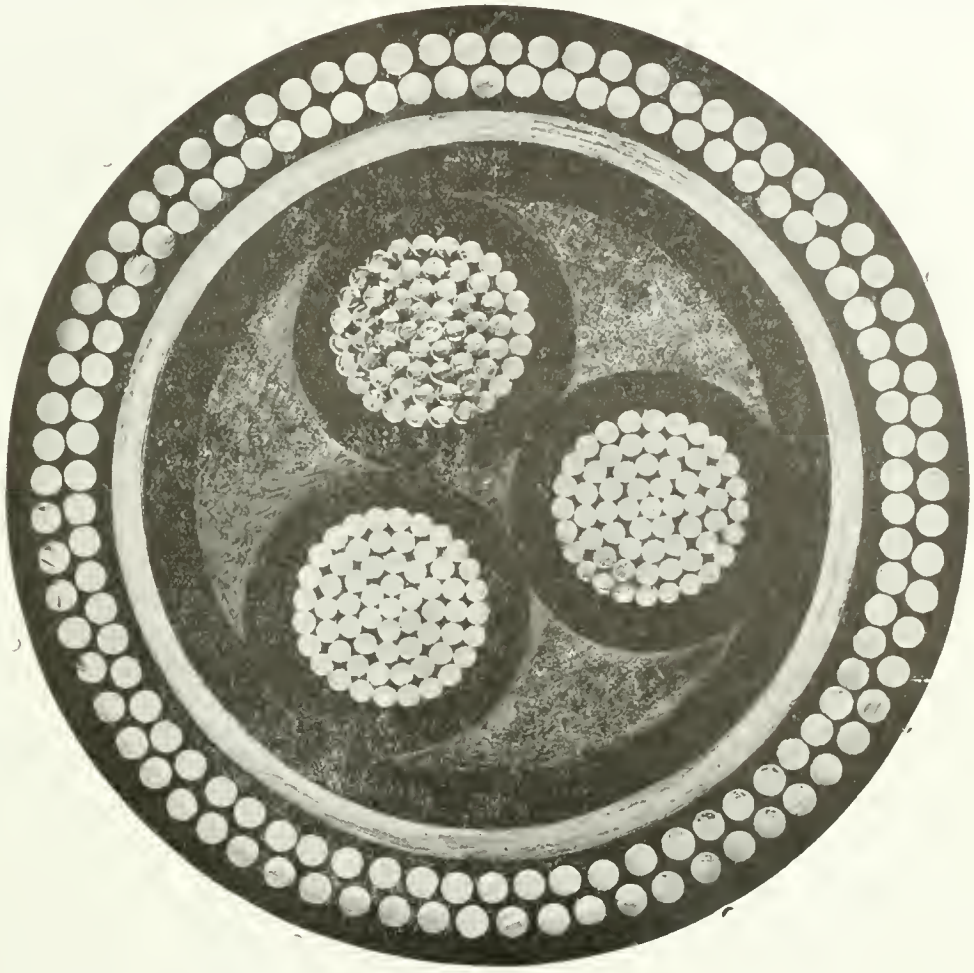

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MONTREAL

ing the concrete substructure of the bridge being constructed by the Montreal and Southern Counties Railway Co., over the Yamaska River, at St. Cesaire.

Montreal, Que.—The Board of Control have presented to the city aldermen a report asking for the construction of sidewalks on a number of the city's streets, amounting in cost to $20,984.74.

New Glasgow, N.S.—Owing to the delay in receiving from the United States certain parts of the steel span which are not rolled in Canada, the contractors, W. P. McNeil Co., Limited, New Glasgow, have been unable to erect the bridge on schedule time. But the company promises that, unless still further delay occurs in the assembling of materials, the bridge will be built during the month of October.

+—New Rochelle, N.Y.—The contract has been awarded to WILKES-CASEY ENGINEERING AND CONSTRUCTION COMPANY, of New Rochelle, N.Y., for the laying of 14,000 square yards of Dolarway pavement at New Rochelle.

Ottawa, Ont.—Tenders will be received up till October 3rd, 1913, for the construction of the substructures of a number of bridges. Plans and specifications may be obtained from the Department of Railways and Canals. L. K. Jones, Secretary.

Regina, Sask.—General repair work on the roadways and walks of the city is to be carried on at once, so that before the frost sets in the roads within the limits shall be in good condition.

Regina, Sask.—The city council has passed a by-law providing for new pavements aggregating in cost $650,782.46. The council has authorized also the construction of concrete sidewalks, totalling $119.427.24 in cost.

Toronto, Ont.—Tenders will be received up till October 7th, 1913, for the construction of asphalt, brick block, bitulithic and concrete pavements, for grading, concrete curbing, concrete walks and sewers. Plans and specifications may be obtained from the Chairman of the Board of Control, H. C. Hocken (Mayor).

+—Winnipeg, Man.—The contract has been awarded the DOMINION CONSTRUCTION CO., by the municipality of Assiniboia for the laying of granulithic sidewalk on Portage Avenue, from Albany Street to Deer Lodge. The contract was let for $5,021.

INDUSTRIAL WORKS.

Cap Chat, Que.—Tenders will be received up till October 22nd, 1913, for the construction of an extension to training pier at Cap Chat, County of Gaspe, Que. Plans and specifications may be obtained from J. T. Bertrand, Esq., District Engineer, Isle Verte, Que. Signed, R. C. Desrochers, Secretary, Public Works Department, Ottawa.

Edmonton, Alta.—A matter recently referred to the city council by Mr. J. D. McArthur, railroad contractor of Winnipeg, is the extension of the city's water mains to the yards of the E.D. and B.C Railway.

Fredericton, N.B.—A new suction dredge, constructed by James Fleming and Sons, St. John, at a cost of about $100,000, is being used in dredging for a channel 300 feet wide through the Oromocto shoals. The channel will be about a mile long and will improve greatly opportunities for navigation on the river.

▲—Halifax, N.S.—Tenders will be received up till October 15th, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations of buildings, sewers, dredging of harbor and filling reclaimed areas. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, Assistant Deputy Minister and Secretary.

Hamilton, Ont.—Mr. James Bain, chief engineer of the Beach pumping station, has devised a method of repairing the fusion vanes of the system instead of replacing them when worn out. The scheme has been approved by the Board of Control and other city officials, and, it is estimated, will save 75 per cent. on the cost of vanes.

+—Montreal, Que.—The contract has been awarded the RAYMOND CONCRETE PILING COMPANY by the Harbor Commissioners for the piling of two new sheds.

Montreal, Que.—The special dyke committee reported to the Verdun City Council recently that the dyke under construction will be completed by October 15th; that contracts had been placed for two pumps with a capacity of 15,000 gallons; and that plans for the pumping station had been approved. The work will be begun at once so that all will be in readiness for the spring.

Niagara Falls, Ont.—It is contemplated that there will be employment for 3,000 men on section No. 3 of the new Welland Canal, to be constructed by O'Brien and Doughey. About 200 men are already engaged in unloading large consignments of the plant which are arriving at Thorold, where the work is to commence.

▲—Ottawa, Ont.—Tenders will be received up till October 11th, 1913, for the construction of an extension to the Rifle Range at Kingston. Plans and specifications may be obtained from the Department of Militia and Defence, Ottawa. Eugene Fiset, Deputy Minister.

+—Ottawa, Ont.—The contract has been awarded MESSRS. REID AND ARCHIBALD, of Annapolis, N.S., for the construction of ice piers at that centre, the contract price being $34,700.

Ottawa, Ont.—Tenders will be received up till October 27th, 1913, for the construction of a training pier and revetment wall at Poupore, Labelle County, Que. Plans and specifications may be obtained from J. L. Michaud, Esq., District Engineer, Post Office Building, Montreal, Que. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received up till October 21st, 1913, for the construction of Wing Dam, No. 3, at the mouth of Woodward's Slough, Fraser River (Lower), B.C. Plans and specifications may be obtained from J. S. MacLachlan, Esq., District Engineer, Victoria, B.C. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

+—Ottawa, Ont.—A contract has been awarded the ISLAND DREDGING AND CONSTRUCTION COMPANY for a wharf at Dorchester, N.B., at a cost of $15,400.

+—Ottawa, Ont.—The contract was awarded to ANDREW McCONNELL for a wharf at Canoe, the contract price being $5,450.

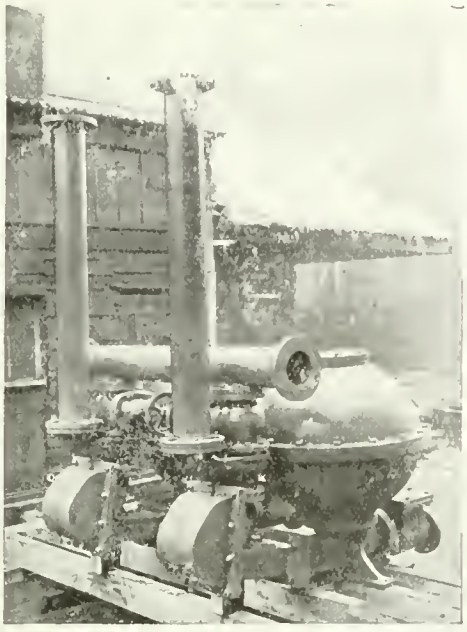
Ottawa, Ont.—Tenders will be received up till October 29th, 1913, for the construction of harbor improvements at Wellington, Prince Edward Co., Ont. Plans and specifications may be obtained from J. G. Sing, District Engineer, Confederation Life Building, Toronto, or from the Department of Public Works. R. C. Desrochers, Secretary.

Prince Albert, Sask.—The department of Dominion Public Works has entered upon a scheme of protective work on the river front from the present wharf to the C.N.R. rail and traffic bridge. The work is the same type of construction as has been greatly used on the banks of the Mississippi, and which will be employed on a large scale along the river when other contemplated improvements have been carried out. Rows of close piling which will be tied in with caps and iron straps are being driven into the bed some ten or twelve feet from the present bank. The intervening space between the shore and the piling will be filled in with rock and gravel sufficient to render the work perfectly safe, and the municipal authorities are expected to do much piling in above this level and thus reclaim a considerable addition to the boulevard, which skirts the river front, and provide a pleasant slope to the water edge.

+—Sault Ste. Marie, Ont.—The contract has been awarded the SOO DREDGING AND CONSTRUCTION COMPANY by the Lake Superior Corporation for deepening the power channel of the Lake Superior Company from 18 feet to 21 feet, at a cost of $300,000. This is the beginning of extension work on the company's steel mills, which will, in the end, aggregate several millions of expense.

Sault Ste. Marie, Ont.—It is now evident that besides the new Welland Canal, the government will build another at the Soo. The new canal will be but another part accomplished in the carrying out of the scheme of improvement for navigation in Canada's great waterway of the St. Lawrence and the Great Lakes. The St. Lawrence canals also are to be deepened, making all the canals equal in facility and size for handling the greatly expanding traffic.

Ste. Anne de Monts, Que.—Tenders will be received up till October 22nd, 1913, for the construction of a wharf at Ste. Anne de Monts, County of Gaspe, Que. Plans and speci-



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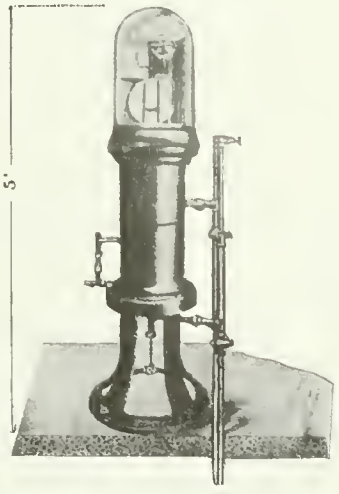

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fications may be obtained from Chas. Chapais, Esq., District Engineer, Quebec, Que. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

St. John, N.B.—Mr. H. L. McGowan has asked the city commissioners to consider a grant to him of a reasonable commission to promote the establishment of a cement plant at Greenhead.

Summerland, B.C.—Tenders will be received up till October 31st, 1913, for the construction of a wharf at Summerland, B.C. Plans and specifications may be obtained from F. W. Aylmer, Esq., District Engineer, Chase, B.C. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

+—Vancouver, B.C.—It is announced by MESSRS. J. G. WHITE, eminent British harbor engineers, that they have secured the contract, involving about £6,000,000 sterling, for a scheme of harbor extension in Vancouver, where foreshore rights were granted recently by the provincial government to the Vanconver Harbor and Dock Extension Company. Twenty-five miles of dockage at Luln Island and Sea Island, and many miles for industrial sites and railway terminals will be provided. The government will have control over dockage rates, and all railways and steamship lines will be allowed equal privileges. By the agreement the government has the further right to purchase at an arbitrated value the works which the company will place at the disposal of the industrial world.

Victoria, B.C.—The new orange peel dredge, the fifth placed on the work of excavating a channel in the harbor, has been set in operation in the inner harbor.

▲—Welland, Ont.—Tenders will be received up till October 15th, 1913, for section No. 2, Welland Ship Canal. Plans and specifications may be obtained from L. K. Jones, Assist. Deputy Minister and Secretary, Department of Railways and Canals.

MISCELLANEOUS.

Brandon, Man.—The Everfresh Company, of Calgary, propose erecting a plant in this city, and have conferred with the city officials concerning the selection of a suitable site. Further arrangements with regard to the establishment of the industry will be made next month.

Calgary, Alta.—A site has been secured for the erection of a building for the Lewis File and Rasp Co., of Massillon, Ohio. The present plant of the company at Massillon is capable of turning out 100 dozen files a day, but more machinery is to be placed in the plant when re-established in Calgary, and an increased output will be the result.

Calgary, Alta.—The city is making a move to facilitate the location of manufacturers in Calgary. It is proposed to erect an industrial building for the housing of infant industries, and to that effect a by-law has been submitted to the ratepayers.

Calgary, Alta.—It was announced by Sir William Mackenzie, while in this city, that the C.N.R. will build a $500,000 depot in Calgary; and that the company approve the Calgary live stock scheme, will join with the C.P.R. and G.T.R. in financing the undertaking, and will do all in its power to make of the Calgary institution the greatest live stock market in Canada.

Fort William, Ont.—Plans for the foundation of the plant to be built by the Canadian Conley Frog and Switch Company at Port Arthur have been received by G. R. Duncan and Co. Tenders are being received and the work is expected to begin at once.

Fort William, Ont.—Before the close of this year, a pulp mill, the first to be located in western Ontario, which will manufactnre print paper only and will have a capacity of 100 tons a day, will be in operation.

Hamilton, Ont.—Plans have been completed by Mr. W. A. Edwards for an office building to be erected by the Royal Templars of Temperance at a cost of $22,000; and work on the structure is to begin immediately.

Lethbridge, Alta.—Plans prepared by William R. Perrin, abattoir engineers of Chicago and Toronto, for the packing plant to be erected by Delany's, Limited, have reached Lethbridge. After arrangements have been made with the city council, the company will let contracts for the erection of the basement of the building this fall.

+—Montreal, Que.—The contract has been awarded the DOMINION BRIDGE CO. for $3,200 worth of structural steel required by the city of Montreal.

Moose Jaw, Sask.—The contractors for the storage elevators have decided not to sublet the work on the excavations for the interior storage elevators, and it will be commenced at once. The material has been ordered and will be delivered to the site as soon as a spur track has been laid.

Moose Jaw, Sask.—Work has been started on the foundation of the distributing warehouse of George White and Sons, Limited, which will be removed here from the city of Regina. As much of the construction as will serve the needs of the company will be completed this winter, and in the spring of 1914, the work of erecting the remaining buildings called for by the agreement with the city will be undertaken.

Moose Jaw, Sask.—Plans for the interior storage elevator to be erected by the Dominion Government, have arrived in Moose Jaw. The elevator is to consist of 84 concrete tanks with 60 interspace tanks, and the space occupied by these will be 144 by 88 feet. The buildings are to be of fireproof construction, concrete and brick with reinforced steel. There will be receiving, cleaning and shipping plants with workhouse, track sheds, storage house, and drier plant, all to be completed and ready for operation by December 1st, 1914.

+—New Denver, B.C.—The contract has been awarded to A. DOUCETTE for the construction of a powder factory for the Steelite Explosives Company, of Nelson, at New Denver.

+—Newmarket, Ont.—The contract has been awarded to W. B. GRAHAM, of Toronto, by the Industrial Home Commissioners of York County, for the erection of a new Isolation Hospital, a short distance from the central building at Newmarket.

New York, N.Y.—The plans for the proposed $20,000,000 plant of the United States Steel Corporation, to be located at Ojibway, Ont., have not been completed, and building operations will not likely commence until next spring.

Ottawa, Ont.—A large building program is being set on foot for the capital. The printing bureau building will be torn down and replaced by a large modern building on a different site, while the present site will be utilized for the construction of a national library. The parliamentary library is at present too small to meet requirements. It is proposed further to enlarge the archives building, which also has become crowded.

Peterboro, Ont.—Tenders will be received up till October 4th, 1913, for the erection of a foundry building. Plans and specifications may be obtained from W. Blackwell, Architect, Water Street, Peterboro.

Saskatoon, Sask.—The newest industry to be incorporated in Saskatoon, is the Electric Cosy Cushion Company. The electric cosy cushion is an invention of Mr. Frank A. Cote; and Mr. J. Cahill, together with a number of local business men, plans to manufacture the devices of Mr. Cote as soon as a satisfactory laboratory and workshop have been properly fitted. A plant is already being used for the manufacture of the cosy cushion.

+—St. John, N.B.—The contract has been awarded JOHN S. METCALF CO., LIMITED, Constructing Engineers, Montreal, for approximately half a mile of Grain Shipping Conveyer Galleries at berths Nos. 5 and 6, Sand Point, West St. John, N.B. The cost is approximately $135,000.

+—Stratford, Ont.—The contract has been awarded MR. JOHN L. YOUNGS by the Canadian Allis-Chalmers Company, formerly the Stratford Mill-Building Company, for the construction of a new brick building to duplicate the present one. A new kiln and two cement sheds are also to be erected.

Toronto, Ont.—Tenders will be received up till October 7th, 1913, for the erection of an ornamental stone and iron gateway at the High Park Boulevard entrance to High Park, Toronto. Plans and specifications may be obtained from H. C. Hocken, chairman of the Board of Control.

Vancouver, B.C.—A site has been chosen on Shaughnessy Heights by Dominic Burns for a new Catholic cathedral. It is planned to erect a building at a cost of not less than $1,000,000.

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Our business is divided into a number of departments in order that it may be handled most expeditiously and to the best interests of our customers.

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WINNIPEG CALGARY SASKATOON VANCOUVER

Vancouver, B.C.—It is being negotiated to erect a $25,000 factory for a company manufacturing rubber goods on the north arm of the Fraser River, near Main St., South Vancouver. Among other goods to be manufactured are Kelly-Springfield tyres.

Vancouver, B.C.—The board of directors of the General Hospital have appointed a committee to draft a scheme for the enlargement of several buildings of the institution, with a view to increase of revenue for the hospital and also to further accommodation of both nurses and patients.

Vancouver, B.C.—An agreement for the acquisition by the Pacific and Great Eastern Railway for its terminal site of the Squamish Reserve, at Newport, has been closed between D'Arcy Tate, vice-president of the P.G.E. and Chief Joseph. However, the agreement will have to be submitted to the Indian commission for ratification.

Winnipeg, Man.—The United Steel Products Co., of New Jersey, U.S., has applied for permission to do business in Manitoba. It is believed that the organization is the selling corporation of the United States Steel Corporation, a company empowered to enter into all branches of the steel industry, selling and tributary industries, such as mining, smelting and dealing in lands. It is not known whether the steel trust intend to enter into manufacturing in Manitoba, or merely to open a selling agency in the province.

Winnipeg, Man.—Application has been made for a permit for the Manitoba new parliament buildings. The plans filed by Messrs. Thomas Kelly and Sons, call for the expenditure of $2,859,750 on the work.

Winnipeg, Man.—Tenders will be received up till October 16th, 1913, for the manufacture, delivery, installation and testing in the Grand Trunk Pacific shops at Transcona, of transformers and switching apparatus. Plans and specifications may be obtained from the Light and Power Department, 54 King Street. Signed, M. Peterson. Secretary, Board of Control, Winnipeg.

Winnipeg, Man.—Tenders will be received up till October 8th, 1913, for the supply and installation of the necessary apparatus for gas testing stations. Plans and specifications may be obtained from M. Peterson, Secretary, Board of Control, Winnipeg, Man.

CURRENT NEWS.

Brandon, Man.—Good progress is reported on the carbarns being erected here. The steel is being put in position, and the brickwork will in all probabilty be completed, as scheduled, by October 12th. The building will be ready for housing the cars by the end of November.

Calgary, Alta.—The warehouse and office building of the Cockshutt Plow Co., Limited, has just been completed. Calgary has now the most complete and up-to-date implement warehouse in Western Canada. The building is equipped with two large electric freight elevators of capacities of 3,000 pounds and 5,000 pounds respectively, while two spur tracks enable the company to handle six carloads of implements at once.

Calgary, Alta.—It is stated that a mining syndicate of American capitalists has ordered machinery to work four mines about 100 miles south of Calgary. The company is capitalized at $2,000,000. In order to place their coal on western markets, railroad connection will be necessary, which may have its terminal in Calgary.

Calgary, Alta.—The Alberta Packing Company will place before the mayor of this city the benefit which would be incurred to both city and province by the opening of large packing plants and abattoirs at Calgary. Every influence will be brought to bear on the council and ratepayers to pass a by-law allowing packing companies to open stockyards here.

Kenora, Ont.—Messrs. Arthur V. Arthur, Toronto, and A. F. Myers, Minneapolis, surveyors of the International Joint Waterways Commission, accompanied by Mr. Douglas N. McLean, of the Manitoba Hydrographic Survey, have visited Kenora to examine evidence relating to water levels and to inspect new gauges which have been established. Survey parties were also set in operation to examine places bordering on the shore of the lake, which might be affected by holding the water of the lake at various stages.

Kingston, Ont.—It is reported that the Canadian Northern Railway will have its Toronto-Kingston train in operation before the end of the year, and that as good time will be made by it as by the Grand Trunk.

London, Ont.—Many west end residents are of the opinion that the sum of $22,000 provided for breakwater purposes will be inadequate.

Montreal, Que.—Sir Philip Watts and Mr. J. H. Noble, two directors of the Armstrong-Whitworth Company, in company with Mr. M. J. Butler, consulting engineer for the company's new steel plant being constructed on the south side of the river, have inspected the work, and have expressed themselves well pleased with the progress shown, as well as with the site chosen. The plant consists of five large buildings. The water mains, important in the cooling process of the plant, have been laid, and there is every indication that by December, the entire plant will be roofed, and ready for the installation of machinery.

Ottawa, Ont.—An arrangement satisfactory to shippers and other business interests concerned and the railway systems, brought about through the intervention of the Board of Railways' Commissioners, provides that the railways continue their cartage service in eastern cities from September 30th to December 31st. However, the rate will be increased by half a cent a hundred pounds, with a minimum of 20 cents.

Port Nelson, Hudson Bay.—180,000 feet of large bridge timber have been landed by the freighters, and it is the intention of the Government to rush the loading of the supplies so that a full start may be made with steel next spring.

Saskatoon, Sask.—The city council have asked the Dominion Grain Commissioners, if they will consider new propositions in regard to the selection of a site for the new interior storage elevator. The chief grain commissioner, R. Magill, Esq., is opposed to changing the site already decided upon, since construction would be delayed. However, the matter is to be placed before the entire board of grain commissioners.

Sault Ste. Marie, Ont.—The first step towards the linking of Sault Ste. Marie and St. Ignace, which would give the Grand Trunk a route from Southern Michigan right to the Grand Trunk Pacific, over the line of the Algoma Central, has been successfully taken. Mr. W. C. Franz, vice-president and general manager of the transportation lines of the Lake Superior Corporation, has announced that the Algoma Central Railway has secured running rights over the International bridge, which spans the St. Mary's River rapids.

Toronto, Ont.—The Board of Control have been asked by the Hydro-Electric Commission to approve an additional capital expenditure of $700,000, for extensions to the system.

Vancouver, B.C.—Prominent railway officials in the persons of Col. E. Moody, passenger traffic manager of the Pennsylvania line, and Mr. Z. L. A. Thompson, district passenger agent at Chicago, have recently visited Vancouver.

Victoria, B.C.—Mr. Walter Luney, of Luney Brothers, contractors for the excavation of the site of the Hudson's Bay Company's new mammoth store, hopes to have that part of the work completed within the time prescribed. Owing to the exceptional size of the site, it is estimated that 24,000 yards of material will have to be removed, and that two-thirds of this will be rock. However, a large compressor plant has been secured, and Mr. Luney is confident that the blasting of the rock will not delay the completion of the work beyond the three months' limit.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.:—A manufacturers' agent at Odessa desires to get into communication with Canadian manufacturers of agricultural implements and other goods, for which there would be a market in Russia.—

From the branch for city trade inquiries, 73 Basinghall Street, London, E.C.:—A Glasgow firm who are open to contract for regular supplies of pulp board, invite quotations from Canadian manufacturers. A London firm desire the addresses of Canadian manufacturers of wrought iron tubes, in a position to fill export orders. A London firm are open to receive offers from Canadian producers of turpentine and of oils.

Insurance Engineering

We maintain a skilled force of engineers and inspectors to advise in regard to the insurance of industrial undertakings.

We offer our services as consultants to engineers and architects who have charge of industrial construction. We have a thorough knowledge of fire protection and the many matters which govern insurance rating.

Manufacturers are invited to permit us to make an inspection and to let us make suggestions regarding fire protection which will add security and also likely more than pay for themselves through reduced insurance rates.

Insurance may be placed through our firm in the same manner as it would be through other insurance brokerage firms. The service rendered—in most cases without cost to our clients—by our staff of inspectors and engineers makes it profitable for owners who are placing insurance on industrial undertakings to place the insurance through our firm.

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From the Dean of an Engineering College:—

"I have been favorably impressed with the ground covered, with the general make-up and the ease of finding any particular class of material. It seems to me that it should immediately take a very important place in the library of every civil engineer."

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16mo, Morocco, 1200 cuts, 500 tables 1483 pages.

PRICE, $5.00 NET

Sewers must carry the sewage quickly and surely to the distant point of disposal.

Therefore they must not only be laid in a proper gradient, but they must also be of a smooth material that will not cause delays in the flow of the sewage. Smooth, round, perfect, salt-glazed vitrified pipe, without blisters or scales and without cracks—in short, MIMICO PIPE—is absolutely required for a perfect sewer. It will pay you to get in touch with us.

Round Pipe and Square Dealings *Write, or 1913 catalogue*

The Ontario Sewer Pipe Co.
LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

TENDERS CALLED FOR

DEPARTMENT OF MILITIA AND DEFENCE. KINGSTON, ONT.—RIFLE RANGE.

NOTICE TO CONTRACTORS.

Sealed tenders, marked on the envelope "Tender for additions to Rifle Range, Kingston, Ont.," and addressed to the Director of Contracts, Militia Headquarters, Ottawa, will be received until noon, 11th October, proximo, for the construction of an extension to the Rifle Range at Kingston, Ont.

Plans and specifications may be seen and full information obtained at the offices of the Officer Commanding the 3rd Divisional Area, Kingston Ont., and the Director General of Engineer Services, Headquarters, Ottawa.

Tenders must be made on forms supplied by the Department and each tender must be accompanied by an accepted cheque on a Canadian Chartered Bank for 10 per cent. of the amount of the tender, payable to the order of the Honorable the Minister of Militia and Defence, which amount will be forfeited if the party tendering declines to enter into or if the Contractor fails to complete his contract in accordance with the tender.

The Department does not bind itself to accept the lowest or any tender.

EUGENE FISET, Colonel,
Deputy Minister.

Department of Militia and Defence,
Ottawa, September 18, 1913.

Newspapers will not be paid if they insert this advertisement without authority from the Department.

H.Q. 18-114-2.—48030.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

CANADIAN GOVERNMENT RAILWAYS.

Halifax Ocean Terminals Railway, Halifax, N.S.

Sealed tenders addressed to the undersigned and endorsed "Tender for docks, First Unit, Contract No. 3, Halifax Ocean Terminal," will be received at this office until twelve o'clock noon, Wednesday, the fifteenth day of October, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor to a depth of 45 feet at low water, and filling reclaimed areas.

Plans and specifications and form of tender may be seen and full information obtained at the office of the General Manager, Moncton, N.B., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Halifax, N.S.

The right is reserved to reject any or all tenders.

By order, L. K. JONES,
Assistant Deputy-Minister and Secretary.

Department of Railways and Canals,
Ottawa, September 2nd, 1913.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

WELLAND SHIP CANAL.

SECTION No. 2.

NOTICE TO CONTRACTORS.

Sealed Tenders, addressed to the undersigned and marked "Tender for Section No. 2. Welland Ship Canal," will be received at this office until 12 o'clock noon on **Wednesday, October 15th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, St. Catharines, Ontario.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered bank of Canada for the sum of $150,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 22nd September, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—48056.

(For further Tenders see page 88.)

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES—IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

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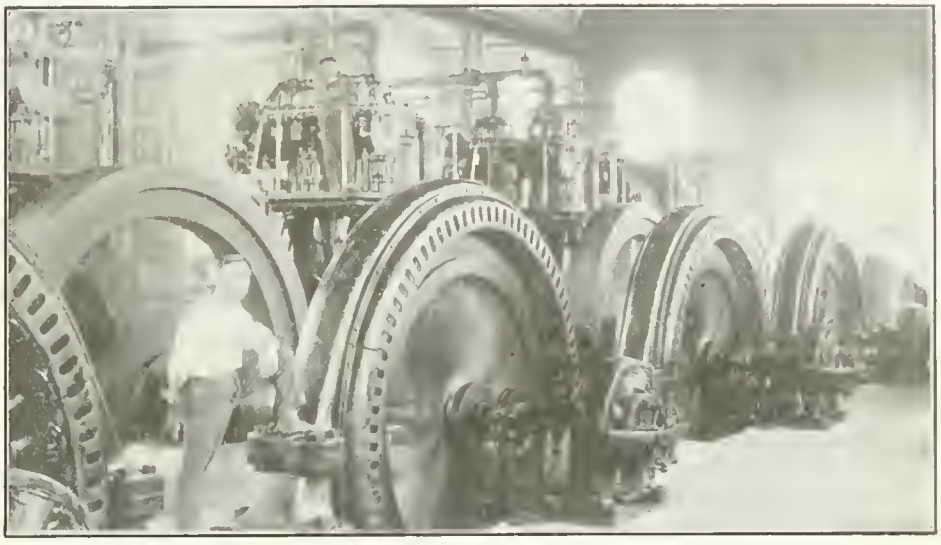

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Refined to definite standards
Every barrel guaranteed uniform

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TRANSPORTATION BUILDING — MONTREAL

PAVING WITH MEXICAN ASPHALT

The view to the left shows the small roller running over the raked surface. The view to the right shows spreaders in the foreground, roller in the rear. The white surface is the finished powdered road.

SECOND-HAND MACHINERY

Drills
Hammers
Grinders
Flue Rollers
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Simplest to operate: Costs least for repairs.

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General Machinery Dealers

TORONTO, ONT.

GAS AND GASOLINE ENGINE, ten horsepower, Fairbanks-Morse; excellent condition; bargain. Can be seen in operation. Review Company, Bridgeburg, Ont.

FOR SALE.—Three to five-ton tandem steam road roller. Machine is in excellent condition and will be sold cheap for cash. Address Box 146, *The Canadian Engineer*, Toronto.

WANTED.—Second-hand locomotive crane. Must be in good working order and capable of lifting 8 tons at a radius of 50 feet. Address Box 148, *The Canadian Engineer*, 628 Board of Trade Building, Montreal.

FOR SALE.—Contractor's machinery, including hoisting engine, 16 dump cars, 1 Ransome mixer, 21 concrete buckets. Address Box 150, *The Canadian Engineer*, Toronto.

Tenders Called For

Sealed tenders addressed to the undersigned, and endorsed "Tender for Harbor Improvements at Wellington, Ont.," will be received at this office until 4 p.m., on Wednesday, October 29, 1913, for the construction of Harbor Improvements at Wellington, Prince Edward County, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Wellington, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, September 30, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—46393.

(For further Tenders see page 86.)

A 40-TON LOAD.

The illustration shows an interesting use of a contractor's haulage outfit in transporting a huge electric train in Pittsburg, recently. The road freight car is one of the Buffalo Pitts Company, Buffalo, N.Y., standard 20-ton capacity cars used by contractors in their work.

The car is built with wooden frame, with steel facing and steel braces. The axles are 3½-inch solid steel. The wheels

A 20-ton road freight car, put to unusual service.

are also of steel, and are 48 inches high, with a 14-inch tire face. The car is equipped with a patent reversible gear that makes every wheel track perfectly, and enables steering a number of these cars en train either front or back with ease.

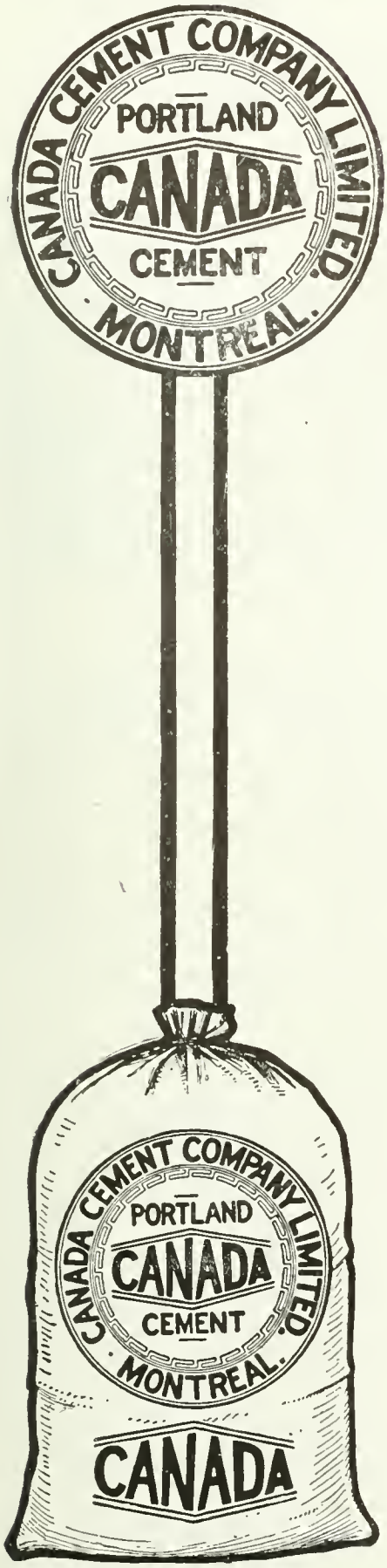
Contractors are using haulage outfits for every conceivable kind of work outside their regular field of application. The above company build many types of special cars on order and furnish their different types of standard cars in 5-ton, 10-ton, and 20-ton capacity with patent reversible gears, so that they may be coupled in one train.

The tractor shown is also of Buffalo Pitts Company make.

NEW INCORPORATIONS.

Toronto, Ont.—Burnham Engineering Company, $40,000. J. H. Ronan, B. Folliot, E. Hayes. Dominion Brick and Tile Company, $200,000. F. J. Foley, E. N. Heather, V. W. Price. Flavelle Mining Company, $250,000. T. Browning, T. Cruse, T. I. Cooke. Amalgamated Motors, $1,000,000. J. F. Selby, W. H. Smith, T. O. Pardoe. Orr Gold Mines, $2,000,000. J. A. Campbell, G. P. McHugh, W. H. Clipsham. John A. Hendricks Company, $40,000. H. Riley, J. F. MacGregor, W. H. Walter. Consolidated Construction Company, $500,000. H. E. Larkin, A. E. Sangster, both of St. Catharines, T. R. Hinds, Toronto.

PERMANENCE—



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The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

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MONTREAL TORONTO WINNIPEG CALGARY

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

POSITION open for fourth-year student engineer or graduate. Apply, stating age, experience and salary to Charles D. Campbell, Town Engineer, Galt, Ont.

CHIEF ENGINEER.—An excellent opportunity is offered to an experienced all-round engineer, to connect with an established Consulting Engineering and Construction Corporation, based on co-operative plan, offices in Cleveland, Detroit, Buffalo and New York City. The position requires a man to take complete charge of the mechanical, electrical, structural and drafting departments. Highest references and $1,500 investment required. Contract with salary, commission and interest in business guaranteed. Box 140, *The Canadian Engineer*, Toronto.

WANTED.—Instrument man and two chainmen for Dom. Land Survey Work's Party, to organize at Winnipeg about November 10th. Preference to articled pupils. Apply, stating experience and salary expected to Box 144, *The Canadian Engineer*, Toronto.

CENTRAL HEATING!

Agents with considerable capital and own warehouses wanted in important places by first-class German Special-Factory for new patented regulating-cocks, (valves for steam and hotwater heating arrangements). Only experienced men with old and good clientele will be considered. Detailed offers, with references, to be sent to

METALLWERK TERNA, BERLIN
(Germany), Schlesische Strasse 29/30.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

CIVIL ENGINEER (40) with 18 years' experience in railway exploration and location, surveys, construction and maintenance, concrete foundations and bridge erection, at present engaged, will be open for employment about October 1st, Please reply Box 130, *The Canadian Engineer*, Toronto.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

STRUCTURAL ENGINEER. Experienced in design; field and shop practice in structural steel and reinforced concrete, seeks technical commercial position. Address Box 132 *The Canadian Engineer*, Toronto.

AN ASSOCIATE Member Institute Civil Engineers, at present in position in London (England), wants berth in United States or Canada. Experience in railways, bridges, workshops, etc. Good draughtsman and surveyor. Moderate salary required. Disengaged shortly. Will pay own travelling expenses. "Engineer," 383 Selby Street, Westmount, Montreal.

WANTED position as resident engineer, instrument man or draftsman. Experience on railroad location, construction and maintenance and general reinforced concrete construction. Location immaterial. Box 142, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

ELECTRIC FURNACE.—The proprietors of Canadian Letters Patent No. 134,772 of 1911, are prepared to sell, or license Canadian manufacturers to work in Canada, this patent, which relates to a furnace to be used for the refining of steel or for other refining or smelting operations. Address, International Acheson Graphite Co., Niagara Falls, Ont.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 136182, granted on October 17th, 1911, to G. W. Clarke, T. B. Eastman and F. M. Wright, of California, U.S.A., for matrix plate, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Smart, 53 Queen Street, Ottawa, Canada. Russel S. Smart, Resident.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 136018, granted on October 3rd, 1911, to F. M. Walter, of Bournemouth, Hants, England, for mowing and plowing machine, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Co., 53 Queen Street, Ottawa, Canada. Russel S. Smart, Resident.

MONTREAL MARKET LETTER.

The effect of the new tariff laws to come into force in the United States shortly, is the most interesting feature of the iron and steel market; yet the market seems to give very few signs on what must prove a great change. A despatch from the United States says:—"For some time foreign bars and other products have been quoted for Pacific coast delivery at prices contingent on the proposed low duties going into effect. Some American inquiries for European billets are reported. Like recent inquiries from this side for English pig iron, they are more an effort to find what could be done than actually to buy."

There has been considerable disappointment throughout the United States owing to the lack of the placing of contracts for steel products of various kinds. It is now thought that the first of the large rail orders for next year must shortly be placed. When these orders begin to come along a good idea of the requirements of the railways will be obtained. The outlook at the moment does not seem to be particularly encouraging. Steel bars are holding firm and mills seem to have been taking orders at prices subject to revision in case of a decline and up to the present seem to have been able to hold the price at 1.40c. basis. Iron bars are holding about steady. Some orders for structural work have been coming out and the supply is fairly large.

The pig iron market appears to be holding its own fairly well. There was a slight firming of prices about a month ago and this level has been maintained. Contracts are already being placed for the first quarter of 1914, although the volume up to the present seems to be small. Producers of iron, fortunately, are able to purchase coke at a slight reduction, and this will help out considerably.

Iron and steel circles in Montreal are particularly interested in the outcome of the receivership for the Canada Iron Corporation. From all that can be learned, the difficulty has arisen through operating the pig iron furnace at a loss. The company has apparently been unable to meet competitive prices. The other departments of the corporation are said to have been operated at a profit.

Orders for iron and steel have been coming out as well as expected. There has been some falling off in business, but several companies report that they expect the most remunerative year in their history. They are, however, beginning to fear the effects of the lowering of the American tariff, inasmuch as it now seems to be pretty generally admitted that this will bring down costs in the United States and thus create more competition in the Canadian market

Manufacturing 48" Pipe at Berlin, Ontario, Canada.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, September 27th, 1913.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel, $3; machine steel, iron finish, $2.25.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags repurchased at 10c. each. Paper bags cost 25 cents extra, or 10c. per bbl. weight.

Chain.—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¼ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¼ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No 1 Summerlee, $22.50 per ton, selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron, number for number and grade for grade is quoted about the same price as Summerlee. Canadian Iron sells here at about $19.25 to $19.50 per ton, on track.

Lath.—See Lumber, etc.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph Poles: seven-inch top, cedar poles, 25-ft. poles, $2 each; 30-ft., $3.75; 35-ft., $4.50 each, 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce, 4-ft x 1½-in., mill run, $3 to $3.25; pine, 4-ft. x 1½-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe.—Cast Iron.—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is fair and the market steady:—¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. of for galvanized; 3½-inch $95; 4-inch $1 08.

Toronto, October 1st, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted.

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron.—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel.—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks.—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto, 60 cents.

Cement.—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot.—The market is lower at 15¾ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps.—75c. and $1 per 100; case lots, 5,0000, 20 per cent. off.

Dynamite.—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¾ cents pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ¼ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1¼ cent.

Fuses.—Electric Blasting.—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain.—¼-inch, $5.75; 5-16-in, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe.—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanied Pipe, ¼-inch, $2.86; ⅜-inch, $2.86 ½-inch, $5.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead.—Firmer, $5.25 to $5.50.

Pig Iron.—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar.—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate.—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being sleeker and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green, $8, with a prospect of advance. Dealers are fairly busy.

Sand.—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe.—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0.25	$0.40	$0.65	$1.00	$ 5.05
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	15.00
Double junctions	1.25	2.00	3.25	5.00	16.05
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H traps	2.00	3.20	6 50	15.00	.....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes, 9 inches and under or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels.—Active.—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Sheet Copper.—22c. per lb.

Sheet Steel.—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized.—Apollo Brand.—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 pounds. Fleur de Lis, 28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin.—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates.—3-16-inch, $2.40 per 100 lbs.

Zinc.—Spelter.—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, September 30th, 1913.

Anvils.—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10½c.; anvil and vise combined, each $5.50.

Bar Iron.—$2.50 base.

Bars.—Crow, $4.50 per 100 pounds.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick.—Kiln run per M, $13; sewer per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland.—$2.40 to $2.50 per barrel.

Chain.—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5½c. Tie out, 70 and 10 per cent.

Copper.—Tinned, boiler, 26½c., planished 29½c.; boiler and T. K. plts, plain, tinned, 45 per cent discount.

Dynamite.—$11 to $13 per case.

Galvanized Iron.—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4, 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe.—Iron, black, per 100 feet, ⅜-inch, $2.40; ½-inch, $2.35; ¾-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.80; 1½-inch, $9.35; 2-inch, $12.50; galvanized—½-inch, $4.15; ¾-inch, $5 20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7 60 per cent., full coil.

Pitch.—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled.—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50, cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel.—8½ to 15c. per pound.

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Contents of this issue on page 561

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

POINTS IN BRICKS AND BRICK CONSTRUCTION

STANDARDIZATION OF BRICK IS TIMELY—LOSS OF STRENGTH IN BRICKWORK DUE TO FROGS—LACK OF UNIFORMITY IN SIZES—CLASSIFICATION OF BRICKS—BRICK MORTARS—SUGGESTED IMPROVEMENTS OVER PRESENT PRACTICE

By ROBT. J. MARSHALL, B.A.Sc.,

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THE commonest building material used to-day in factory construction is the old-fashioned brick. The art of brick-making and brick-laying is a very ancient trade. One of the causes of trouble, according to Biblical record, between the Israelites and Egyptians had to do with the making of bricks, and from this we are at liberty to infer that brick-laying, as well as brick-making was a very ancient craft. Some of the oldest ruins of the Orient remain to-day as monuments of the skill of these men.

It follows, therefore, that when a student of present-day building materials discovers a desire to investigate all parts of his subject, he ought to be fully warned about the seriousness of tampering with history. The age of these ancient crafts and the history surrounding them, make the art of the brickmaker and bricklayer venerable and exempt from the invasion of recent learning. They seem to have been the barrier which has prevented the thorough examination such as all the newer materials have had to undergo in recent years.

Brick is the last of the commonest of the building materials to be standardized. The investigation and subsequent standardization of the brick crafts are being undertaken by the American Society for Testing Materials, and this society may be depended upon to carry on the work in the same thorough way that they have done in the case of steel and concrete.

The reasons for the present revision of the rules of brick-making and brick-laying is that present methods are uneconomical, inefficient and careless. The necessity of economical consideration is the result of the present tendency to build high buildings. The inefficiency is seen in the ineffective distribution of material; and the carelessness is everywhere evident in the business.

In recent years factory and office buildings have grown from the old three, four and five-story type to the present ten, fifteen and twenty-story buildings. If brick buildings were restricted to the old type there would be no pressing reason for a change. But office and factory buildings are so expensive to erect at present that prospective builders are compelled to give careful consideration to economy in their building material. A good brick building would suit a great many such builders if designed on an economical principle, allowing an adequate factor of safety.

Economical designs are not now possible under our very conservative building by-laws. But the by-laws are not properly to blame, for back of them there are good and sufficient reasons for the conservation; and those reasons are the direct result of carelessness all through the brick-making and building trades.

In the last thirty years, the rules governing the use of all our building materials have undergone, or are undergoing, revision. Technical and economical considerations have led to new, more accurate and appropriate uses. Processes of manufacture are yearly improving the uniformity of most building materials. The result of these improvements is a more reliable material. The more reliable it is, the closer may the safe working

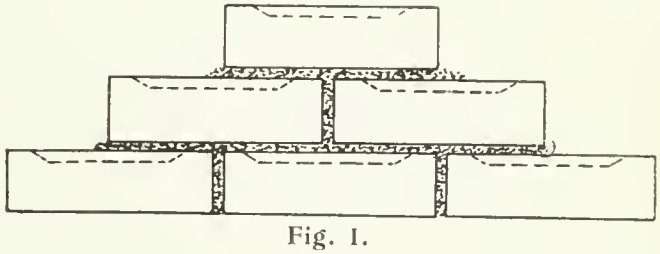


Fig. 1.

load be figured to the ultimate strength of the material. As a result of the above-mentioned improvements, safety factors are becoming more clearly defined and they will continue to diminish as materials improve in reliability.

The commonly accepted safety factor for steel is 4; for concrete, 5 to 6; for timber, 7+; and for brick, 10+. These empirics are an index of uniformity and reliability, and indicate in a general way the channels in which manufacturers have made the most progress. The high safety factor is very necessary in timber, owing to natural defects, such as knots, cross-graining, etc., but where a man commences with the raw material and makes a brick wall by his own process, it seems to be a misjudgment to lay the blame for all the defects of the resultant to natural causes.

The Effect of the Frog in Brickwork.—The first point at issue is the use of the frog in bricks. The commonly-accepted theory, with regard to the frog in a brick, is that it is the bond which resists the possible horizontal shearing stresses. If Fig. 1 is examined, it will be seen

that the mortar between the bricks is bonding the frogged surface of the lower brick to the flat surface of the upper course. Failure from such shearing stresses will take place across the weakest horizontal section, which would be in this case the sections at the flat surface. Therefore, the resistance to shear between the bricks depends upon the bond between the mortar and the flat surface, hence it is obvious that equal resistance to shear would be obtained if the surfaces were flat below and flat above. In practice the Canadian bricklayer spreads his mortar on the preceding course, which is laid frog downwards, as in Fig. 2a, then he takes the point of his trowel and runs a gutter in the mortar along about the centre of the course of bricks. The bricks are then laid frog downward, making the frog fit over the gutter in the mortar, as shown in Fig. 2b. That this is the case has been proven by a test, in which fifty bricks were selected on different jobs; so that the fault could not be claimed as local to any one contractor, and of the fifty selected but three frogs contained any mortar, and in those cases it seemed to have been more by accident than intention. The present practice clearly destroys the bonding and shearing theory supporting the use of a frog in bricks, and it also furnishes a very strong argument against its use at all.

The above is by no means the most serious defect of a wall so constructed. Consider the effect the loss in bearing area, caused by this practice, has on the compression value of a wall. The average brick laid flat gives a bearing area of $4'' \times 8\frac{1}{2}'' = 34$ sq. ins., the area of the frog is $2'' \times 6'' = 12$ sq. ins., so that the actual bearing area of a frogged brick is 22 sq. ins. Thus the frog decreases the effective strength of the wall by 35%. Actually the strength is decreased by much more than 35%, as experiments will show. Brick masonry, under an increasing load, begins to fail by the lime failing and breaking the bond between the small particles of sand; the mortar then acts in the same manner as sand, flattening out and flowing to the points where the pressure is least, which would be in this case the outside edge or the frog of the brick. Also, the sand in flowing at the edges and at the frog, assumes the same angle of repose as ordinary sand (about 45°), and thus decreases the bearing area of the upper brick, as shown in Fig. 3. It might be pointed out, further, that the process of failure of a wall is, first, the failure of the mortar as described above, and later the failure of the bricks. Between these two failures there is a difference of anywhere from 15 to 35% of the ultimate strength of the wall. To illustrate: if a wall has an ultimate compressive strength of 1,000 lbs. per sq. in., the mortar will fail anywhere between 650 and 850 lbs. per sq. in.

That the different positions of the frog has a real effect upon the strength of the wall is recognized by our building by-laws where pier wall construction is defined as requiring that the bricks should be laid frog upwards and the wall grouted, thus making certain that the frog is well filled. Additional bearing values must therefore be allowed for a wall so constructed. If a wall of a certain compressive strength per sq. in. is desired and the bricks may be laid either of these ways, it follows that to build the wall pier construction throughout, ought to mean a saving in bricks, and thus an economy in material would be effected.

Another argument which is sometimes advanced in favor of the frog is that bricks are easier and quicker laid when placed frog downward. As has been already stated, this is the Canadian practice. English and continental practice is to lay every brick frog upward, and fill the frog. The question of which way is easier and quicker seems to be only a matter of which way a bricklayer is taught and rapidity then is but a matter of practice.

Variation in Size of Bricks.—Bricks vary in height from 2 ins. to 3 ins., due to at least two causes: (1) a difference in the size of the forming mould; (2) the process by which they are solidified. It seems necessary to establish a minimum and a maximum dimension in height, allowing a variation of not more than one-eighth of an inch in the finished product. The difficulties of estimating air-shrinking and fire-shrinking in clay brick is well known, but they are not such that they cannot be overcome. That some precaution is necessary can be very well illustrated by considering the difference in the amount of mortar in the face and back of a wall, where the bricks differ by one-eighth inch in height. (The writer knows of cases where the face and filling bricks have differed by as much as one-half inch.) The difference of one-eighth of an inch in the height of the bricks would mean a difference of one-half to the vertical foot of wall, assuming four bricks to the vertical foot. In a fifty-foot wall there is a difference of twenty-five inches in

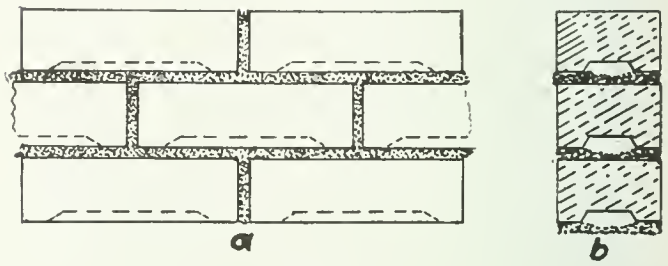


Fig. 2.

the amount of mortar. The mortar is the weaker material in the wall, and therefore the inside of the wall, which has to carry the floor loads and should be stronger, is weaker than the outside.

Classification According to Strength.—There should also be a minimum requirement of strength in a definite period after a brick is made. Bricks, as they are used now, vary in crushing strength from 400 lbs. per sq. in. to 7,000 lbs. per sq. in., and are classified according to appearance and not according to strength. The above-mentioned brick showing a strength of 400 lbs. per sq. in. would probably be used as a filler, and placed in the back of the wall where it would have to carry the greater portion of the load. It is because these poor bricks are used that building regulations are justified in allowing a compressive strength of from 50 to 75 lbs. per sq. in. This laxity in allowing the use of the poor bricks is the reason for discounting the strength shown in 85% of the bricks produced, for any of the modern kilns will show 85% of the bricks to be hard burnt. Therefore, if some rigid standard was enforced for factory and office building construction, such as a requirement of 2,000 lbs. per sq. in. in compression, one month after being made, it would only exclude about 15% of the bricks produced and many uses could be found for the rejected 15%. Building regulations would then be justified in raising the allowable unit stresses in brick wall construction.

Lime versus Cement Mortar.—In Table I. is given the results of compression tests on blocks of cement and lime mortar.

Table I.—Strength of Mortars.

Composition of mortar.	Age when tested.	Strength in lbs. per sq. in.
1 lime : 2 sand	1 month	94.
1 lime : 2 sand	3 months	136.
1 lime : 2 sand	6 months	245.
1 cement : 3 sand	2½ months	1352.
1 cement : 3 sand	8 days	655.
1 cement : 3 sand	13 days	1320.
1 cement : 3 sand	28 days	2155.
1 cement : 2 sand	8 days	895.
1 cement : 2 sand	13 days	2325.
1 cement : 2 sand	28 days	2690.

The table shows that cement mortar is much stronger and gains strength much more quickly than the lime mortar. In factory and tall building construction, both of these points of superiority of cement mortar are of importance. By the use of a mortar such as 1 part cement to 2 parts sand a much higher allowable strength could very safely be allowed than is allowed at the present time, which would mean an additional economy in material.

Another difficulty with mortar, and especially lime mortar, is the variation in quality due to carelessness in proportioning and mixing. The proportions are usually left to the experience and guessing ability of the mortar mixer, and seldom, if ever, is the material accurately measured. The only tests required of the fitness of the resulting mixtures are their spreading and working qualities, which are in many cases very different from strength qualities. More care in measuring and mixing the materials of a mortar would improve its strength and reliability.

The purpose of this article is to point out where improvements might be made. What has been termed carelessness is as much the fault of the architect and engineer as it is the fault of the brickmaker or bricklayer. If specifications were drawn up more carefully and precisely a great many of the inaccuracies in using building materials would be eliminated; for instance, if architects, by agreement, were to issue specifications for bricks without frogs it would be but a short time until the manufacturers would be making only that kind of brick. To the brickmaker the frog is more or less of a nuisance anyway, and its elimination would, in most cases, mean but slight changes in his moulding machinery. The writer knows of four firms of architects doing business in Toronto and Montreal whose specifications are of the type described. Most of the other difficulties pointed out could be gotten rid of by a similar process.

In Canada at present the ceramic industries are booming. The development has improved the quality as well as increased the quantity and ultimately the improvement in quality must be recognized by increasing the allowable safe loads and thus cutting down the waste in building operations.

The following points are suggested as improvements over the present practices:—

1. The elimination of the frog in bricks.
2. The use of cement mortars, not exceeding 1 part cement to 3 of sand, in all but residential buildings.
3. A definite minimum and maximum height for all bricks.
4. Better and more precise specifications for proportioning and mixing mortars.
5. Increased bearing values.
6. That the following be the specification for bricks, which is the specification proposed by the American Society for Testing Materials:—

Selection of Samples.—For the purpose of tests, brick should be selected by some disinterested and experienced person to represent the commercial products. All brick shall be carefully examined, and their condition noted before being subjected to any test.

Transverse Test.—At least five brick to be tested, laid flat-wise with a span of seven inches, and with the load applied at mid span. The knife edges shall be slightly curved in the direction of their length. Steel bearing plates, about ¼-inch thick and 1½-inches wide, may be placed between the knife edges and the brick. The use of a wooden base-block, slightly rounded transversely across its top, upon which to rest the lower knife edges, is recommended. The modulus of rupture shall be obtained by the following formula.

$$R = \frac{3\ W\ L}{2\ b\ d^2}$$

in which:—

L. is the distance between supports in inches.
b. is the breadth of the bricks in inches.
d. is the depth of the brick in inches.
W. is the load in pounds at which the brick failed.

The half brick resulting from the transverse test shall be used for the compression and absorption tests. One half to be crushed in its dry condition. The other half to be used for the absorption test and crushed while in this wet condition. No specimen shall be used if any part of the line of fracture is more than one inch from the centre line.

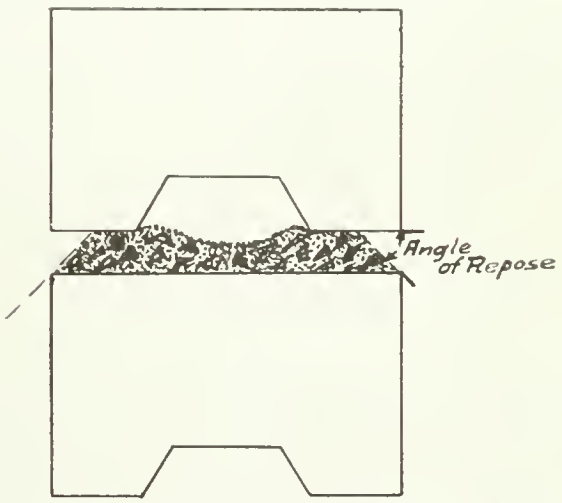


Fig. 3.—Showing Effect of Crushing on the Mortar.

Compression Test.—Compression test shall be made on half brick, resulting from the transverse test. The brick shall be bedded flat-wise on blotting paper, heavy fibrous building paper, or heavy felt, to secure a uniform bearing in the testing machine. In case the brick have uneven bearing surfaces, they shall be bedded in a thin coat of plaster of Paris. For dry test, before applying the plaster of Paris, the bearing surfaces of the brick shall receive a coat of shellac. The machine used for compression tests shall be equipped with spherical bearing block. The breaking load shall be divided by the area in compression, and the results reported in pounds per square inch.

Absorption Test.—At least five half brick shall be first thoroughly dried to constant weight, at a temperature of from 200 to 250 degrees F., weighed, then placed on their face in

water to a depth of one inch, in a covered container. The brick shall be weighed at the following intervals: one-half hour, six hours, and forty-eight hours. Superfluous moisture to be removed before each weighing. The absorption shall be expressed in terms of the dry weight and the balance used must be accurate to five drams.

Freezing and Thawing Test.—In case the freezing and thawing test is desired, at least five bricks shall be thoroughly saturated by immersion in cold water, the temperature of the water to be raised to 200 degrees F. in thirty minutes, then allowed to cool. The specimen shall be immersed in ice water for not less than one hour, weighed, then transferred to the refrigerator and supported in such a manner that all faces will be exposed. The specimen shall be subjected to a temperature of less than 15 degrees F. for at least five hours; then removed and placed in water at a temperature of not less than 150 degrees F., nor more than 200 degrees F., for two hours. This operation shall be repeated twenty times, after which the bricks shall be again weighed, still saturated The character of the bricks shall be noted before and during the test, and all visible changes noted. Immediately on completion of this test, samples are to be thoroughly dried and subjected to the transverse and compression tests.

Requirements.—The following requirements shall be met:—

Modulus of rupture shall be as follows:—

	Average.	Minimum
For samples thoroughly dry	400 lbs.	325 lbs
For samples thoroughly saturated .	275 lbs.	225 lbs
For samples subjected to freezing and thawing process	275 lbs.	225 lbs.

The ultimate compression strength shall be as follows:—

	Average. lbs. Sq. In.	Minimum lbs. Sq. In.
For samples thoroughly dry	3,000	2,500
For samples thoroughly saturated ..	2,500	2,000
For samples subjected to freezing and thawing process	2,500	2,000

The absorption shall not average higher than 15 per cent., and in no case shall it exceed 20 per cent.

The freezing and thawing tests shall not cause cracking or serious spalling in any of the bricks tested, nor cause the serious disintegration of the material.

Economic Minerals and Mining Industries of Canada, a 77-page illustrated pamphlet, by Mr. J. McLeish, Chief of the Division of Mineral Resources and Statistics, contains data concerning the main geographic and geologic features of the country, and a brief description of the same, treating separately each mineral and mineral product. A summary of the mineral production of each province and references to the laws governing mining and the ownership of mining lands in the various provinces, also are included. The pamphlet is issued by the Mines Branch, Department of Mines, Ottawa.

The railway-terminal problem of Chicago is to be investigated under the direction of a public commission composed of leading engineers and business men. This is to be undertaken for the reason that the council committee on railway terminals, which was forced by public agitation to order such an investigation made under its direction, is considered to be prejudiced in favor of the plans submitted by the Pennsylvania Railroad. The committee has openly advocated these plans, and has predicted that they will be approved by the city authorities, thus indicating that it will give slight consideration to other plans or to the general problem of improvement of the railway-terminal system of the city.

ROYAL COMMISSION'S SEWAGE DISPOSAL ENQUIRY.

THE Royal Commission on Sewage Disposal (Great Britain) has recently issued an appendix to its eighth report which was published last autumn. This report dealt with the establishment of some co-relation between the chemical character of the water of rivers and streams, and the relative purity and freedom of them from nuisance. It will be remembered that the Commission expressed its opinion that the liability of a stream to become objectionable under unfavorable conditions might fairly be estimated by the amount of dissolved oxygen absorbed in five days at a constant temperature of 65° F. This it regarded as the best indication of the liability of a stream to become offensive in warm weather and that is surpassed in value as an index to the stream's conditions, the percentage of ammoniacal nitrogen present.

The Commission's conclusions defined the limits of temperature variations as 37.2° F. lowest, and 64.4° F. highest, from observations taken on a number of streams.

In the appendix, now issued, the Commission sets forth in detail the experimental work which constituted the basis of its recommendations and a great deal is contained therein of value to engineers concerned in the prevention and abatement of river pollution. "Engineering" (London), outlines the work as follows:—

In commencing their operations the Commission addressed inquiries to all the county medical officers of England and Wales, as well as to the various river conservancy boards, and from the information thus acquired, a preliminary list of fifty streams was drawn up and personally inspected. As the result of this examination, which was carried out by Mr. G. B. Kershaw, the engineer to the Commission, twenty-five places were selected for further inspection and examination, but in the end attention was mainly concentrated on sixteen of the sites thus chosen. The object of the inquiry being to correlate the chemical characteristics of the waters of a stream with its state as estimated by the eye and nose, careful note was taken of the condition of its bed and banks. Stones from the shallows were examined for algæ growth, water insects, and the like, and special attention was paid to any deposits of mud in the pools and banks. Fish life was also carefully noted, and at the same time data were taken of the relative rapidity of the streams, which were classified as follows:—

Mean current velocity.	Character of stream.
From 20 ft. per minute downwards	Sluggish to very sluggish
From 20 ft. to 40 ft. per minute	Slow
" 40 ft. to 60 ft. "	Moderate
" 60 ft. to 80 ft. "	Rapid
Over 100 ft. per minute	Very rapid

Based on these observations the Commission have been able to tabulate the features given in the accompanying table as characteristic of the relative purity of natural waterways in normal summer conditions.

The cases of pollution inquired into by the Commission covered every condition, from insignificant to distinctly bad. The relative volume of effluent to the stream in which it was discharged was in some instances as low as 1 to 2, and in others less than 1 to 1,000, but in all cases a pretty close connection was established between the results of the oxygen-absorption test and the place which would be assigned to the stream in the table, as

the result of an inspection by eye and nose. The grev growth mentioned in the last column of the table appears to be eminently characteristic of an undesirable degree of pollution.

The efficacy of the test recommended depends upon the fact that clean river water in normal condition, and at 60 deg. F., contains in solution 7 c.c. of oxygen, or 1 part by weight, in 100,000 of water. If polluted, this dissolved oxygen, as the result of bacterial action, enters into combination with the organic matter present, with a consequent reduction in the amount of that freely dissolved, and this loss of oxygen thus serves to indicate the degree of pollution of a stream. All river water contains some organic impurity, and hence, if kept in conditions in which the store of oxygen cannot readily be replaced from the air, there will, on keeping, be always some reduction in the quantity of oxygen contained in solution. With clean river water, however, this loss is small, whilst with badly contaminated streams the whole of the dissolved gas may disappear from the sample under test. The connection between the oxygen dissolved and the character of the stream is stated to be as follows:—

	Gramme of dissolved oxygen in 5 days.
Very clean	0.1
Clean	0.2
Fairly clean	0.3
Doubtful	0.5
Bad	1.0

The figures refer to the weight lost from 100,000 grammes of the water under test. It will be noted in the above table that the figure given for a badly polluted stream exceeds the total amount of oxygen which water is capable of holding in solution at a temperature of 65° F. This, in fact, was frequently the case in the tests, which were made by mixing the sample under observation with tap water in such proportion that some 50 to 60 per cent. of the total dissolved oxygen was taken up in the five days over which the test extended. This degree of dilution was found by experiment to yield the most concordant results.

A very fair correlation was, as already mentioned, also established between the condition of a stream and the ammoniacal nitrogen present, but the Commissioners came to the conclusion that this test was on the whole the less satisfactory of the two, since the ammonia figure in the case of a stream receiving sewage effluents was not always as good an index of the actual condition of the stream as the dissolved oxygen test was found to be.

A most interesting feature of the present series of researches has been the comparisons made between the condition of a stream above a sewage outlet and below it. Probably the most interesting observations made in the whole investigation are those on the River Avon, from Rugby to Stratford. This river rises in Northamptonshire, near Naseby, and flows across Warwickshire to the River Severn at Tewkesbury. It is a winding, sluggish stream, with a muddy bed, and there are many weirs on it. On it, or its tributaries, are situated the towns of Rugby, Coventry, Kenilworth, Leamington, Warwick, Stratford, and Evesham, the distance between successive centres of pollution being generally about 10 miles. For many years the stream received the untreated sewage effluents from all the centres above named; but as matters stand to-day, it would appear that the effluents sent into the stream are in the main fairly satisfactory, and that the river is maintained in a passable condition. Between Rugby and Stratford the proportion of sewage-derived water in the river never falls below 1 in 8 or 1 in 9, and in one reach amounts to as much as 1 in 2.5.

The town of Rugby has a population of 21,000, and is sewered on the "partially separate" system. The sewage, which is "domestic" in character, is treated in septic tanks, the effluent from which is passed through percolating filters and irrigated over land. This effluent is stated to be bright and clear, with a clean, healthy smell, and is

Features Characteristic of Streams in Normal Summer Weather.

Condition of water as regards	"Very Clean"	"Clean"	"Fairly Clean"	"Moderate"	"Doubtful"	"Bad"
Suspended matter	Clear	Clear	Fairly clear	Fairly clear	Slightly turbid	Turbid
Opalescence	Bright	Bright	Slightly opalescent	Distinctly opalescent	Opalescent	Opalescent
Smell on being shaken in bottle	Odorless	Faint earthy smell	Pronounced earthy smell	Earthy wormy smell	Strong earthy wormy smell	Soapy, fœcal, or putrid smell
Appearance in bulk	Limpid	—	Slightly brown and opalescent	Brown and opalescent	Black looking	Brown or black and soapy looking
Delicate fish	May be plentiful	Scarce	Probably absent	Absent	Absent	Absent
Coarse fish	—	Plentiful	Plentiful	Present	Scarce	Do
Stones in shallows	Clean and bare	Clean	Lightly coated with brown fluffy deposit	Coated with brown or dark green layer	Coated with brown fluffy deposit	Coated with grey growth and deposit
Stones in pools	Do	Covered with fine light brown deposit	Do	Coated with brown deposit	Do	Coated with brown or black mud
Water weeds	Scarce	Plentiful; fronds clean except in late autumn	Plentiful; fronds brown-colored in places	Abundant and covered with deposit in pools	Plentiful and covered with fluffy deposit	Scarce
Green algæ	Do	Moderate quantities in shallows	Plentiful in shallows	Plentiful	Abundant	Abundant in protected pools
Grey algæ	—	—	—	—	Present	Plentiful
Insects, larvæ, etc.	—	—	—	Plentiful in green algæ	Plentiful in green algæ	Abundant in green algæ

non-putrescible on incubation. It contained in 100,000 parts about 1.5 parts of matter in suspension, and when maintained at 65° F. for five days took up 1.97 parts of oxygen per 100,000.

The ratio of the sewage effluent to the dry-weather flow of the river is about 1 to 8; the river flow being 4,500,000 gallons per twenty-four hours. No smell was observed near the Rugby outfall, and there was very little of the grey growth, which, as already stated, seems to be characteristic of polluted waters. Small coarse fish were present in the water below the outfalls, although in dry weather the admixture of the effluent caused considerable deoxygenation of the water in the sluggish reaches. The Coventry sewage reaches the river 13 to 14 miles further down. At this point the river has practically completely recovered from the effects of the Rugby discharge, at least so far as its chemical constitution is concerned, the chlorine content of the water alone being permanently increased. Coventry has a population of 90,000, and the sewage discharged amounted to 4,000,000 gallons per day in 1911. It is of a domestic character, but with trade wastes. The treatment to which it is subjected before discharge is settlement followed by land irrigation and land filtration; the area assigned for this purpose was 378 acres at the time of the observations, but has since been largely augmented. The effluents are stated to be very variable in quality. The dry-weather flow of the river, which is said to be fairly clean on its arrival at Coventry, is put at 7,500,000 gallons per hour, and the ratio of dilution less than 3 to 1. Under these conditions of an inferior effluent and little dilution there was an abundant grey growth below both outfalls, and masses of putrifying mud have formed in parts of a very sluggish reach, where many dead fish are found in warm, dry weather, accompanied by an objectionable smell. Nevertheless, the river purifies itself further on, and though it receives also the sewage effluent from Leamington, Warwick, Kenilworth, Stratford, and Evesham, it is, as already stated, now maintained in a passably fair condition, so far as actual nuisance is concerned. Bacteriologically the results are much less satisfactory, although there is in all cases a well-marked progressive improvement of the river as the distance from each new outfall increases. It appears, however, that from the standpoint of bacteriology reversion to the original state of the unpolluted stream cannot in general be effected within the limits of distance which are probable in this country between independent sources of pollution.

The observations made at Berkhampstead have rather a special interest, since the sewage is discharged not into a natural stream, but into the Grand Junction Canal, where practically the whole of the flow is merely that due to lockage operations. The sewage is from a population of 8,000, and is "domestic" in character. It is treated in closed septic tanks, followed by double-contact beds, the average flow being 500,000 gallons per 24 hours. The effluent is slightly opalescent, with a brown tint, and generally, but not always, has a clean smell. Two out of seven samples putrified on incubation. This effluent is discharged into a pound, where the water is practically stagnant. This water has a stale wormy smell on shaking, but there was no smell on the tow-path. Much grey fungus was present below the outfall, and the only fish observed in the pound were minnows. Several cases in which sewage is discharged direct into the stream without treatment of any kind are discussed in the report. Apparently where the dilution is sufficient this practice does not give rise to any active nuisance, but even in these cases the discharge of paper, corks, and matches into the stream is objectionable, and could be avoided by straining the sewage before discharge.

"DUKE OF CONNAUGHT" TOLLS.

The Canadian Gazette publishes the tariff of tolls submitted by the Canadian Vickers, Limited, in connection with their floating dock, the "Duke of Connaught," at Montreal. The schedule has been recommended for approval, subject to amendment, by the Minister of Public Works. It is as follows:—

Montreal Floating Ship-Dock Canadian Vickers, Limited Tariff.

Gross Reg. Tons.	1st day	Commencing 24 hrs. after vessel is raised. Following days or fractions thereof each.
Up to 1,000.....	$ 300.00	$ 80.00
1,000— 1,199.....	340.00	95.00
1,200— 1,399.....	365.00	95.00
1,400— 1,599.....	390.00	95.00
1,600— 1,799.....	415.00	110.00
1,800— 1,999.....	450.00	110.00
2,000— 2,249.....	475.00	110.00
2,250— 2,499.....	500.00	125.00
2,500— 2,749.....	525.00	125.00
2,750— 2,999.....	550.00	125.00
3,000— 3,499.....	575.00	150.00
3,500— 3,999.....	600.00	150.00
4,000— 4,499.....	625.00	150.00
4,500— 4,999.....	650.00	175.00
5,000— 5,499.....	700.00	175.00
5,500— 5,999.....	750.00	200.00
6,000— 6,749.....	875.00	200.00
6,750— 7,499.....	950.00	225.00
7,500— 8,249.....	1,025.00	225.00
8,250— 8,999.....	1,100.00	250.00
9,000— 9,999.....	1,200.00	275.00
10,000—10,999.....	1,300.00	300.00
11,000—11,999.....	1,400.00	350.00
12,000—12,999.....	1,500.00	400.00
13,000—13,999.....	1,600.00	450.00
14,000—14,999.....	1,700.00	500.00
15,000—15,999.....	1,800.00	550.00
16,000—16,999.....	1,950.00	600.00
17,000—17,999.....	2,050.00	650.00
18,000—18,999.....	2,150.00	700.00
19,000—19,999.....	2,250.00	750.00
20,000—20,999.....	2,350.00	850.00
21,000—21,999.....	2,450.00	950.00
22,000—22,999.....	2,550.00	1,050.00
23,000—23,999.....	2,650.00	1,150.00
24,000—25,000.....	2,750.00	1,250.00

THE MONTANA IRRIGATION PROJECT.

The Sun River diversion dam, a part of an immense irrigation project in Montana, is at present under construction by the United States Government. A contract has just been awarded to MacArthur Bros. Company, of New York, consisting of the construction of about forty-five miles of main canal and several small tunnels, aggregating about three-quarters of a mile in length. The canal will have a capacity of 1,700 feet per acre per day. It will be twenty-seven feet wide at the bottom and sixty-nine feet in width at the top, the water having a depth of eleven feet. Its cost will amount to about $900,000.

THE SASKATOON TRAFFIC BRIDGE

THE new traffic bridge which will supplant the present steel bridge at Saskatoon, is in its early stages of construction, and will probably be ready for use by December of next year. The present bridge was built in 1906-07, but during the past six years the city has grown so rapidly that the structure is quite inadequate to accommodate the large traffic crossing the river. The old bridge is built on concrete piers. It is interesting to note that the petition of 1904, asking for a bridge at Saskatoon, estimated the population at 1,200, while the 1901 census had placed it at 113, a conservative estimation of the present population being 20,000.

Early in 1912 the need of a new and larger bridge was voiced, resulting in a thorough investigation on the part of the Board of Highway Commissioners, and in June of last year the site was selected. It was definitely decided that the bridge should span the river between Twenty-fifth Street on the west and Saskatchewan Street, which bounds the University grounds, on the east. It was agreed that only a very wide bridge would meet the requirements.

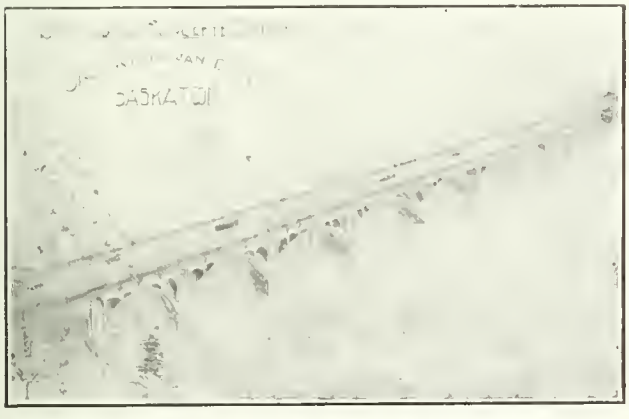


Fig. 1.—Accepted Design for Saskatoon Traffic Bridge.

The site chosen offered various difficulties from an engineering standpoint. The elevation of the bank at the University side is some fifty feet higher than on the city side. The river is about 1,100 feet wide during high water at this point. The bridge was to cross from a park on the city side to the University grounds on the other, and the aesthetic treatment demanded great care.

The Board of Highway Commissioners designed bridges of two types for this crossing—a steel superstructure on concrete piers, and a bridge composed of a series of reinforced concrete arches. The estimated cost of the two types varied by only about $6,000, and the selection became a question of type rather than cost. The steel bridge required a long approach on the city side of the river in order to overcome the grade as it was not considered practicable to build a large steel structure with so large a grade. This approach was at the best an unsightly structure, and would have caused considerable claims for property damage from residents of Twenty-fifth Street.

The reinforced concrete bridge was chosen because of greater permanency and better appearance, and as best suiting the requirements. An agreement was drawn up with the city of Saskatoon by which they agreed to pay one-third of the cost of the structure. Plans were prepared of a bridge consisting of a series of arches with a floor on a grade of 2.88 per cent. The total width of the bridge is to be 65 feet, and two 8-foot sidewalks are to be cantilevered from the roadway. Provision was made for two street car tracks, and two 14-foot roadways.

The total length of the bridge and the retaining walls at its approaches is about 1,490 feet. It consists of one arch of 25 feet span, one arch of 60 feet span, one arch of 92 feet span, one arch of 103 feet span, one arch of 136 feet span, four arches of 150 feet span, and one irregular arch of 94 feet span. The arches of 150 feet are notable as being longer in span than any in Canada.

The design was most carefully worked out and the allowable stresses are most moderate. The bridge is designed for a temperature range of from 50 degrees below zero to 90 degrees above. This variation of temperature is thought to be larger than that used in designing any other concrete bridge.

Tenders were called for the construction of the bridge and closed on July 15. The R. J. Lecky Company, of Regina, was the lowest bidder and its tender was accepted. The price for the estimated quantities was some $240,000. Cement and reinforcing steel are to be supplied by the Board, and the estimated quantities are 725 tons of reinforcing steel and 114,000 bags of cement. The cost of these must be added to the contract price to obtain the actual cost of the work.

The bridge was designed under the personal direction of Mr. A. J. McPherson, chairman of the Board of Highway Commissioners, by the engineering staff of the bridge branch, of which Mr. A. P. Linton is assistant chief engineer. Mr. Daniel B. Luten, of Indianapolis, who is an authority on concrete bridges, acted in an advisory capacity, and examined and approved the general arrangement and the working plans.

In Western Canada the bridge will only be surpassed in size and importance by the bridge over the North Saskatchewan at Battleford. It will, however, be by far the largest reinforced concrete bridge in this country, and will take high rank among the big bridges of the North American continent. The illustration gives an idea of the accepted design, a more detailed description of which will be published at a later date.

According to the report of Mr. J. McLeish on Economic Minerals and Mining Industries in Canada, these statistics are given for the total production of petroleum in the Province of New Brunswick; in 1911, an aggregate of 2,461 lbs., valued at $3,019; and in 1912, 2,679 lbs., valued at $3,799.

Railway building in Western Canada is one of the wonders of the age, over seven miles of new track being laid down for every day in the year. Each year the railway map of Western Canada shows hundreds of miles of extensions laid in all directions. The railway mileage of the Western Provinces in 1900 was 3,680, and is now 13,560 miles, and before long, instead of one, three transcontinental railroads will belt the prairies, with branches and feeders extending in every direction, opening up large areas of new territory for agricultural and commercial development. The railway extension programme laid down for completion this year by the Canadian Pacific, Canadian Northern and Grand Trunk Pacific Railways is the largest yet attempted. Active work is now in progress on the Hudson's Bay Railway, which, in addition to forming a new outlet and more direct ocean communication for the Western Provinces, will open up a large area of new and undeveloped territory to the north. This extensive increase in transportation facilities will, without doubt, increase the acreage cultivated, which will in turn, create an ever-increasing demand for manufactured goods.

MASSACHUSETTS HIGHWAY COMMISSION REPORT, 1912.

THE Massachusetts Highway Commission has under its charge road work, motor vehicles and the supervision of telephone and telegraph companies, each with its own practically separate department. The commissioners are Col. Wm. D. Sohier, chairman; Mr. F. D. Kemp, and Mr. Jas. W. Synan. The highway department has charge of all road and bridge work, advice to municipal authorities, etc. At its head is the chief engineer, Mr. A. W. Dean, whose assistant is Mr. S. A. Parsons. The office engineering department which makes the surveys, prepares all plans and estimates, etc., is in charge of Mr. A. M. Lovis, and under him are employed 20 to 50 engineers, draftsmen, instrumentmen and rodmen, depending on the season of the year and the amount of work on hand.

The State is divided into four divisions, each in charge of a division engineer, who has one or two assistants in charge of particular work, like "small town" work, maintenance, etc., and as many resident engineers are assigned to his division from time to time as are necessary to supervise and inspect the actual work which is in progress. Most of the principal engineers and assistants have been in the service for over 10 years, and quite a number for a much longer period. The various departments report to the commission through its secretary.

During the year ending November 30th, 1912, the commission completed 11.25 miles on contracts that were pending at the beginning of the year and 21.57 miles of roads commenced during the year, making a total of 32.82 miles of construction for the year, or a grand total of 920.51 miles since work began. Construction was commenced, but not completed, on 20.16 miles of road in 1912.

Of the above 32.82 miles, 4.58 miles were of water-bound macadam; 6.72, gravel; 3.19, sand-bound with oil; 12.02, bituminous macadam; 3.93, water-bound macadam with an oil surface applied; 2.24, gravel with the top service bound with bituminous binder. The costs of construction of these highways are shown in the accompanying Table I., in such a manner that comparisons may be made between the different costs of work in different portions of the State under varying conditions.

In Massachusetts, as elsewhere, the increase in travel by automobiles, and the use of motor trucks for long distances to and from cities, has augmented the question of maintenance into one of vital importance. The report of the commission, from which this information is derived, states that in 1912 over $500,000 was spent in maintaining state highways, $200,000 of which was provided by direct appropriation by the Legislature and the balance secured from motor vehicle fees. (The total expenditure by the commission up to the end of last year for the construction of state highways since the work began, amounted to $8,379,080.) Bituminous material was used in maintenance work during 1912, on 283.55 miles, and in construction on 21.38 miles, there existing at that time 729.83 miles of state highway on which bituminous material was used either in construction or maintenance. In his report, Mr. A. W. Dean, chief engineer, states: "While there have been a few failures of bituminous roads, the use of bituminous material seems at the present time to be an economical way of preserving the roads under the present traffic, and I recommend continuing the use of this material in construction and maintenance."

The commission is of the opinion that it is absolutely necessary to-day to apply some form of dust layer or bituminous binder to macadam roads, either by a surface application or by incorporating it into the upper 3 in. of broken stone. If this is not done the roads will shortly be destroyed by the high-speed motor vehicle travel. The commission states that it has found the application of bituminous binders under pressure produces more uniform results than were formerly secured by the so-called gravity method. The cost of maintaining the roads is over $500 per mile per year and will probably be more in the future, certainly until many miles of the older roads on through

TABLE I—APPROXIMATE COSTS OF ROADS COMPLETED IN 1912

Town	Type of Surface	Length of calculations		Drainage, culverts and bridges total cost	Grading and foundation cost per mile	Cost of surface	
		Miles	Sq. yds.			Per mile	Per sq yd.
Amesbury	Macadam, 4½-in., trap rock, bituminous binder	.28	2,464	$ 907	$3.564	$7,593	$0.86
Ashby	Macadam, 5-in., local stone	.60	5,280	592	3,133	5,275	.60
Ashby, 1911	Macadam, 5-in., local stone	.44	3,872	296	4,600	4,968	.56
Bourne	Macadam, 3¾-in., trap rock bituminous binder	.68	5,984	624	1,348	7,135	.81
Chelmsford, 1911	Gravel, 5-in.	1.42	12,496	672	2,447	1,201	.13
Dighton, 1911	Macadam, 4¼-in., local stone, bituminous surface coat	1.02	8,976	141	1,140	3,727	.42
Erving	Concrete, 5-in., bituminous surface coat, concrete beam bridge	.03	264	2,299	4,977	10,833	1.25
Franklin, 1911	Gravel, 6-in.	1.17	10,296	467	2,915	1,795	.20
Haverhill	Macadam, 5 in., trap rock, bituminous binder	.43	3,784	1,140	3,602	7,116	.80
Lakeville	Macadam, 4¼-in., local stone, bituminous binder	1.24	10,912	282	2,890	5,690	.64
Lanesborough	Macadam, 4-in., trap rock, bituminous binder	.34	2,992	400	5,490	5,976	.66
Montague, 1910	Macadam, 5-in., local stone	.82	7,216	253	2,058	4,416	.50
Plymouth, 1911	Sand and oil, 3½-in., mixed	1.00	8,800	859	8,192	4,027	.45
Raynham	Macadam, 4-in., local stone, bituminous binder	.96	8,448	326	3,731	6,262	.74
Salisbury, 1911	Macadam, 4¼-in., local stone, bituminous binder	1.22	10,736	621	2,160	5,225	.59
Sandwich	Sand and oil, 3-in., mixed	.85	7,978	318	1,245	4,545	.48
South Hadley	Macadam, 5-in., trap rock	1.31	11,528	1,131	5,754	4,575	.52
Spencer, 1911	Macadam, 5 in., trap rock, concrete arch	.03	264	4,727	10,166	9,441	1.07
Swansea, 1911	Macadam, 4-in., local stone	.78	6,864	543	1,356	2,946	.43
Tyngsborough	Macadam, 4-in., trap rock, bituminous binder	.72	6,336	1,581	1,525	6,740	.76

routes, especially near the cities and larger towns, where the traffic is extremely heavy, have been reconstructed with some more permanent surface.

In a subsequent issue the part of the commission's report dealing with the traffic census will be summarized.

CONCRETE ROADS IN WAYNE COUNTY, MICH.

WAYNE County, Michigan, in which Detroit is situated, is credited with having the finest system of concrete roadways in the world. They are over 100 miles in length. The upkeep expense is less than $5 per mile per year, which includes the cleaning of ditches and the cutting of weeds along the roadside; and they are always smooth and dustless.

Practically every government report that has been issued during the past five years has told of the failure of the ordinary macadam road to withstand the traffic of the present day. In New York State the maintenance expense has gone as high as $1,000 per mile per year. And within a few years these highways have had to be completely rebuilt. The concrete highway, which originally costs a third more, is practically permanent. But several conditions govern the building of concrete roads which must be observed. In the first place they must be placed honestly as to the proportion of gravel, sand and cement; they must be "cured," that is, watered and allowed to stand for several weeks before being used; and they must be built under good weather conditions. When these features are complied with the concrete highway will generally last for many years without being touched.

"The Story of a Country Road" is the title of a booklet that Edward N. Hines, road commissioner of Wayne County, is distributing, and which explains clearly how the concrete road is made.

"We prepare and shape the subgrade, roll it hard with a 10-ton roller and lay the concrete right on the natural sub-soil," writes Mr. Hines. "Side rails are used and when the concrete has become sufficiently hard to remove the rail the finishers pare off the outer edges to prevent a sharp dividing line between the concrete and the gravel shoulders.

"Our trunk roads are built 16 feet wide with gravel shoulders four feet wide on each side. The lesser-travelled roads have 12 and 15 feet of concrete with a minimum width over-all of 24 feet. We have also built concrete roads from 10 to 18 feet wide. They are always wide enough to make passing of teams or automobiles going in the opposite or the same direction very easy.

"The concrete is put down wet so that no tamping is necessary after it is placed. When this is done no workman is permitted in anyway to disturb the concrete by stepping in it or throwing anything on it. Smoothing is done with simple wooden floats.

"Each day's work is finished up to an expansion joint and no more than 20 minutes is permitted to elapse between batches of concrete during the day. The work of the day is covered with canvass and the next day the canvass is removed and the concrete covered to a depth of about two inches with any sand or loose soil available to keep the concrete from drying too rapidly. The concrete is sprinkled continuously for eight days. Roads are not opened for traffic until at least two weeks after the last concrete is put in place.

"Machinery is used whenever the same or a better result can be secured and large hauling engines trail from two to four wagons each loaded with stone or gravel. Graders are also drawn by steam, doing the work of from 6 to 8 horses more efficiently and rapidly. Old roads are rooted up with a scarifier or plow. Water is pumped in pipes for miles by gasoline engines. Stone and sand on some of the roads is unloaded with a grab bucket and many smaller and economical labor-saving devices are employed. Cement is mixed in a mechanical batch mixer.

"The cost of the roads averages from $12,000 to $16,000 per mile, as Wayne County has to have all materials shipped in. It would be higher if it were not for our labor-saving devices. When far from the city the men are boarded and given cots in tented cities. We have nearly 1,100 employees, and politics cut no figure in the employment of them."

A NOTABLE PONTOON BRIDGE.

A wooden pontoon bridge to temporarily cross the Panama Canal at Paraiso, is briefly described in the Canal Record. The plans are based upon designs obtained from the Chicago, Milwaukee and St. Paul Railway, which has used pontoon bridges of this type for many years. One of the most notable of its bridges is that over the Mississippi River at Prairie du Chien, Wis., which has been in service 35 or 40 years. In the construction of the Canal pontoon bridge, a somewhat simpler design will be followed, consisting of a timber scow 55 feet wide, 378 feet long, and six feet deep. On top of this hull, a wooden trestle, following quite closely the ordinary type of construction, will be built to an elevation of about 113.5 feet, and on this will be placed a railroad track and a highway for vehicles. The spans will be 14 feet between centres, and at these points, a transverse wooden truss, with iron rods, will be placed in the hull to carry the concentrated loads. Lighter trusses, without rods, will be placed at 2-foot intervals between the heavier trusses. The sheathing on the hull will be four inches thick at the bottom and sides, and three inches on top. To minimize the bending and shearing stresses to which the structure will be subjected, the design includes two heavy stiffening trusses, the stringers under the rails being utilized as top chords, while the lower chords are placed at the bottom of the hull. In addition, there will be heavy longitudinal keelsons.

The bridge is designed for a train load of 4,000 pounds per running foot. In order to reduce the expense of the approaches as much as possible, it is proposed to use as a connection between the bridge and the shore some of the spare lock gate girders, supported on rockers. These rocking approaches will have a downward grade when the water is at a low level, and an upward grade when it is at a high level. The pontoon will turn about a fixed pivot, and to avoid its projecting into the fairway of the canal, a recess will be excavated in the east bank, so that when the bridge is opened, it will leave the canal channel unobstructed. About 600,000 feet B.M. of yellow pine, or fir, timber, and 375,000 pounds of steel and iron, will be required.

Mr. Harry Croswell, surveyor and prospector, after a visit to the Sibola Creek goldfields, B.C., gave it as his opinion that immense wealth in gold, copper, lead, iron and zinc lies buried in British Columbia awaiting the opening up of railways and other means of transportation to make it possible for prospectors and miners to penetrate to the heart of the province. At present owing to natural obstructions, it is impossible to reach the wild districts where these minerals undoubtedly abound.

DESIGN OF FOOTINGS IN REINFORCED CONCRETE.

By A. N. Worthington,
Trussed Concrete Steel Company, of Canada, Limited.

THE design of footings in a reinforced concrete building presents perhaps more unusual features and difficulties than does any other portion of the building. This is due to a great extent to the fact that very little satisfactory information may be obtained on the subject from texts.

The first step, of course, is the calculation of the column loads. Great care must be exercised in this particular, as unequal pressure on the soil from two adjacent columns will, in all probability, result in cracking of the beams and slabs.

Consider a building, say, five stories high. The load which will come on the wall column footing is usually about 70% dead load which is always present, and about 30% live load which is seldom all present; while the load on an interior column footing is about 40% dead load and 60% live load. From this it is readily seen that unless the above facts have been considered in the design, the load under average conditions is less per square foot on the interior footings than on the exterior footings.

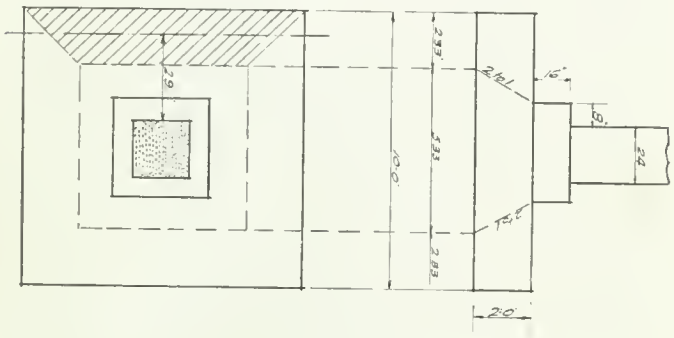


Fig. 1.

The practice of reducing the live load figured on the footing of a building over a certain height eliminates the above to some extent, though it would appear more logical to allow a greater live load reduction on the interior footings than on the exterior footings.

The principle underlying the design of a simple footing is that the portion inside the dotted lines which are at a 30-inch slope from the edge of the cap, in Fig. 1, are considered as self-supporting, and the portions outside these lines, i.e., the shaded portions in plan, are to be carried as cantilevers.

An example of the above is as follows:—

Allowable soil pressure = 4,000 lbs.; load on column = 400,000 lbs.; size of column = 24" x 24"; size of cap = 3' 4" x 3' 4" x 16".

Required area of footing $= \frac{\text{load}}{\text{soil pressure}} = \frac{400{,}000}{4{,}000} =$ 100 sq. ft. = 10' 0" x 10' 0".

Total soil reaction represented by shaded portion: $(2.33 \times 2.33) + (2.33 \times 2.17) \times 4{,}000 = 17.5 \times 4{,}000$.

Since this reaction is to be distributed over 5.17 ft., the reaction per ft. width $= \frac{17.5 \times 4{,}000 \text{ lbs.}}{5.17}$. Then area of steel required $= \frac{17.5 \times 4{,}000}{5.17} \times \frac{2.91 \times 12}{.86 \times 16{,}000 \times 22}$ = 1.54 sq. ins.

In the case where the edge of a building extends to the lot line, and it is not permissible to encroach on the neighboring property, it is seen that the load on the footings would be of an eccentric nature which would cause the footing to have an overturning tendency and throw tension into the outer face of the column. This may be

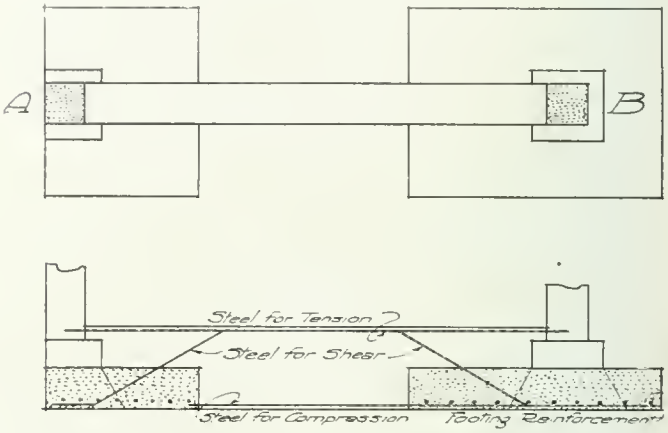


Fig. 2.

overcome by tying the wall column footing to an interior column footing by means of a wide concrete beam. Another method of accomplishing this, of course, would be to employ a raft footing spanning the entire length of the building along the walls. The former, however, is, under average loads, better engineering practice and more economical, and the writer will endeavor to illustrate briefly the designing of a footing by this method.

In the plan and section shown in Fig. 2, as previously assumed in simple footings, the portions inside the dotted lines are self-sustaining and the remaining portions are carried as cantilevers. The load which the beam will sustain will be the sum of the areas of these cantilevered portions and the area of the beams multiplied by the allowable soil pressure.

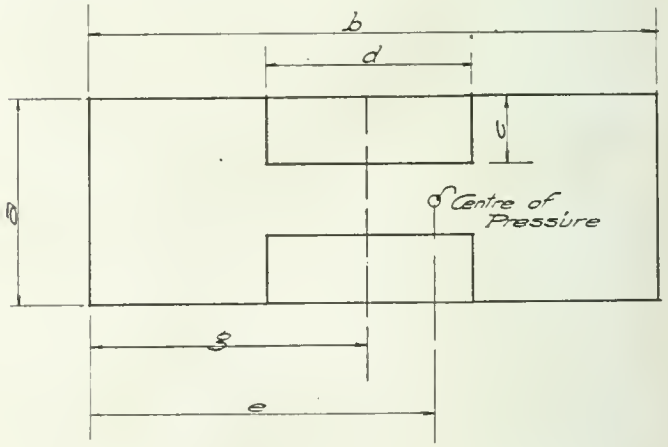


Fig. 3.

The most important adjustment to be made in the design is to have the centre of pressure of the column loads passing through the centre of gravity of the areas supporting them. If these areas do not coincide, the soil will settle on the side which is most heavily loaded, which condition may result in cracking the beams and slabs in the floors above, if not in failure.

A complete design of a footing of this type would be as follows: Let us consider a building in which the columns are spaced 24′ 0″, centre to centre. The load on the wall column "A" is 267,500 lbs., and on the interior column "B" is 504,000 lbs. Distance of centre of pressure from line x-x (Fig. 2)

$$= \frac{\text{moment of loads about x-x}}{\text{sum of loads}} = \frac{(504{,}000 \times 24) + (267{,}500 \times 0)}{771{,}500} = 15.679 \text{ ft.}$$

To distribute the area so that the centre of gravity of the area corresponds with the centre of pressure of loads, we will assume a rectangle, a b, with two pieces, c d, deducted from it in such a way that the above condition holds.

Let area required to resist load at given soil pressure = P sq. ft.

Therefore $P = a\,b - 2\,c\,d$

$$C = \frac{P + a\,b}{2\,d}$$

Moment of whole rectangle (Fig. 3) $= \frac{a\,b^2}{2}$

Moment of portion to be deducted $= 2\,c\,d\,y$

Moment of adjusted portion $= (a\,b - 2\,c\,d) \times e$

Therefore $(a\,b - 2\,c\,d) \times e = \frac{a\,b^2}{2} - 2\,c\,d\,y$

$$Y = \frac{\frac{a\,b^2}{2} - (a\,b - 2\,c\,d) \times e}{2\,c\,d}$$

By using these formulæ we would proceed as follows:

Total load = 711,500 lbs.

Area required to resist this load with allowable soil pressure of 4,000 lbs. = 192.875 sq. ft.

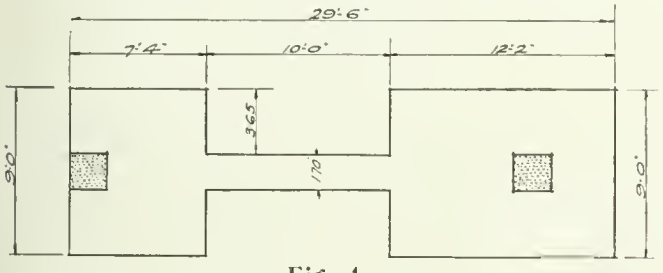


Fig. 4.

Assuming size of original rectangle as 9′ 0″ x 29′ 6″,

$$C = \frac{29.5 \times 9 - 192.875}{2 \times 10} = 2.65$$

Therefore, size of pieces to be deducted = 10′ 0″ x 3.65 ft.

Solving for $Y = 9 \times \frac{29.5}{2} \times 29.5 - (9 \times 2.95 \times \frac{2.95}{2}) \div (2 \times 10 \times 3.65)$

$$\frac{15677 - 20 \times 3.65 \times 15.69}{3920 - (4160 - 1142)} = \frac{}{73} =$$

12.3 ft.

With this information we may now design the shape of the footing. (See Fig. 4.)

The depth of the footing is governed by the shear along the line c—c— and is equal per foot to the area of a strip one foot wide and 3.65 feet long multiplied by the soil pressure = 14,000 lbs.

Safe resisting value of concrete to shear = 60 lbs.

Therefore, resisting shear = 60 lbs. × 22 × 12 = 15,840 lbs.

Therefore the assumed thickness of 24″ is correct.

The area of steel in the footings is found in a way similar to that used previously in simple footings. The reinforcement is placed in one direction only in footing "A" and that at right angles to the beam and both ways in footing "B."

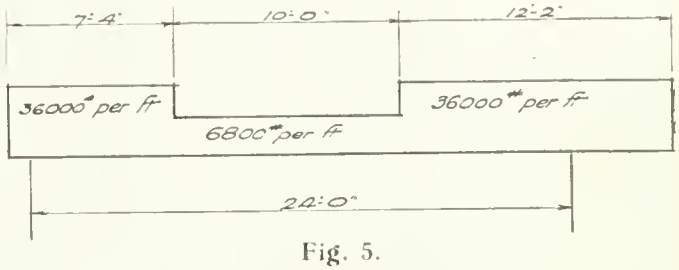


Fig. 5.

In the design of the beam, we have to consider the loading, as shown in the diagram (Fig. 5), found by the method already described. The span of the beam is figured as 24′ 0″.

$$\text{Let reaction} = \frac{36000 \times 7 \times 18.12}{24} = 190{,}000 \text{ pds.}$$

$$\frac{6800 \times 10}{2} = 34{,}000 \text{ pds.}$$

$$\frac{36000 \times 6.08 \times 300}{24} = 27{,}750 \text{ pds.}$$

$$\text{Total} = 251{,}750 \text{ pds.}$$

Maximum bending moment will occur at centre of span and $= (25175 \times 12) - (36000 \times 7.3 \times 8.66) + (6800 \times 5 \times \frac{5}{2}) = 833{,}000$ foot-pounds.

$$\text{Area of steel} = \frac{833000 \times 12}{.86 \times 160 \times 46} = 15.72 \text{ sq. in.}$$

This result is the area of steel required for the entire width of beam.

Therefore, area required per foot of width $= \frac{15.72}{1.7} = 9.25$ sq. in.

As the available depth of concrete will not develop this steel in compression it will be necessary to place additional steel in the compressive side of the beam.

The above is only one of a number of ways of arriving at these results and, as mentioned previously, only one of a number of accomplishing the desired end. It may, however, be stated in conclusion that the type of footing designed by this method has been recently employed in numerous buildings with unvarying success.

PURIFICATION OF SEWAGE EFFLUENT.

By Gilbert J. Fowler and E. Moore Mumford.

IT will hardly be disputed that the most costly part of a modern sewage works, certainly in capital expenditure and often in revenue charges, is the filtration area. Just as the difficulty of land treatment of the sewage of large cities forced on the consideration of more compact processes, so these in their turn are becoming impracticable when great centres of population have to be considered. This conclusion was impressed upon the senior author of this paper when called upon recently to report on the proposals of the Metropolitan Sewerage Commission of New York for the disposal of the sewage of that city. This conclusion was shared by his colleague, Mr. J. D. Watson, who reported simultaneously from an engineering point of view.

The area and cost of filter-beds depends mainly, it will be found, on the amount of colloidal matter present in the sewage, and much confusion of ideas is probably due to the fact that the ordinary sewage filter, be it contact or trickling, is called upon to do two entirely different things at the same time—viz., on the one hand to oxidize, granulate, and finally discharge as humus the colloidal matters present, and on the other to oxidize and nitrify substances in true solution.

A very open grade deep filter is best suited for the first purpose, a shallow fine-grained filter is the most economical for the second. It is true that a tank effluent well clarified by sedimentation can, by accurate distribution, be very efficiently purified on filters of fine material, but even then the area and cost involved when exceptionally large works are under consideration make the problem a very serious one. For these and other reasons the thoughts of many workers in sewage treatment have been turned to the possibility of more efficient removal of colloidal matter before the filtration process.

Hitherto almost the only practical method has been heavy chemical precipitation. The cost and difficulty of this process when really efficiently carried out (and it should be emphasized that a mere perfunctory addition of a few grains per gallon of precipitant is money thrown away) become very great as the volume of sewage increases. Not only are enormous quantities of chemicals necessary, but the disposal of the vast volume of resultant sludge, without menace in some way to the community, becomes increasingly difficult and costly.

The thought which has been in the minds of the authors of the present paper has been to find a method of obtaining a thoroughly clarified effluent without the use of large quantities of chemicals and with the minimum production of sludge. By a thoroughly clarified effluent is meant one which will not eventually deposit solid matter either on the bottom of a stream into which it flows or in the interstices of a bacterial filter. It is clear that in a sewage filter a combined oxidation and coagulation of the colloidal matter must go on, resulting in the production of the so-called residual humus, which either is collected in humus tanks or is periodically washed out of the medium. If this oxidizing and coagulating process could be brought about by suitable open-tank treatment before the filtration process, it is obvious that the latter could be enormously accelerated, if not dispensed with altogether, and the whole operation of sewage treatment could be conducted on a much smaller area.

In the course of a research on another matter, one of the authors had occasion to study the reactions of an organism occurring in nature in pit water impregnated with iron. This organism is a true facultative organism, preferably an aërobe, and exercises a specific action on iron solutions.

The action of the bacillus on iron solutions proceeds in two stages, in which the aërobic and anaërobic actions appear to be symbiotic, at any rate under the conditions occurring in nature. The aërobic action is to precipitate ferric hydroxide from iron solutions, while the anaërobic action is to transform the hydroxide thus precipitated into bog ore, with partial reduction of the iron to a ferrus state. It was found that in order to precipitate the iron sufficiently the organism required a certain proportion of albuminoid organic matter. It was therefore natural to expect that ordinary sewage matter could be utilized in this way. Experiment, in fact, showed that a sewage effluent could be effectively clarified in this way when acted upon by this organism in presence of small quantities of ferric salts, aërobic conditions being maintained in the liquid by means of a current of air.

The process, therefore, by which it is proposed to clarify sewage is, in the first place, to remove the grosser solids, either in a plain sedimentation tank, an Emscher tank, or a Dibdin slate bed, in such a manner, i.e., as shall give rise to the least amount of putrefactive change in the liquid portion of the sewage. The effluent from this preliminary process would be led into a second tank, where it is inoculated with the organism, a small dose of ferric salt is added, and air blown through till clarification sets in. A period of settlement is then allowed for precipitation of the coagulated matter, and eventually the clear liquid is run off, either for rapid final filtration or for direct discharge into the stream. The precise mode of action of the organism is not yet fully worked out, but it seems likely that simultaneous precipitation and solution takes place, some of the organic matter being converted into amido derivatives, and some being coagulated and thrown down with the ferric hydroxide.

The ordinary methods of sewage analysis fail to reveal the change which has really taken place during this process, as they do not differentiate between organic and nitrogenous material in the colloidal and crystalloidal states respectively. It should be pointed out that a fairly strong solution of amido acids, which are the end products of protein degradation, is not necessarily putrefactive, though they require oxygen for their final conversion into nitrate. A recent unpublished research by Mr. R. M. Beesley, a co-worker of the authors, has shown that there is no great difference between the rate of oxidation of substances such as uric acid and glycin, and simpler bodies such as urea. It may be anticipated, therefore, on all grounds, that the clarified liquid resulting from the process as above described can be oxidized at a very rapid rate.

As the conditions during the process are maintained, as far as possible, aërobic throughout, and there is always a certain amount of ferric hydrate present to oxidize offensive sulphur compounds, it is not anticipated that the aëration can give rise to nuisance, and none has been observed in laboratory trials where these conditions have been fulfilled. Experiments in the laboratory witb quantities up to four litres have shown that it is possible to clarify a strong fæcal emulsion in this way.

* From a paper read at the Exeter (England) Congress of the Royal Sanitary Institute.

A limpid, sparkling and non-putrefactive effluent was obtained from domestic sewage drawn from a sewer near the laboratory. Ordinary tank effluent from the Manchester Corporation sewage works at Davyhulme has been rendered non-putrefactive on incubation. So far only approximate estimates can be given of the amount of iron salt required and the duration of the blowing process. Experiments would indicate that 1 grain of iron-salt per gallon is the maximum need, and that a total of twelve hours' tankage—i.e., six hours' aëration and six hours' settlement—will be sufficient.

As regards the inoculation of the organism, once the growth has been established in a tank there appears to be no difficulty in maintaining it. The fact that large bodies of water in the old colliery workings at Worsley, near Manchester, are teeming with the organism, is sufficient evidence of its vitality. An experimental plant has been erected at the University of Manchester which will permit of accurate observations of this process to be made, and sufficient data to be collected to serve as a basis for work on the larger scale. It is already evident that the conditioning factor is the cost of an air blast; the pressure of air will, of course, depend simply on the depth of water to be blown through, and a number of engineering conditions will naturally affect this part of the problem.

It is reasonable to suggest that much of the power required could be obtained on the one hand from gas collected from the fermentation of the main bulk of the sewage solids, either in Emscher tanks or by some kindred process, or the fall available from the aërating tank might often admit of the water-head being turned into power. In any event the authors believe that they are justified in bringing the idea forward at this congress in order that it may be discussed from different points of view.

Experiments on the aëration of sewage in different ways have, of course, been made by different observers. Dr. Dupré and Mr. Dibdin, in Vol. 2 of the Report to the Royal Commission on Metropolitan Sewage Discharge, in 1884, describe a large number of experiments on the aëration of London sewage. In 1888, Mr. Hartland, in conjunction with Mr. Kaye-Parry, patented an aëration chamber for purification of tank effluent. In 1892, Mr. Sydney R. Lowcock conducted experiments on the aëration of filter-beds by a forced air supply. Dr. Adeney's long series of careful researches have thrown great light on the chemical changes occurring when sewage is completely oxidized by prolonged aëration. In 1897 one of the present authors carried out extensive experiments on the aëration of tank effluent under various conditions, and recently Messrs. Black and Phelps have carried out a number of experiments on the aëration of New York sewage, while the subject is also being studied by the chemists of the Massachusetts State Board of Health.

The advance claimed in the present communication is the use of a specific organism found in nature, together with iron salts, to effect the clarification of the effluent—that is, the coagulation of the colloidal matter as distinct from the purification of the effluent taken as a whole. To use a simple illustration, the addition of a little rennet does not appreciably alter the composition of milk as a whole, but separates it into a solid and liquid portion. The endeavor of the authors has been to obtain a similar result in the case of a sewage tank effluent; to collect the precipitated colloids, and purify the liquid portions by high-speed filters, or it may be in large tanks stocked with suitable aquatic plants.

PUBLIC HEALTH MEASURES IN QUEBEC.

Public health legislation in the Province of Quebec began in the reign of Louis XVI., when Canada was still under the French regime. The system has been steadily extending since Canada passed under English domination in 1795, until the present decade, which has witnessed a marked spread of recognition and power.

The provincial by-laws concerning municipalities, establish a standard which all municipalities have to obey, but in no way prevents them from making municipal regulations, which would be more adapted to their needs, provided that, in the opinion of the Provincial Board of Health, such municipal regulations are at least equivalent to the provincial provisions.

In October, 1909, the Board organized a sanitary engineering division, which took charge of waterworks and sewerage systems, and which makes a systematic sanitary survey of all the rivers of the province. Up to date, the Ottawa River, the des Prairies River, and the Richelieu River have been surveyed.

In 1910 it was decided to divide the province into ten sanitary districts, six of which have since been organized, with an inspector located in each.

At the present time careful attention is being given to the important question of the pollution of streams. As so many of the cities and towns of Quebec are using these streams to supply the citizens with the water necessary for drinking and domestic purposes, it is regarded by the Provincial Board of Health as absolutely imperative that proper legislation be enacted to prevent streams being polluted to such a degree that it might increase unfairly the burden of the municipalities which have to go to these streams for their supply of water.

TUNGSTEN.

The tungsten bearing mineral scheelite has been found at a number of localities in Canada, but the only place at which it has been worked commercially is at Scheelite Mines, Moose River district, N.S., according to report by J. McLeish, in Economic Minerals and Mining Industries of Canada. Here it occurs in quartz veins cutting the quartzites and slates of the gold bearing series. The quartz veins also carry mispickel and several other minerals but are not gold bearing. A mill has been erected and about 15 tons of concentrated ore (72 per cent. sheelite) have already been shipped. Sheelite also occurs in the Malaga gold mining district, Halifax county, while at one locality near South East Margaree in Inverness county, C.B., from 300 to 500 lbs. of hübnerite (Fe, Mn) WO_4 were recovered from a large detached mass of quartz. The mineral has also been noted at New Ross, in Lunenburg county, and at Perry Lake, West Waverley, Halifax county, N.S.

In the province of Quebec, scheelite has been found in Beauce county, in a quartz vein traversing Pre-Cambrian rocks, while in Ontario it is found occurring in small nodular masses in parts of the veins around Pearl Lake, Porcupine gold mining district.

In British Columbia its occurrence has been noted in quartz veins on the Meteor claim, Slocan City mining division, West Kootenay, and also in the Cariboo district at Hardscrabble creek where the scheelite appears to be very irregularly distributed in the country rock.

In the Yukon territory at Dublin gulch, scheelite is encountered in small water worn nodules of yellowish color, which are caught in the sluice boxes at Highet Creek.

The mineral is employed in the steel manufacturing industry making a tungsten steel of high tensile strength.

GOVERNMENT ELEVATOR AT PORT ARTHUR.

THE construction of the Dominion Government grain elevator at Port Arthur has reached the final stages and the structure is just being put into commission. The machinery is practically all installed and the high potential power line into the plant is almost completed. Tracks have been laid to give the Canadian Pacific and Canadian Northern access to the elevator and arrangements will shortly be made to give the Grand Trunk Pacific Railway a similar connection.

The elevator is of reinforced concrete construction throughout, except that in the walls of the working house brick panelling is used in a skeleton of reinforced concrete. This latter construction was used to facilitate rapid erection of the house, and adds to its appearance as well. No inflammable material is included in either building or machinery.

The elevator will be operated by electric power throughout, and a separate motor has been installed for each machine. Twenty cars can be unloaded simultaneously, the unloading capacity of the house being about forty cars per hour. An interlocking device connecting the valves of the car hoppers prevents any possibility of mixing the contents of one car with those of another. The normal loading capacity to boats will be about 75,000 bushels per hour, but for the first hour this can be increased to 115,000 bushels.

The Government Elevator at Port Arthur in Course of Erection.

The working house towers to a height of 185 feet above the water level. It contains seventy-five circular bins of about 7,000 bushels capacity each, fifty-six interspace bins of 3,000 bushels and thirty-six outer-space bins of 1,500 bushels capacity each. Its total capacity is about 750,000 bushels. The storage house has seventy circular bins, each 24 feet in diameter and ninety feet in height of 30,000 bushels capacity, together with fifty-four interspaces of about 8,000 bushels capacity each. The total capacity of the elevator is 3,250,000 bushels. In designing the elevator especial provision was made for a large number of bins of small capacity for storing small lots of grain that may require separate binning.

The working house is equipped with ten hopper scales of 2,000 bushels capacity, with a garner of equal capacity over each scale. The elevator legs are as follows: five for receiving, five for shipping, five for cleaning, one for screenings, one for drying, one for oats, and two for flax. Fifteen sets of receiving cleaners are provided for cleaning oats, wheat and barley, and fifteen additional cleaners can be installed when they are needed. Special machines are also installed for separating oats from wheat, in addition to two screenings separators and two flax separators.

At the south end of the working house a drying plant is installed in a separate building. This has a capacity of 48,000 bushels per day, and is for drying damp, tough or wet grain, and putting such grain in condition for storage.

A revetment wall is being built around three sides of the site, which contains about 32½ acres. The site was formerly covered by water, but is now being filled in level

Another View of the Structure.

with the top of the revetment wall. A slip 1,200 feet long will provide ample space for the largest lake boats alongside the working house. Four lines of railroad tracks extend through the house and beyond it for a distance of 800 feet, so that eighty cars can be spotted at one time, and taken into the house by the car pullers. Provision has been made for increasing the capacity of the elevator to a total of ten million bushels, should additional capacity be required, and the site affords ample space for increasing this capacity still further.

The production of peat in 1912 in Canada given in Mr. McLeish's report on Economic Minerals and Mining Industries was 700 tons, and was valued at $2,900.

The total production of pig-iron in Canada in 1912 was 1,014,587 short tons and of steel ingots and castings 957,681 short tons. That the domestic production is insufficient to meet home demands is indicated by the large imports which in 1912 exceeded 1,300,000 tons of pig-iron, ingots, blooms, etc., plates, bars and rods, structural steel, rails, pipe, nails, wire forgings, castings, etc. The opportunity in so far as the market is concerned for the development of Canadian iron resources is evident.

The Eighth Annual Convention of the Federation of Trade Press Association in the United States will be held at the Hotel Astor in New York, September 18th, 19th and 20th. It is expected that a great majority of the technical and trade journals in Canada will be represented. Relative to journalism of this nature, it is stated that the capital invested in trade journals in the United States has been estimated at not less than $50,000,000, and that the Federal papers represent a capital investment of more than $35,000,000. The Federation was organized in 1906. At the start it concerned itself chiefly with press problems, but in later years more consideration has been given to ways and means of promoting best interests of the trade press in many other directions. Managers, manufacturers and advertising men interested in the idea of business promotion through trade press efficiency, which are to be featured at the coming Convention, should consider well the invitation to attend, as there will be papers and addresses to all these, as well as to paper and book publishers.

WATERWAY STRUCTURES.*

By A. R. Hirst,
State Highway Engineer of Wisconsin.

Among the most important considerations affecting the construction of public roads is that of drainage. The life of every road structure depends upon the drainage given it, and the culverts and bridges necessary must be built not only to serve the purpose of drainage, but must serve also the convenience and safety of travel. The failure of a road results only in the additional expence necessary to replace it in proper condition, but the failure of a bridge results also in the suspension of travel, and if it occurs at the wrong moment, may cause considerable loss of property and possibly injury or death to those travelling the road.

For many years both the design and erection of highway bridges was practically entirely in the hands of the steel bridge companies, who used their opportunity to the utmost, an decorated the landscape with structures which had little to commend them except the fat prices they brought from an unknowing public.

Within the last few years, however, many States have created highway commissions which have effectually taken up the problem of bridge design, and a considerable change for the better has occurred, both in the strength of bridge superstructures and in the foundations, more especially in the latter, which was the place where most of the older structures were especially deficient, if one point of weakness can be selected from the mass of general ineffectiveness.

A properly designed waterway structure should fulfil the following requirements:—

1. Waterway sufficient to carry off promptly the water coming to it.
2. Proper foundations to bear the loads, resist undermining, and give long service.
3. Superstructure designed to bear for a long period of years any load which may legally be imposed upon it.
4. Superstructure wide enough and so constructed as to serve the comfort and convenience of travel.
5. Economy of maintenance.

A sixth factor, that of æsthetic design and fitness of the structure to the surroundings, has been and is little considered in bridge and culvert design, but will probably be demanded more and more as public appreciation of the value of pleasing design grows.

In the short compass of this paper we cannot enter into a discussion of bridge design, or give any details of any specific type of structure. We will, however, give some account of the standard practice in the State highway work in Wisconsin, and probably this will be sufficient evidence as to what constitutes a proper waterway structure.

Wisconsin is a State-aid State, and gives State aid to bridges and culverts, as well as to road construction. All waterway structures 6 feet and under in span are classed as culverts, and are built out of the funds available for the construction of the road. All waterways structures over 6 feet in span are considered as bridges, and must be provided for by separate appropriations, the State paying 20 per cent. of their cost instead of 33 1-3 per cent. as in the case of culverts on roads.

Wisconsin has a drastic bridge law, which provides that culverts under 18 in. in span must be so constructed or reconstructed as to stand without planking a load of 18 tons, and waterway structures over this span must be designed, "in accordance with standard engineering practice," to stand a load of 15 tons without planking.

In addition to the duty of designing all State-aid bridges and culverts, the State Highway Commission has imposed upon it by law the duty of approving as to their safety and engineering sufficiency the plans of all bridges constructed with county aid. In the seven seasons of the existence of the Wisconsin Highway Commission and its predecessor in highway work, the Wisconsin Geological and Natural History Survey, we have designed about 1,000 highway bridges of a span exceeding 10 feet for counties, and about 400 bridges exceeding 6 feet in span, and innumerable culverts under this span for the State-aid construction. In addition to this, we have approved the plans for probably 500 bridges not designed by our engineers, but simply checked as to engineering sufficiency. Actual culvert and bridge construction under our own designs has cost about $2,000,000.

We may roughly divide our bridge superstructures into five classes as follows:—

Class 1.—*Spans from 18 inches to 10 feet.*—Almost invariably constructed of reinforced concrete of the slab type. We are building even the smallest culverts of reinforced concrete, as we find in Wisconsin that they are entirely serviceable, easily constructed, and in probably 50 per cent. of the cases cost less than any other type of culvert except wood, which is not allowed on any of our work. The smallest concrete structure we are now building is 18 in. x 12 in., as we have found the smaller sizes equally as expensive and very easily blocked with ice and debris.

In some cases where the foundation conditions are extraordinarily soft and difficult, or concrete materials are not reasonably available, we use culverts of corrugated metal with concrete or stone end walls, but such culverts are used only where it is impracticable to use concrete, and probably not 1 per cent. of our culverts are now built of this material. Vitrified clay is not used at all on State-aid work, as they have been found almost invariably to crack by filling and freezing. Concrete pipes moulded in place and afterwards moved to the job are not used for the same reason. Under conditions favorable to their use, both make excellent culvert, and we could recommend them in less severe climates. Cast-iron water pipe has not been used on account of its cost, which invariably exceeds that of concrete.

We find in the small concrete culverts from 18 inches to 10 feet the average cost per cubic yard complete, including the excavation and back-filling, is about $8.00, and very seldom runs above $10.00 per cubic yard; sometimes as low as $6.00.

Class 2.—*Spans 10 feet to 40 feet.*—Either reinforced concrete, the slab type up to 18 feet and the through girder type up to 40 feet, or I-beam structures with concrete floors are used. We are building many true reinforced concrete bridges, but with public lettings open to any bidder, the workmanship and finished appearance has been so poor in many cases that we are using more I-beam structures than we otherwise would. In the case of I-beams, a five-inch concrete floor is placed on top of the I-beams, and the corrugated arch type of support for the concrete between the I-beams is but seldom used.

Class 3.—*Spans from 40 to 80 feet.*—We are using the Warren riveted pony truss practically exclusively, though a few plate girders are being used where the conditions of hauling are favorable. All of these structures have concrete floors.

* Read at American Road Congress, held at Detroit, Mich., September 29th to October 4th, 1913.

Class 4.—*Spans from 80 to 135 feet.*—We use the riveted Pratt high truss with a horizontal top chord, also with a reinforced concrete floor.

Class 5.—*Spans over 135 feet.*—We use a Pratt riveted high truss with a curved top chord. Practically all of these larger spans are also built with a reinforced concrete floor. Very seldom do we use a pin connected truss, either for Class 4 or 5, probably not once in twenty-five cases.

From our cost figures on all bridges so far constructed, we find that for any span the price erected (including substructure and superstructure) figures out very closely to $40 per linear foot of the over-all span. Reinforced concrete floors average about 20 cents per square foot. Steel in plate girder and truss spans averages from $25 to $70 a ton erected, and I-beam spans figure from $50 to $60 a ton erected.

Widths of Structures.—We have adopted for widths for concrete culverts and bridges the standards recommended by the Association of State Highway Department, which are as follows:—

First Class Roads.

Culverts under 12 ft. span, minimum width	24 ft.
Slab bridges over 12 ft. span, minimum width	20 ft.
All other concrete spans, minimum width..	20 ft.
Very long bridges less if necessary.	

Second Class Roads.

Culverts less than 12 ft. span, minimum width	20 ft.
Slab bridges over 12 ft. span, minimum width	18 ft.
All other concrete bridges, minimum width.	18 ft.

Third Class Roads.

Culverts less than 12 ft. span, minimum width	20 ft.
Slab bridges over 12 ft. span, minimum width	18 ft.
Longer bridges may be, minimum width....	16 ft.

Steel bridges are built almost invariably with a 16-ft. roadway; that is, 16 ft. clear distance between trusses or rails, no matter what the class of road, although for spans under 80 ft. some 18-ft clear roadways have been built.

Abutments under practically all structures are plain concrete, as with concrete materials as cheap as we have them in Wisconsin, and with the difficulty of getting first-class workmanship in reinforced concrete foundations without constant inspection, we find that this is the cheapest type of abutment. Occasionally cement rubble masonry abutments are used, and once in many times driven steel I-beam piles surrounded by a concrete wall are used. The last type of abutment has been found to be very satisfactory and economical for high abutments on sandy bottoms, and has largely displaced the use of cylinders with steel backing. Steel backing is not allowed on any State-aid structure. The price of concrete in bridge abutments and piers averaged last year about $8.00 per cubic yard.

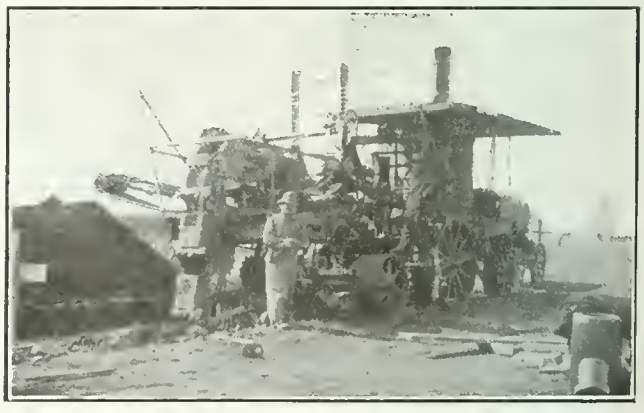
A large share of the trouble with bridge structures results from improperly designed foundations. A common fault is stopping work before a proper depth below stream bed is reached. Seldom should foundations extend less than four feet below stream bed, and whenever doubt as to the bearing power of the soil at that point is entertained, or as to undermining from a rapid stream, they should be carried down to solid soil or thoroughly piled. All foundation work should be inspected as the excavation is made and material is placed, not necessarily by an engineer, but at least by an honest man with good judgment and backbone. All concrete work in any part of the structure should be inspected as it is placed. Inspection of steel and workmanship on it as it is erected is not so necessary, as it can be inspected and its compliance with the specifications determined after erection at the time acceptance is to be given.

As to methods of letting the work. We have found it necessary to have open competition and sealed bids on bridge work, and by asking for mailed bids on all work have established true competition, and have to a very large extent broken up the old system of "pooling," and combinations of the bridge agents who may be on the ground at the letting. We furnish complete plans for foundations and for reinforced concrete, I-beam and plate girder spans, and all bidders submit prices on our uniform plans. For truss spans, we furnish the truss diagram showing the stresses in the truss members and the make-up of the truss members, floor system, and principal connections, and the successful bidder submits for approval the shop drawings before fabrication is commenced. For trusses, we believe the latter system is preferable to that of furnishing complete shop drawings, as it allows manufacturers to follow their standard shop practice in detailing so long as these details are satisfactory.

The proper design for culverts and bridges is an engineering problem which should always be left to engineers. Probably a State highway department can handle it more economically than can private engineers, as so many bridges will be built of one span that superstructure plans can be standardized, and even the same foundation plan may fit several bridges. The cost of designing, letting and accepting bridges in Wisconsin has averaged about 3½ per cent. of the total cost. Inspection has been paid for separately by the local units. It would probably be better to have a State inspector on each bridge, but we have gotten very good results through local inspection at probably 25 per cent. of the cost of placing a man on each job. Important jobs should have a skilled inspector by all means.

MODERN DITCH DIGGING.

Machines are rapidly supplanting manual labor in digging trenches for water mains, sewers, irrigation, etc. The illustration below, which was made from a photograph taken by Willis Chipman, C.E., of Toronto, shows one of many different types of modern trench diggers. These machines have been especially successful in Western Canada, but are gradually coming into great favor in the East, also, for all large contracts where the material to be excavated does not contain too much stone of large size. Among the many types of these machines, the best known in Canada are the Parsons, the Austin, the Harris, the Monahan, the Potter, and the Carson excavators.



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CONTENTS OF THIS ISSUE.

	PAGE
Editorial:	
Stream Flow in Sewage Disposal	561
Canadian Oil Resources	562
Commission Control of Ontario Waterpowers	562
Leading Articles:	
Points in Bricks and Brick Construction	545
Royal Commission's Sewage Disposal Enquiry	548
The Saskatoon Traffic Bridge	551
Massachusetts Highway Commission Report, 1912	552
Concrete Roads in Wayne County, Mich.	553
Design of Footings in Reinforced Concrete	554
Purification of Sewage Effluent	556
Government Elevator at Port Arthur	558
Waterway Structures	559
Oil and Gas Prospects in Western Canada	563
Increase of "Run" in Mechanical Filters	564
Present Stage of Scientific Water Supply in America	565
Reinforced Pile Foundations for Blast Furnaces	567
Treatment of Worn Out Macadam Surfaces	568
Electrification of Mount Royal Tunnel	571
Coast to Coast	572
Personals	574
Coming Meetings	574
Railway Orders	73
Construction News	76
Market Conditions	92
Technical and Municipal Societies	94

STREAM FLOW IN SEWAGE DISPOSAL.

On another page reference is made to a recent publication of the Royal Commission on Sewage Disposal, which body, acting under the direction of the British Government, has attempted to present standards of purity of sewage effluents and streams to serve as a guidance in the installation of sewage treatment plants and the disposal of sewage by dilution. These standards are not definitely fixed and may be varied at the discretion of a central authority.

In America no concerted effort has been made to establish standards to regulate the use of streams and lakes as receptacles for sewage and sewage effluents, although various fundamental principles have been suggested, based largely upon observations of existing conditions. For instance, it has been determined by various investigators that untreated sewage must receive a dilution of from 3.5 to 6 cubic feet per second per thousand persons tributary to avoid objectionable conditions. Another authority has tentatively suggested a formula to determine the safety of discharging sewage into streams used for water supply purposes, and various other ill-defined standards have been suggested.

While commenting upon the standardization of dilution of sewage, the Ohio State Board of Health recently expressed the hope that provision would be made at an early date whereby an accurate and comprehensive knowledge of the streams of that State might be made available. The same applies generally to Canada, and particularly to the Province of Ontario.

The fundamental factor which is required in the application of any standard is the volume of flow of the stream considered. Little is known of the actual flow of streams in this country, although the Hydro-Electric Power Commission has been carefully accumulating data for several years, in connection with power investigation. The United States Government has attempted to obtain this very important information for sewage disposal purposes, in addition to similar statistics which have been collected with respect to power development during the past half century. In the proper consideration of problems attending the disposal of sewage, such a knowledge of the flow of streams is absolutely necessary.

Ontario's sewerage problem is one that cannot be satisfactorily solved by the application of systems such as have been evolved for the disposal of dangerous effluents in European cities. Although the standard of purity attained in Birmingham, England, and in Essen, Germany, is for the world to admire, the cities bordering upon Ontario waters have entirely different conditions to meet, and such systems, although the most scientific that have yet been developed for the handling of sewage, would be quite inefficient here. One reason for this is that the water of our rivers and lakes is restricted and is not subject to the beneficial influence of tides.

Not a few Canadian cities are taking chances in the matter of water supply, because of the effluents from their own or neighboring sewers, and as the seasons come and go these effluents assume greater proportions, Nature being expected to extend her purifying agencies to an ever-increasing degree. It is to be hoped that the study which the provincial departments of public health are making will bring forward many requisitions in this matter, tending toward greater care and safety.

Disposal by dilution should be carried out only under scientific methods. Absolute surety of a generous factor of safety is essential for healthful and wholesome water. The sentiment that is associated with the question of water supply should not be entirely disregarded, either.

And, science in the matter of disposal by dilution must have, as a basis, an accurate and comprehensive knowledge of stream flow. When Canada has acquired this necessity, to it may be applied certain safe and standard rules governing the degree of purity which an effluent must possess before its entrance into our streams and lakes should be permitted.

CANADIAN OIL RESOURCES.

It is said that the British Admiralty is endeavoring to ascertain the extent of oil deposits within the Empire, with a view to securing requisite supplies for naval purposes. It is also stated that from present knowledge of Imperial oil lands, the supply will be derived mainly from shale rather than from wells yielding liquid petroleum.

At the present moment interest is centred upon the enormous deposits of oil shale which are known to exist in Albert county, New Brunswick. These deposits have been known to exist for a long time, though they have not been worked hitherto on any large scale. Now, however, these shales appear to have become of inestimable value, capable of yielding from 27 to 48½ gallons of fuel oil per ton of shale. The reports of English experts, as well as those made by the Geological Survey of Canada, show that, without doubt, there are between 200,000,000 tons and 300,000,000 tons of shale in one section alone of the Albert fields; so that a calculation on the basis of 40 gallons per ton means a supply of fuel oil of 10,000,000,000 gallons, or 40,000,000 tons. Another important point about the shales of New Brunswick, also, is that they are very easily and economically worked, and it is estimated that fuel oil derived from these can be supplied at a very low rate, in consequence of the fact that the oil shale may be obtained by open pit mining. By this means it is stated to be possible to provide 2,000 tons per day for over one hundred years. Apart; however, from this bed, there are other deposits north and south which are as rich in shale as the deposit referred to.

In Western Canada even greater interest is being shown toward the newer sources of fuel, and activities in the quest of oil and gas are assuming importance. Reference is made in another column to the report upon the prospective wealth of these fields, by Mr. Wyatt Malcolm. In this connection it is worthy of note that one large stretch of country being very actively prospected at the present time is that of the Province of Alberta. In consequence of the recent discoveries of asphalt and natural gas deposits in various parts of the Western Provinces, an active campaign has set in among prospectors and experts, who are making an exhaustive search for indications of oil in Central and Southern Alberta. The experts of the Dominion and Provincial Governments are engaged in this work of prospecting and mining, and drilling outfits have been shipped from Edmonton recently. The wells which have been put down are at the present time over 2,000 ft. in depth, and there is a sanguine feeling that good results will be obtained at an early date. The Canadian Pacific Railway is keenly interested in the development of these new sources of fuel supply in the West, especially oil. Drillers are at work close to the railway at Calgary, in the Athabasca and Peace River territories, and at a number of different points on the Pacific Coast. Enlargement of storage facilities in the neighborhood of Vancouver is also contemplated, as larger quantities of liquid fuel are being purchased for use upon their passenger steamers on the Pacific.

Mr. Malcolm, in his report, calls attention to the possibilities of the Western part of Canada as an agricultural country, in which towns are rapidly springing up as distributing centres and villages growing into cities. With an increase of population will come an increased demand for material for light and fuel, so that, taken altogether, the finding of a market for oil and gas will be an easy problem, and the demand will be sufficient to greatly stimulate the effort of drillers.

COMMISSION CONTROL OF ONTARIO WATER-POWERS.

"In view of the comprehensive schemes outlined by the Dominion Government for the creation and improvement of waterways in connection with the St. Lawrence River, Welland Canal, French River, Sault Ste. Marie, Trent, Ottawa and others, involving a large expenditure of public money; and in view of the extensive power developments which are possible in consequence thereof; also, in view of the rapidly increasing power requirements of the Province, be it resolved that this Association request the Dominion Government to put all such waterpowers under the jurisdiction of the Hydro-Electric Power Commission of Ontario, to be developed by them for the use of the municipalities of the Province for the benefit of the people."

In adopting this resolution at its recent convention in Toronto, the Ontario Municipal Electrical Association, a body whose membership consists chiefly of mayors and aldermen of various cities and towns of Ontario, fairly representative of the whole province, has expressed a general note of disapproval against control by private corporations of the valuable assets to be developed from waterpowers. The resolution is going forward to the Dominion Government in the form of a memorial, it being pointed out by those prominently in support of the action, that it frequently happened that the control of these powers passed on to private companies before the people got a chance to express any wish to control them for themselves.

The Hydro-Electric Power Commission of Ontario has, by request of various municipalities, exercised its judgment over a number of proposed developments throughout the Province, and already a great deal of unnecessary expenditure has been averted by its timely investigation.

In the establishment of a power service there are many features, especially in connection with mechanical and electrical details, that are more or less of a stereotyped nature, and apply to all plants with approximate equanimity. But these factors are governed by and depend upon the quantity, consistency and other characteristics of the available water supply. It is to be regretted that the present accelerated movement toward a wider use of the waterpowers of the Province for electrical energy is not in possession of stream flow data extending back through a greater period. Except for the past few years, a cursory knowledge based upon the memory and integrity of the "oldest inhabitant," is too frequently the only available information bearing upon the conditions in the past that are of great importance. The result is that there have been plants installed that are quite out of proportion with the available supply of water; and in the prevention of similar occurrences the Hydro-Electric Power Commission is rendering a service that is being felt. Further, the records which it commenced several years ago to acquire relative to Ontario stream flow emphasize the fact that the matter of the resolution referred to above is quite in keeping with the object which promoted it.

EDITORIAL COMMENT.

It is now several months since the position of city architect was made vacant in Toronto. The Board of Control is at last considering the appointment of a successor to Mr. McCallum.

* * * *

In discussing the question of Canadian freight rates, Mr. Ben. H. Morgan introduced the subject of Canadian duties on British machinery, steel and iron girders, and heavy material of that class, stating that if concessions, by way of reduction or abolition, were made in the tariff with respect to these items, the resulting attraction of British goods to the Canadian market would assure such a freightage in the direction of Canada that British tramp steamers would be encouraged at once to ply between British and Canadian ports. Without the tramp steamer low freight rates are claimed to be an economic impossibility at present.

* * * *

The Burrard Peninsula Joint Sewerage Board was constituted last month by the Provincial Government of British Columbia. It consists of a chairman and four members, all appointed by the Government, the chairman receiving a salary of $5,000 per annum and the members $600. The latter are nominated by the four municipalities in the Sewerage District—Vancouver, South Vancouver, Point Grey and Burnaby. The Board was appointed to construct and operate a system of trunk sewers, interceptors and outfalls on the lines laid down in Mr. R. S. Lea's report to the Joint Committee, the construction of the subsidiary sewers being left in the hands of the municipalities, who must submit all plans to the board for approval. The Board controls an area of nearly 90 square miles, and has powers to borrow a sum of $11,000,000, the principal and interest being guaranteed by the Provincial Government. Interest and sinking fund charges will be met by an assessment on the municipalities, who have the right of appeal to the Lieutenant-Governor-in-Council from any assessment made by the Board. The works will be constructed as the necessity arises, and, as much of the territory is at present very sparsely populated, it will probably be many years before the scheme is completed. The Provincial Government and the municipalities concerned are, on the advice of their engineers, profiting by the experience of the older cities of the world, where, in most cases, the sewerage systems, like Topsy, have "just growed," and have to be revised and readjusted from time to time at very considerable expense, together with the abandonment of points of outfall and lines of sewer often before the loan under which they were originally constructed has been paid off.

* * * *

In the organized counties of old Ontario there are 50,000 miles of road, according to a report made by Mr. W. A. MacLean, of the Highways Department of the Provincial Government. A classification would be approximately as follows:

Trunk roads connecting the large towns and cities	2,500 miles
County or leading market roads	6,000 miles
(a) Main township roads	25,000 miles
(b) Secondary township roads	16,500 miles

The roads described as trunk roads are, with the exception of a few connecting links, amongst the most important of the county roads. Main township roads comprise principally the concession roads on which numerous farms front and which converge into and create the traffic of trunk or county roads. Secondary township roads include the little travelled connecting roads.

OIL AND GAS PROSPECTS IN WESTERN CANADA

IN Memoir No. 29-E of the Department of Mines, Canada, Mr. Wyatt Malcolm outlines the prospective industrial field for the production of oil and gas in the northwestern provinces of Canada. This memoir is a compilation of information obtained in great part from the reports of Canadian geologists. The object is to lay before the public what is known regarding the oil and gas possibilities of these provinces. To this end it was thought advisable to present in a concise form the geological conditions to be met, and for the benefit of those who are interested in boring operations stress is laid on the lithology and thickness of the different geological formations. Logs of wells of different localities are also given, and evidence bearing on gas and oil production and possibilities is presented.

The most important areas considered in the report are: (a) the Athabaska River district, where the Dakota sandstones are impregnated with a bituminous substance, a petroleum product, and where gas is known to occur in abundance; (b) the country about Medicine Hat and westward where gas has been found at different horizons but in greatest abundance probably in the Dakota sandstone; (c) the Pincher Creek district where there has been some prospecting for oil.

The plains of Western Canada are underlain by a great body of sediments, nearly horizontal in attitude, and resting on a Pre-Cambrian base. The eastern contact between the Pre-Cambrian rocks and the later formations runs in a generally northwest direction from Lake Manitoba past Athabaska, Great Slave, and Great Bear lakes. In the eastern part of the plains a great unconformity exists between the Palæozoic systems, consisting of limestones, dolomites, and shales, and the Cretaceous system, consisting of shales and sandstones, so that we find the Dakota sandstones of the Cretaceous system resting directly upon limestones of the Devonian system. The Palæozoic strata are exposed by faulting in the Rocky Mountains and much of the later sediments has been eroded, only traces of the lower members being left. In the west, deposition during Carboniferous, Triassis, and Jurassic times has to a great extent bridged over the unconformity seen in the east, and the geological column includes formations found in nearly all the great systems from the Cambrian to the Recent. In western Alberta and in some parts of south Saskatchewan the Cretaceous sediments are overlain by Tertiary deposits. Overlying all is a mantle of unconsolidated Pleistocene and Recent deposits.

Little has been done yet to test the gas and oil possibilities of the district. A few wells have been sunk, and in a number of these gas in commercial quantities has been struck. Prospecting for oil has been less successful.

Prospecting for oil has been carried on in two different areas in the Pincher Creek district, southwestern Alberta, one on the south branch of the south fork of Oldman River, and the other on Oil Creek, which flows into Waterton Lake. This has apparently resulted in no great measure of success. In northern Alberta the Dakota sandstone, where exposed along the Athabaska and its tributaries, is impregnated with a bituminous substance believed to be a petroleum product, and it is thought that liquid petroleum exists in this porous rock at some distance from the outcrop. To test the validity of this belief, wells were drilled during the nineties by the Dominion Government at Victoria on the Saskatchewan, at Athabaska Landing, and at the mouth of Pelican River. In the first two wells the Dakota sandstone was not reached, while in the last it was reached at a depth of 750 feet, penetrated about 87 feet, and found to carry maltha or heavy, tarry petroleum.

Prospecting for gas has been much more encouraging. The boring at the mouth of Pelican River, although disappointing so far as oil is concerned, proved the presence of a great reservoir of gas in the Dakota sandstones, and heavy flows were struck at 820 and 837 feet. In southern Alberta, also, gas is found in paying quantities. A good field exists at Medicine Hat, and flows have been obtained at several different points west of that city. At Bow Island a flow of several million feet is obtained.

Thus, while the presence of oil in commercial quantities remains to be proved, boring operations have demonstrated beyond a doubt the existence of large reservoirs of natural gas, and it seems probable that further exploratory work throughout the wide area underlain by the Cretaceous rocks should lead to the discovery of other reservoirs.

It is believed that the Devonian limestone is the source of the gas and petroleum products of northern Alberta, while the porous Dakota sandstone forms the reservoir into which they have risen and in which they have been retained by the overlying shales. The Dakota sandstone is the productive formation at the mouth of Pelican River, and it is also believed to be the gas-bearing formation at Bow Island in southern Alberta. As the Devonian limestone and Dakota sandstone are of wide distribution and probably underlie the western part of Manitoba and a great part of Saskatchewan and Alberta the prospects for the discovery of other gas fields seem favorable. On account of the great thickness of sediments overlying these formations, the driller, however, must be prepared to go to a considerable depth.

INCREASE OF "RUN" IN MECHANICAL FILTERS.

IN a paper presented to the American Waterworks Association at Minneapolis Mr. Frederick H. Storer, Bacteriologist and chemist to the Louisville Water Company, has dealt with one of the causes of trouble in mechanical filters.

It is shown that though it might reasonably be inferred that the operation of the mechanical filter would be easiest at times when bacteria and suspended matter are present in the raw water in the least amount, many filter superintendents are finding that such is not always the case, and that warm weather and clear water bring troubles peculiarly their own, shortening the filter runs and producing odors in the filters. At such times the unfiltered waters are found to contain very minute forms of life, diatoms and a few algæ, accompanied by considerable amounts of very fine matter of indeterminate form capable of adhering together in flakes. This matter is supposed to be the result of bacterial action on organic substances. Thus, conditions of clear, warm, shallow water, abundant sunlight and sluggish current afford these micro-organisms the most favorable conditions for development, and their numbers increase rapidly at such times, while the sedimentation basins give the required conditions.

An instance is quoted where, during a period of twenty-six days, the number of micro-organisms present in the unfiltered water remained practically constant; yet during this period the length of the filter runs steadily decreased, and this result was considered as being due to the cumulative effects of a constant number of organisms. When, however, copper sulphate was added to the water in the sedimentation basins there was a general increase in the length of the runs. Also later, when the organisms had died from natural causes, a similar increase in the length of the runs was noted. During this time the degree of turbidity of the water had remained unaltered, and it was found that the length of the filter runs followed quite closely the variations in the number of micro-organisms present. The manner in which the clogging occurred is described as differing from that experienced with water of greater turbidity.

It was at first believed that with waters of very low turbidity, owing to the fact that the size and consistency of the film formed on the filter surface was reduced, the very fine suspended matter was able to penetrate into the sand in a manner which was not the case with water of greater turbidity, and in the absence of any considerable number of organisms the shortening of the filter runs was first attributed to fine turbidity alone. It was, however, found, on microscopic examination, that the sand generally showed the presence of numerous diatoms and other organisms apparently cemented together in a matrix of amorphous matter and fine turbidity, and the author is of opinion that the living organisms accelerate the formation and retention of this gelatinous film upon the sand grains. Practically, the surface of the sand under these conditions became abnormally hard and compact in a short time, and when broken up the sand grains showed a slight tendency to stick together, and this condition could not be wholly corrected even by thorough washing.

Under these conditions it was considered that some method of treatment should be adopted to prevent the clogging, and three methods were tried, though it seems that only one of these—the successful method—received any great degree of care, owing to the difficulties of application under the particular circumstances. The killing of the micro-organisms by chemicals was attempted, but owing to lack of equipment for applying it accurately as a continuously fed solution, hypochlorite was applied to one of the filter beds in the form of powder. This was done by draining off the filter till about 3 in. of water remained on it, and scattering the powder over the surface and allowing the bed to stand thus for twenty-four hours. The result did not prove to be useful, and the bacterial efficiency of the bed was, moreover, impaired. Copper sulphate was then applied in the second sedimentation basin, and in the coagulant basin, and favorable results were at once obtained. The method adopted was that of dragging bags of the copper sulphate through the water. The third method was that of using the river water without preliminary sedimentation, the water being run direct to the coagulant basins. This was done on two occasions, and in both cases encouraging results were obtained, although in each case an increase in turbidity followed within a few days, and thus left no opportunity to see how long the improvement would have lasted.

The summary at the end of the paper states that the water of the Ohio River, when of a turbidity below 30 parts per 1,000,000, almost invariably causes decreases in the lengths of the filter runs. If such turbidities are accomplished by micro-organism and much amorphous matter, still greater decreases follow. Filter runs may be greatly increased by the judicious use of copper sulphate, although aftergrowths of bacteria sometimes follow its application, and must be guarded against. Small doses of hypochlorite of lime do not affect these micro-organisms in such a way as to increase the length of the filter runs. The determination of the time of filtration of samples of water through small laboratory filters will in some instances enable the operator to select the water from that point of his system which will give the longest filter runs.

PRESENT STAGE OF SCIENTIFIC WATER SUPPLY IN AMERICA

REPORT OF AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS' COMMITTEE ON WATER WORKS AND WATER SUPPLY—PRESENTED AT 20TH ANNUAL CONVENTION, WILMINGTON, DEL., OCT. 7TH.

By A. F. MACALLUM, C.E.,
Chairman

IN looking over the legislation of the past year and the greater amount of knowledge on water supply displayed by the press, it must be confessed that the different States and municipalities have not been developing their laws for the proper protection of the people from contamination of water supplies as rapidly as is considered necessary: This has been due principally to the ignorance of the average legislator, and sometimes the political pressure brought to bear upon him from interested sources.

Legislation in Minnesota.—In Minnesota a bill was placed before the State Legislature for adequate protection of the water supply throughout the State. This bill provided that all persons, corporations, and municipalities, other than first class cities, supplying water for private or public consumption within the State must file with the State Board of Health certified copies of plans of their water supply, and that no such source of water supply shall be used until plans have been placed before the State Board of Health and favorably considered. This also applies to new places for the disposal of sewage. This State approval would have been a step in the right direction, and Minnesota, following in the steps of New York, New Jersey, Pennsylvania, Massachusetts, Ohio, and the Province of Ontario, but unfortunately the opposition was so strong that the bill was withdrawn.

Water Waste.—In Philadelphia water is still wasted, and its water system is now heavily overworked, with the result that in attempting to keep up with this waste the quality of the water, along with efficiency and economy in operation, have been sacrificed for the sake of quantity, and the present filters are being worked at a higher rate of filtration than is thought advisable, or that would be necessary under normal restrictions. This applies to other cities also, and the public seem very slow in awakening to the tremendous unnecessary expense, although brought to the fore by probably every manager of municipal waterworks in the country, and every advance made to curtail the water to reasonable limits is only gained after hard and very often bitter opposition.

In New York it was found that 33,500,000,000 gallons of water were saved at a total expense of $138,000.00 by careful house-to-house inspections, which amount was ascertained after careful pitometer gaugings before and after district inspections.

Pollution of Lake Erie.—During the spring a conference was held at Cleveland between the Ohio State Board of Health and representatives from cities on the south side of the lake to discuss the sewage pollution of Lake Erie, and it was thought probable that there was no general pollution of that lake, and that any pollution was confined to zones within limited distances of cities and rivers contributing sewage. It was also brought out that the sewage from any particular city was more detrimental in its effect upon its water supply if taken from the lake than upon that of any other city, taken from the lake, and that water supplies taken from limited distances from the shore should be purified. At this meeting a resolution was adopted asking the State Board of Ohio to investigate the degree and extent of the pollution of Lake Erie, and also a resolution was adopted providing for the appointment of a committee to fix standard methods of analysis of samples and the nature of the determinations to be made in the investigation.

Commenting on this, we may say that, while the pollution would generally be within limited distance of cities and rivers, yet there are authentic cases on these great lakes where islands of polluted water have been found fourteen miles distant under certain weather conditions, which, however, are not common.

Analysis.—In the chemical and bacteriological determination for the purity of water the procedure originally developed by the Massachusetts State Board of Health has almost universally been followed. That analyses estimate the amount of chlorine, nitrates, nitrites, oxygen consumed, oxygen dissolved, odor, turbidity, hardness and sediment, along with bacteria count and tests for B. Coli; yet it has recently been pointed out by Dr. H. E. Barnard, chemist of the Indiana State Board of Health, that in many tests made the values for chlorine, nitrates and nitrites under varying conditions are of little value. For instance, the nitrite factor, of considerable value in the determination of well supplies, is of little value in rivers or lakes, varying more widely during conditions of low and high water than of varying amounts of sewage inflow. The same remarks apply to the presence of free ammonia. It was found, however, that two factors of oxygen consumed and dissolved were of prime importance, although they varied also in rivers somewhat according to the variable flow and by turbidity. However, the determination of these two factors, with the bacterial count and test for colon bacillus, is of great benefit in ascertaining the purity of a water supply at the time the tests were taken; but to be of prime value there should be a large number of tests extending over different conditions of the river or lake, for no chemist can definitely say that any water supply is good or bad upon the result of isolated tests, and without knowing the local conditions and surroundings at the time the samples were taken. We have dwelt on this because of the almost universal idea held that one determination of a water supply is quite sufficient, and of the habit of some chemists of approving or condemning a supply upon such a test and without a knowledge of the locality from which the samples were taken.

In looking over the typhoid statistics of some fifty large American cities a considerable decrease has been noticed, there being only twelve cities in this list where the rate has been greater than last year. This is due, no doubt, to the betterment of the water supplies and the general improvement in sanitary conditions.

Filtration.—The filtration of water is practically limited to two standard methods on this continent—one being by means of graded sand and without the use usually of any chemicals; the other by mechanical methods for treatment with chemicals. Each method gives equally effective results, although the selection of which method adopted is governed generally by local conditions.

In the slow sand method of filtration the water is passed through beds of graded sand and gravel, without the addition of chemicals, at the rate of about four million gallons per acre per day, which at times may be increased 25 per cent. without loss of efficiency. The water is then collected in reservoirs.

With the mechanical system the water is first impregnated with a coagulant, such as sulphate of alumina, and allowed to stand in sedimentation basins for a few hours to allow a sufficient precipitation, after which the comparatively clear liquid is pumped through rapid sand filters at the rate of from 100 to 150 million gallons per twenty-four hours. It is then ready for distribution.

The first cost of mechanical filtration is considerably less than for slow sand filtration, besides requiring much less area for the plant, which ratio of cost will vary according to local conditions—as, for instance, the material upon which the filters are to be built, with the resulting foundations. The mechanical system can usually be built in half the time that is required to build slow sand filters. On the other hand, the cost of operation is largely in favor of the slow sand method, which averages, for operation, about $1.90 per million gallons, while for the mechanical mehod the cost would be about $4.70 per million gallons. This difference is principally due to, and varies with the cost of, the coagulant. This does not include pumping or capital charges in either case, although the additional head required for the mechanical operation is included.

The mechanical method will successfully treat any water, regardless of turbidity or color, while the slow sand method works best when there is comparatively little suspended matter or color.

With the conditions existing at Philadelphia it was found necessary to eliminate some of the suspended matter by means of a roughing filter, which removed a considerable amount of this suspended matter, and allowed the slow sand filter to be operated above their rating. This combination was effective in obtaining results at a lower operating cost than with mechanical filters, and at the same time successfully treated a water otherwise not altogether suitable for the slow sand method.

It might be supposed that mechanical filters would work best when bacteria and suspended matter were least, but many filter superintendents are finding that such is not always the case, and that in warm weather with clear water odors are produced in the filter, with shortening filter runs, caused by clogging of the sand. Examinations of the unfiltered water showed minute forms of life diatoms and a few algæ, accompanied with a fine, flaky matter, supposed to be the result of bacterial action on organic substances. This matter formed a gelatinous firm upon the sand grains, causing the surface of the sand to become abnormally compact, and with a tendency of its grains to stick together, which was not altogether corrected by washing. This clogging was successfully overcome by the judicious use of copper sulphate. After the copper sulphate treatment bacteria increased, probably because it reduced or removed unfavorable conditions, but no B. Coli was detected, and the increase in bacteria was eliminated by adding 0.25 parts per million of available chloride. While this trouble has developed and has been successfully treated at Louisville of the Ohio River water, using mechanical filters, on the other hand, at Toronto, with slow sand filters and Lake Ontario water, it was found that on account of the amount of suspended matter and sand carried to the filters that the filters were almost clogged up. It was also found that from the inset of frost until the warm weather in the spring it was not possible by the means provided to wash the sand scraped from the filter beds. The pipe lines and sand would freeze up during the washing process, necessitating the removal of the sand scrapings until the spring and the washing and re-sanding of the filters. From this we wish to point out that where any installation is contemplated there is need of a very careful study of the quality of the water, the local conditions governing not only the method of treatment to be used, but also the location of the plant.

It has been found that raw water can be treated with seven pounds per million gallons without developing any taste, and if after treating the water can be stored for three or four hours in a reservoir, or aerated, as much as 12.5 pounds per million gallons can be introduced without noticeable taste. It is better to obtain water of the best quality rather than depend upon the efficiency of purifying apparatus, chemicals, and the skill of employees, and in the case of New York a very interesting discussion has been going on as to the advisability of filtration outside of chlorination. Because of the diametrically opposite opinions advanced by the engineers of various municipal bodies interested, filtration outside of hypochlorite treatment was decided against, although it was shown that such treatment did not remove bacteria embedded in particles of suspended matter, decrease turbidity, lessen color or vegetable stain, or remove swamp tastes or odors.

The application of ultra-violet rays for purifying large quantities of water has not advanced very materially during the past year on this continent, although it has been used at Rouen, France, for the past three years. The simplicity of the apparatus, easy maintenance, and high efficiency seems to open a wide field for its application. It is necessary, however, before submitting the raw water to the rays that the suspended matter be removed, otherwise germs protected by such matter do not come directly under the effect of the rays. An ordinary sand filter can be run from five to ten times its ordinary rate and still produce satisfactory water for the after treatment of the ultra-violet rays. The water is exposed for the fraction of a second within an inch of the source of the rays, and this is accomplished by means of various mechanical apparatus, one or two of which are now on the market.

It is our opinion that this treatment of ultra-violet rays is worthy of consideration by consulting and municipal engineers in this country in future installations, and should also be investigated on a commercial basis by engineering colleges.

Andrew F. Macallum, Chairman.
J. Walter Ackerman.
G. A. Roess.

Ohio led the states in the value of her clay products with an output amounting to $34,811,508, or over one-fifth the total production for the United States. Pennsylvania was second, with a production valued at $21,537,221; New Jersey third, with $19,838,533; and Illinois fourth, with $15,210,990. Eight states produced clay products in 1912 to a value exceeding $5,000,000, and 26 states to a value exceeding $1,000,000.

REINFORCED PILE FOUNDATIONS FOR BLAST FURNACES.*

By Armand Baar.

THE question of foundations often plays an important part in iron and steel works, where engineering skill requires to be exercised with special care, in view of the responsibilities which devolve upon the engineer when erecting heavy plant on a poor subsoil. The frequency with which such poor subsoils occur in works is due to three causes: (1) The price of land often compels the utilization of certain areas hitherto undeveloped, owing to their unsuitability for building purposes. (2) The need of a water supply for steam engines often necessitates a works being installed close to a river, which by the gradual shifting of its bed, may have undermined the adjoining areas. (3) Lastly, the production of dump heaps for the embankment of railway junctions require constant filling up with debris either as simple ash-shoots, or by the tipping of slags from blast furnaces into mounds which often attain a height of 65 ft., and upon which it is dangerous to install machinery in motion owing to the lack of stability of the foundations.

In Belgium in particular, as well as in the North of France, and in the Grand Duchy of Luxemburg, a new system of foundations known as Franki piles is being employed with considerable success in most of the big works. The principle is, briefly, as follows: A conical perforator armed with a hard steel point is driven into the ground by the help of a pile-driver. This perforator carries with it telescopic tubes which serve as tubbing, and have an average diameter of 2 ft. The perforator thus passes through the hardest ground. An instance may be adduced at Ougrée, where the process has been applied on a slag tip 30 ft. in height, and consisting entirely of slag blocks from a basic steel works, of a size extending to about 80 cu. ft. each. Reference may also be made to instances where the ground has been exceedingly soft and highly water-bearing, as at the Courrières Collieries, where the soil consists of peat and water-bearing sands, and where three bridges have been erected. The object of the system is to bore through the overlying ground until a solid foundation of clay or gravel is encountered.

The perforator is then withdrawn and replaced by concrete, which is rammed down by degrees as the tubes (commencing with the lowest) are withdrawn. By means of the ram the concrete is compressed so as to press against the sides of the bore-hole and to consolidate them, until ultimately the bottom is enlarged and a cone obtained, pressing against the side walls of the cavity.

Amongst applications of this process which may be referred to, one of the most interesting was the strengthening of No. 2 blast furnace at the Esch-sur-Alzette works of the Société des Aciéries Réunies de Burbach-Eich-Dudelange in the Grand Duchy of Luxemburg, and its supercession by a furnace of twice the size.

The masonry batter of this furnace rested on gravel 14 yards below the level of the soil, and the ground had been packed up entirely with goaf of an inferior description. Several break-outs from the furnace had, however, penetrated the packing at different times, and it was feared that lumps of metal might be encountered at several points, which actually happened later.

Forty-one piles were driven, each calculated to sustain a load of 70 tons, and in order that the concrete arch, which had to rest simultaneously on the batter and on the pile itself, should distribute its load uniformly, there was placed, above the masonry, a layer of granulated crystalline slag 4 in. thick, mixed with a little cement, so that if, under pressure, the fresh cement should spread, any further increase in the load would bear upon the crystalline slag and further compress the latter by crushing it, after which the injection of water at the bottom would finally mortar the arch to the masonry, by the action of the cement originally introduced as an addition, with the dust of the powdered slag.

The furnace is in full working order, and the method of construction has been perfectly successful, and shows no sign of settlement.

Another interesting application of Franki piles was made in erecting the rolling mills of the Ougrée Marihaye Company. On a tip composed entirely of slag blocks to a height of 30 ft., resting on 15 ft. of bad subsoil, these mills work 35 ft. above the level of the Meuse gravels. The whole plant, including mills, buildings, gas producers, etc., rests on 180 piles, which were driven through this thick layer of slag. Not a single pile had to be left unfinished during boring, and the whole of the work proceeded without interruption.

The Athus-Grivegnée Company has erected a similar plant at Athus, under analogous conditions, but in this instance the piles are only 30 ft. long. Franki piles have also been most satisfactorily employed as foundations for gas engines at the works of the Société Métallurgique de la Basse Loire, at Trignac (St. Nazaire), at the Aciéries de Micheville in Meurthe-et-Moselle, and at the works of the Société des Hauts Fourneaux de la Chiers at Longwy.

It may also be interesting to add that before constructing the foundations of the Ougrée Marihaye rolling mill plant, the company carried out a test on a Franki pile, which was loaded with a charge of 473 tons.

Discussion.—Mr. Andrew Lamberton, Coatbridge, said that the subject was a very interesting one, but he would like the author to give some additional information with regard to the stiffening up of insecure foundations. It was largely a question of cost. He would like to know what was the time taken to put down a pile of about 3 ft. in diameter through 30 ft. of solid basic slag, and what was the cost; also whether there was any difficulty in withdrawing the tubes, which he would expect to find was the case. The paper contained a cross-section of a pile which had been put down, and it was obvious that the tubing was much less in diameter than what the slag pile was depicted as being, that diameter being reached by filling in concrete in the metal tube and hammering it down till it expanded. There seemed to be some difficulty about that, and in getting a section resembling that shown in the illustration. A good deal appeared to depend upon the porosity of the material and the number of fissures present, while the concrete might get out of the true line of the pile. The method described was certainly ingenious, and if it could be done satisfactorily and was commercially sound the author would have accomplished a smart thing in engineering.

M. Baar, in reply, said that the cost of driving was about $10.00 per yard in hard soil and about $5.00 in easy soil. With regard to the time element, they had put down one pile per day of 12 hours to a depth of 49 ft., and in the case of one big contract a thousand piles had been put down.

Later, by letter, he replied in respect to a suggestion of simply consolidating the ground by an injection of

* From a paper read before the September, 1913, Convention of the Iron and Steel Institute, Brussels.

cement, as follows: When the tip consists simply of slag blocks from blast furnaces, the space left between the blocks being pretty large, the work would require the injection of a vast amount of cement, and the operation could not be conducted easily over a certain height. In most cases, however, the tip is formed of debris of all kinds, especially clay and earth, and in this the injection of cement is attended with bad results. The Franki pile gives full security, because it not only passes through the tip, but also through the bad soil which lies underneath it, and rests on a strong foundation of clay or gravel.

Mr. Lamberton asked further whether it would be possible to drive tubes having a diameter of 1 yard into a tip of 10 yards in height; in the affirmative, what was the time required for the operation and the cost of the pile. We have driven 180 Franki piles, at the Société d'Ougrée-Marihaye, into a tip composed entirely of slag blocks to a height of 30 ft. resting on 15 ft. of bad soil. The work, therefore, was more difficult than the one alluded to by Mr. Lamberton, and, nevertheless, we regularly made one pile a day with each pile-driver. That the first tube at the ground level had a diameter of 1 yard and a height of $1\frac{1}{2}$ yards was due to the necessity of first digging a hole of such dimensions as to enable the use of tube lengths suitable for the required depth. The upper tube had a diameter of 24 in., the mean one a diameter of 20 in., and the lower one a diameter of 16 in. In a strong ground, free from water, it is not necessary to work with tubes of great diameter, the concrete spreading easily against the walls of the cavity, and agglomerating round the stony materials forming the pile, and increasing the diameter of the latter.

As to the price of the Franki piles, it is generally of $5.00 per yard, for piles driven into an easy, soft, or marshy soil. But in tips of slag blocks, where piling is slow and difficult, the price rises up to $10.00 per yard. From the economical point of view, the following may be regarded as a typical instance:—

One thousand Franki piles are now being driven on account of the Vilorde Coke-Ovens Company. Each pile contains 123.5 cu. ft. of concrete. The total volume of the concrete thus poured in a relatively small area is about 45,800 cu. yds. If reinforced concrete piles made in advance had been used, the cost of the foundations would have been three times as high as that paid by the Vilvorde Coke-Ovens Company to the Frankignoul Company, supposing that, in order to obtain the same compression of the soil, an equal volume of concrete had been driven in the shape of such ready-made piles.

ELECTRICAL POWER IN CHICAGO.

Chicago leads the world in the production of electric power. The output of 303 electric-supply undertakings in Great Britain for the year 1911-12 amounted to 1,127,499,742 units, but Chicago by itself has an annual output of over 800,000,000, and expects within a year to turn out a billion. The Chicago Commonwealth Edison Co., generates more current than the local Edison companies of New York, Philadelphia, Brooklyn and Boston combined. The Eastern companies, however, do not supply power for local transportation, while the Chicago company does. The latter operates the largest single electric-power-generating plant in the world and its price for its product is said to be lower than that of any other electric power-vending company in the world.

TREATMENT OF WORN OUT AND RAVELLED MACADAM SURFACES.*

By Col. Edmund A. Stevens,
State Highway Commissioner of New Jersey.

BEFORE discussing the cure it is well to define the trouble, and to analyze its causes. The word Ravelling is used rather loosely. For my purpose I shall consider it as the loosening of the bond of a road surface until the macadam stone lies loose and free on the road. By macadam stone, I mean, not the small stone used to fill voids and give a smooth finish to the surface, but the stone that constitutes the body of the road's surface. In macadam work this stone when compressed to its final form occupies about 60 per cent. of the volume of the road surface. The 40 per cent. of voids is filled in varying proportions with surface stone, screenings, stone dust, sand, earthy materials and any chemical binder used to "hold the road." The mixture of fine stone, sand and earth filling the voids has no appreciable tensile strength. Its duty is to wedge the macadam stone in place and prevent internal movement. Such a structure is called on to carry loads, to receive and absorb propelling thrusts. The road should be of sufficient depth to transfer the stresses thus imposed to the sub-base without serious internal movement and at unit pressures less than the resisting power of the soil. It is thus subjected to vertical and horizontal forces that contribute largely to ravelling.

Let us briefly consider these.

A draft horse weighing 1,200 lbs. will have all his weight at one time on two feet. He will exert, say, one horse-power at a speed of 4 miles. The vertical force at the foot is 600 lbs., the horizontal $\frac{23{,}000}{2 \times 4 \times 88} = 47$ lbs. These forces are or may well be concentrated on a toe calk two inches in width; the resultant force slightly exceeding 300 lbs. per linear inch.

A motor truck, loaded, 16,000 lbs. and exerting at the wheel rims, say, 30 horse-power at 10 miles an hour, will, with 60 per cent. of load on rear axle, exert a vertical force of 4,800 lbs. and a horizontal of 562.5 lbs. at each rear rim, the resultant being about 800 lbs. per lineal inch for six-inch tire.

For a pleasure car weighing 4,000 lbs. with 60 per cent. of weight on rear axle and exerting 40 horse-power at the wheel rims with a speed of 35 miles, the vertical force at each wheel is 1,200 and the horizontal 214. The resultant is about 400 per linear inch for a bearing width of 3 inches.

At curves with high-speed cars, the horizontal force is considerably increased, for it is impossible to so "bank" a curve as to suit the speed of all classes of traffic.

In the case of wheels transmitting vertical loads only, observation indicates but little dust raising from a road not overlaid with loose dust. Such a wheel will at the point of mathematical tangency have no velocity relative to the road; a vertical velocity is imparted to it, and as any section leaves the surface it will raise with it any of the lighter particles that are loose and may come into contact with it. At the driving wheel there is a slight slip which in addition to lifting will throw particles backwards.

* Read at American Road Congress, held at Detroit, Mich., September 29th to October 4th, 1913.

These are the forces tearing at the road surface. In some cases they are more than the road can stand. The horse's calk acts somewhat like a chisel. It will pry out the binding material between the stones as well as the latter themselves when the bond is weakened. The driving wheels of motor vehicles push or suck any material thus loosened out of place. The binder loses weight as it parts with moisture; besides this, without moisture it also loses, not only its property of recementing itself under pressure, but to a great extent, its binding power as well. The real work of transmitting the stresses due to traffic must be borne by the stone. These are merely held in place by the binder. The latter is gouged out by the horse, drawn or pushed out by the automobile tire, blown away by the wind, or washed off by the rain, and a loosening of the upper stone results.

Even on a well consolidated road climate stresses impose a heavy duty. If, however, there be voids the risk of failure increases. Voids may be due to deficient rolling or to the rise of too much clay in the earthy binder. Lumps of this material will bridge the space between stones even under hard rolling. The bridge will break down eventually either from pressure or moisture or a combination of them. A void forms where the bridge was and continues rising until near the surface, when ravelling results. The same may be true in the cases of too light rolling.

When bituminous material is used as binder it is liable to disintegration from weathering, from overheating, or from admixture of earthy materials.

An ordinary water-bound macadam may lose material by wear up to a thickness of about a half an inch a year without being overloaded. The thickness that can thus be lost will vary with conditions, one of which probably is the ratio of the maximum wheel load to the total tonnage borne by the road.

Whatever the rate of waste, it must be replaced if the road is to be maintained.

To summarize the foregoing:—

Roads ravel from:

1. Improper construction.
2. Overload.
3. Neglect.

In all cases these affect the binder.

Poor workmanship in construction can only be cured by remedying the original defects. These generally show themselves by small local depressions in the surface from which ravelling spreads, in certain cases at an almost incredible speed. In bituminous surface faulty material and thin spots generally show up clearly. In both cases the only remedy is to rebuild the work properly, if necessary, from the sub-base up. This is not strictly repair work.

In considering the effect of overloading and neglect it must be borne in mind that any given type of construction may be so maintained as to vastly increase its carrying capacity. The problem is largely one of economics and administration. As an illustration, assume in two cases the same foundation—let one road have a water-bound macadam surface dressed with a heavy bitumen forming a sheet about ½ in. in thickness and the other a bituminous concrete (mixed method) surface of, say, two inches. The former will cost about 40 cents for stone and 15 cents for dressing, or 55 cents per square yard, and the latter about $1.00 (both exclusive of the foundation). With proper care the lighter surface will last about three years under fairly heavy traffic, the heavier one an unknown period, but let us assume twelve years. The total yearly charges against the two may then be stated about as follows:—

	Cents.
Dressed Macadam:	
Interest on cost, 55 cents at 4 per cent...	2.2
Depreciation, 1-3 of 15 cents.....	5.
Labor (patrol system)	1.9
Materials—Stone, ⅜ cu. ft. at 9 cents...	3.4
Bitumen, ⅛ gallon at 12 cents	1.5
Total	14
Bituminous Concrete:	
Interest on cost, $1.00 at 4 per cent.....	4.
Depreciation, $1.00/12	8.3
Labor	.9
Material	.8
Total	14

The fixed charges are 7.2 cents against 12.3 cents. The operating charges, 6.8 cents against 1.7 cents.

I do not claim that these figures are more than illustrations of the principle involved. They show a great saving in operating charges, those that show up in the yearly tax bill. The fixed charges, however, are just as real, and must be met at some date.

For a road with 9,500 square yards per mile the costs as shown in yearly tax charges, where depreciation and interest are not visible, would in this case be,

For the dressed macadam, per mile.... $636.50

For the bituminous concrete 161.50

yet as shown above the real cost of the two roads is the same. This case affects our subject, because the treatment of a raveller road surface must depend on the system of maintenance.

In most communities the great consideration is the next yearly tax bill. If that can be kept down for a period the ultimate economy of such a policy receives but slight attention. It is generally easier to get money for a new road than for repairs. A road requiring a large yearly repair charge is condemned without a hearing. The road calling for heavy interest and depreciation charges may be an equally or even more expensive solution; but the interest charge is not so apparent, and the depreciation charge is not made. This is simply putting off the day of reckoning, which is sure to come. However, the troubles of those in charge ten years hence are usually lightly borne by the officials of to-day.

If we consider the structure of the road surface we can easily see that the 40 per cent. of voids in the macadam stone will be filled somewhat as follows:—

	Per cent.
Surface stone, passing 1-inch ring and caught on ½-inch ring.....	15 to 20
Screenings, passing ½-inch ring....	15 to 10

The other 10 per cent. should be composed of sand and clay.

When dry, the clay is driven off to a greater or less extent as dust, washed away or splashed off as mud. Its place is supplied to some extent by detritus, the result of the wear of the larger and heavier materials. These also blow or wash away and the road loses its bond. If our road is not overloaded we can retain its usefulness by making good its losses, with proper materials in their needed proportion. It is here that the trained road man is most needed. Nothing can replace his experienced judgment.

In the case of a ravelled road, having first determined that the road was well built, we must decide whether the traffic is too great for the type of surface, or whether the failure was due to neglect. If the former, we must resurface with some better type. If the latter, we can repair the old surface.

Resurfacing should always be preceded by scarifying and by bringing the road up to the necessary depth of stone. For water-bound macadam needing greater surface strength, several classes of chemical binder may be used, of which I shall discuss two, bitumen and lignin.

The bitumen may be applied either by penetration or mixing methods. The former is the cheaper, the latter the more trustworthy. Which method is to be used will, after consideration of the care the road will receive, depend on the estimate of the overload, as will also the depth of the bituminous sheet. My own observation leads me to question the wisdom of attempting to get any thickness exceeding one-half inch by penetration methods. It also leads me for this class of work to prefer tar to asphalt. The former material appears less sensitive to injury by dirt and to yield better results in repair work.

The lignin binders are derived from the waste products of wood pulp or tannin manufacture. They are cements, being also used to bind core sand in foundry work and impart a tensile strength to the binding materials. They will not act on materials soaked in the so-called road oils. The action of some of these materials on slag and red shale is quite remarkable. They are slightly soluble in water, and will, therefore, need renewal. Their application, however, is easy and inexpensive, and the effect of successive applications seems cumulative, increasing not only the depth of penetration, but the strength of the bond. The waterproofing of lignin-bound roads with bituminous tops has been carried out in Connecticut, but I am unable to give any facts as to the results.

For water-bound macadam roads that have failed through neglect a thin coat of gravel carrying some earthy matter, or of screenings or coarse sand mixed with earth, will usually cure cases that have not gone too far. In some of the counties of New Jersey it is usual to fill all ruts, depressions, etc., with fine stone, and to give the middle of the road a coat of the same mixed with a little clay. Much of this material is wasted by being thrown off the road by the traffic, and the old ruts almost invariably reappear. This method, however, is very successful in preventing ravelling. It seems a false economy to omit rolling, and wet rolling at that. The same is true of patching holes with anything but macadam-size stone. The roads treated with small stone are yearly losing depth. The moisture for wet rolling is usually bountifully supplied by nature, in the early spring. It can also be had by the use of hygroscopic salts where water is hard to get. Traffic will usually throw off from the road surface enough stone to pay for rolling.

A treatment of clay, without rolling, will often give astonishing results. Such treatment, however, seems only a palliative, not a cure. Roads thus treated become dusty or muddy according to the weather, show a tendency to ravel again, and are hard to properly treat with bitumens. They will, however, take the lignin binders with good results, if the dose of clay has not been excessive, or if the excess is swept off before treatment.

In closing, a word of warning as to the use of the so-called cold oils may not be out of place. Those of the so-called non-asphaltic class, to a greater extent than the so-called light asphaltic oils, seem to act as lubricant on road materials and to foster pot-holes, ravelling, and other failures. It may be possible to properly apply these materials, but if so it is rarely done. It is certain that even slight depressions will cause a deep penetration of the road. The dust-laying qualities of the material thus absorbed are lost, and its lubricating effect given the best possible conditions to get in its pernicious work. Local authorities, and even private individuals, seem to select roads with uneven surfaces as those on which to use these oils.

ELECTRIC WELDING FOR TRACK REPAIRS.

There are many methods by which electric welding can be carried out, one of the most interesting being, perhaps, that of Zerener, which consists of a combination of an electric arc and an electro-magnetic device whereby the arc can be controlled. Two heavy carbon electrodes are used, and the arc which is struck between them is blown to the position in which it is required by means of the magnet. The most simple is the Bernardos process, which consists of drawing an arc directly between a carbon electrode and the metal which is to be treated. The outfit consists merely of a rheostat for controlling the current, a carbon electrode which consists of a hard, solid carbon rod about 4½ ins. in circumference and some 8 ins. or 10 ins. long, fitted with a clamp to take the conductor, and with an insulated handle and shield to protect the operator. There is also the Lorain system, which requires a comparatively costly plant, with generator and hydraulic grips, used principally for making rail joints by welding on splice bars.

An interesting method of building up new metal in the worn parts of tram and other rails by electric welding is now being used, the special feature of the process being that it requires no carbon electrode. The electrode is a rod of specially treated steel, and the arc between it and the rail, according to information made public by the engineer of the firm using it, fuses the electrode and welds it to the steel, building up new metal in the worn or defective places. Current is taken from the trolley wire, and the equipment consists of a light car provided with rheostats for controlling the current and the necessary switch gear. An insulated handle is provided for holding the metal electrode, which is, of course, the positive terminal, the negative being the rail on which the repair is to be carried out. The electrode is placed in momentary contact with the defective portion and withdrawn, an arc being thus formed which carries metal from the positive bar of steel into the faulty place. The action continues as long as the electrode is held in position, and can be stopped at any moment, either by opening a switch or moving the electrode away, so that the arc is broken.

With a galvanometer receiver reflecting a beam of light on a moving photographic strip, H. Abraham, of the Paris Observatory, makes accurate photographic time records of Hertzian waves. With a clock making second marks on the strip, he claims to make measurements to 1-1,000 second, and to estimate 1-40,000 second on the wave charts.

Clay Products Industry in United States.—The magnitude of the clay-working industry of the United States is shown in a chart just issued, compiled by Jefferson Middleton of the United States Geological Survey. This chart shows a total value for 1912 of $172,811,275, which is an increase of $10,575,094 over the figures for 1911. These products include the several varieties of brick, drain, and other tile, and of sewer pipe, terra cotta, pottery, fire brick, and other clay products, the various building bricks representing the greatest value, with a total of $73,425,810. The number of building bricks manufactured was 10,281,114,000.

ELECTRIFICATION OF MOUNT ROYAL TUNNEL.

ANOTHER stage in the construction of the Canadian Northern terminal and tunnel has been reached, with the letting of the contract for the electrification of both. The contract, which involves a sum of half a million dollars, calls for the complete electrification of the tunnel and terminal, seven electric locomotives and about eight cars for the local service being provided, while the system will be such that it can be extended at any time to any part of the service. Yards near the Back River will be opened, giving track facilities for changing the electric locomotives for steam and vice versâ, and within a year from now trains are expected to be running.

In the construction of the tunnel beneath Mount Royal there have been many new features and much to attract the attention of the engineering world. These features have been currently described in previous issues of *The Canadian Engineer*. Readers will also remember the announcement early in June of a world's record in tunneling in connection with the piercing of the mountain. In the electrification another record will be marked. Of all the great railway systems of the world using electricity for the operation of their terminals, there is not one which has not adopted this system only after previously using steam. The Canadian Northern terminal in Montreal, therefore, will be the first to be operated entirely by electricity from the commencement. No steam locomotive-drawn trains will enter the tunnel. Specially constructed electric locomotives will be exchanged for the steam engines at the Back River yards. For the local service between Montreal and the Model City there will be some eight multiple-unit cars of very heavy construction similar to those in use in some of the New York subways.

The contract, which has been let to the Canadian General Electric Co., provides for the installation of the system at a cost of about half a million dollars.

The installation of this electrically operated system will ensure the entire absence of Canadian Northern locomotives in or near the city, none coming closer than the yards near the Back River. On reaching these yards trains approaching Montreal will have their steam locomotives exchanged for electric motive power, which will take them to the terminal station to be opened on Dorchester Street. In the city there will, of course, be no steam engines as the railway enters and leaves only by way of the tunnel.

Progress on the tunnel construction has of late been rapid, despite the very hard rock now being encountered, and it is practically certain that the headings will meet well before the end of the year. There remains but 2,000 feet of rock separating the two headings, and this is being bored at the rate of 200 feet each week. Already a mile of tunnel has been completed, this being a broadening and enlarging of the heading to a height of 22 feet and a width of 30 feet.

In connection with the electrification of this tunnel it might be mentioned that the same company who will supply its electrical equipment also secured the order from the Canadian Pacific Railway for the electrification of the Castlegar branch in the Kootenay Division. Heavy power locomotives are to be used in this case also, and the voltage adopted is 2,400 volts in both.

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*Canada is one of the three principal mica-producing countries of the world, the others being India and the United States. The average value of the mica produced annually in Canada during the last ten years has been about $185,000.

FELDSPAR.

According to reports in the Economic Minerals and Mining Production of Canada, by J. McLeish, feldspar is employed at the present time almost entirely in the pottery industry (where, in a finely ground form, it is mixed with the clay to act as a flux), or in the enamelling of cooking and similar utensils. Attempts are being made, also, to utilize the mineral as a source of potash, of which it contains as high as 14 per cent.

Feldspar has been mined in Canada since the year 1890, and the present average annual production is 12,000 tons. Practically the whole of the output is exported to the United States, where it is consumed in the New Jersey and Ohio potteries. Almost the entire production of Canadian feldspar is derived from the province of Ontario—the principal mines being located in the county of Frotenac, about twenty miles north of the town of Kingston on the St. Lawrence River. A few small deposits, also, have been worked in the Parry Sound district, in the vicinity of the Muskoka lakes. Formerly feldspar was mined to some extent, also, in the province of Quebec—the deposits being located in Ottawa county. No development of these properties has taken place during recent years the distance from the United States factories rendering mining unprofitable. One mine in this region yields a remarkably pure white feldspar, which is in demand for the manufacture of artificial teeth.

Veins or dykes of pegmatite (a rock having feldspar as its main constituent) are of common occurrence throughout large areas in both Ontario and Quebec, and have in some instances been mined for the mica which they often carry. These deposits vary in width from mere stringers of a few inches to massive bodies of over a hundred feet. Such deposits, while, at the present time, often too remotely situated, or containing too many impurities in the way of accessory minerals to allow of the feldspar being employed for pottery purposes without considerable expensive cleaning, constitute large reserves of the mineral, which may ultimately prove of value as a source of potash or for other purposes.

The addition of trass slightly retards the setting of mortars and concretes, increases their resistance to water, greatly increases the strength of mixtures gauged with lime-water, and decreases the detrimental effect of soap solution. Lime-water increases the strength of trass mortars, but has no influence on the strength and water-tightness of mixtures which do not contain trass. Soap solution renders mortars and concretes water-tight and diminishes the hardening of mortars without trass, which weakening effect is counteracted by the addition of trass .

Scientific methods are giving great exactness to processes for hardening valuable tools and drills. Uniform and easily controlled heating is necessary, and this is easily obtainable with the electric furnace. A special form recommended has a crucible 8 ins. square and 12 ins. deep, lined with firebrick surrounded by heat-insulating material in a sheet-iron case. This crucible contains the heating bath, the temperature of which is regulated by a transformer for varying the voltage, and a pyrometer gives quick and accurate determinations of the degree reached. The bath varies with the temperature required. A mixture of barium chloride and potassium chloride is used for hardening carbon steel, at 750 deg. to 1,000 deg. C., the proportion of barium chloride increasing with rise in temperature, and this salt alone being advised for high-speed steel, at temperatures up to 1,300 deg. The crust of salt which adheres to the tool, preventing oxidation, falls off in the cooling liquid.

COAST TO COAST.

Niagara Falls, Ont.—The Ontario Power Company is seeking permission from the Queen Victoria Niagara Falls Park Commission to construct a third pipe line from its gate house on the upper river to its power house below the Horseshoe Falls. At present the company have two pipe lines, one of steel, which has been in use since the power house was put in operation, the other of concrete which was installed two years ago. Through these the company is diverting about 8,000 cubic feet of water per second, which is approximately two-thirds the amount of water permitted to its use under the provisions of the international treaty. By this amount of water, twelve units in the power house are operated, each generating 1,400 electrical horsepower. Providing the water is increased, the company propose enlarging their battery to 14 units; and where now only 130,000 horsepower can be developed by the plant, the company will be able to transmit 196,000 horsepower. The patents of R. O. Blainey, who assisted in the construction of the second pipe line, for a continuous concrete pipe are being investigated by power company officials, and should they be approved, it is possible that a monolithic pipe, which is the first of its kind in the world, will be constructed.

Hamilton, Ont.—An industry has been secured for Hamilton which gives much promise towards the further expansion of the city and the location of more industries at this centre. It is announced that the Hamilton By-Product Coke Ovens, Limited, has been incorporated at a capitalization of 1,000,000 dollars. The purpose of the company, primarily, is to manufacture coke for smelting and foundry usage in Hamilton and Central Ontario, and also for domestic and minor industrial supply. In addition, the plant will provide a permanent supply of gas of high candlepower and of a very high heat value, which will be of great value in the event of the depletion of the natural gas wells of Haldimand county and its vicinity.

Halifax, N.S.—Considerable discussion is being given to the question of ornamental street lighting in Halifax. The City Improvement League have been bestowing their efforts to bring to the citizens the best opinion of experts on the subject. Recently, at the request of this body, Mr. F. H. Winckly, of Lynn, Mass., an authority on street illumination, gave an address in which he sketched its history from the age of streets clothed in darkness to the present of the "Great White Way."

Montreal, Que.—A new work, which is occupying the attention of the Harbor commissioners at present, is the wharf being constructed by the Canada Cement Company at Point aux Trembles. It is of cement, and will be, when completed, about 600 feet in length.

Montreal, Que.—The end of this season will see unfinished little, if any, of the program of harbor works published at its beginning. The additions to grain elevator No. I., have already attained a height of about 135 feet from the level of the wharf. Concrete bins, 52 in number, have been constructed with a capacity in totum of over a million bushels, the largest to hold upwards of 21,000 bushels, the smaller, from 3,000 to 8,000 bushels.

Port Colborne, Ont.—Inaugural ceremonies, attended the opening of the new plant of the Canadian Furnace Company, Limited, at Port Colborne. It is the most modern of its kind in the world, and has been constructed at a cost of seven million dollars. Miss Theresa Yates, daughter of the vice-president of the Buffalo Union Furnace Company, owners of the Port Colborne plant, applied the torch that lighted the furnace; and William Weller, Esq., Superintendent of Canals for the Dominion of Canada, sounded the whistle of the plant for the first time. The signal was thus given for an answering medley of shrieks from all craft in the town harbor, from the company's locomotives, and from neighbouring factories. Mr. Frederic Nichols of Toronto, president of the Canadian General Electric Company and Mr. R. S. Logan, vice-president of the Grand Trunk Company, responded to toasts; while Mr. E. H. Butler of Buffalo, commended highly the Canadian enterprise and spirit of co-operation which, he declared, is responsible for Canada's rapid development, commercially, agriculturally, and industrially.

Toronto, Ont.—Commendable progress is being made on the power transmission equipment for Eastern Ontario by the Hydro-Electric Power Commission. Plans are deposited with the department of public works for approval of an arrangement for towers and cables across the St. Lawrence River at Morrisburg. The Commission has secured an option of 1,500 horsepower from the New York and Ontario Power Company at Waddington, N.Y., and are awaiting the partial completion of the plant to import a portion of this power to Canada. Until the new plant is entirely complete, the heavy exportation cannot commence. The Canadian line from Morrisburg to Prescott is finished, and it is expected that the line from Winchesteville, Chesterville, and Russell, will be in readiness in a short time.

Regina, Sask.—The Regina Municipal Street Railway showed a deficit of $42,868.11 for the eight months ending August 31, after provision for capital charges had been made.

Ottawa, Ont.—The greatest area under wireless contract in the world, a distance of 2,000 miles will soon be completed in Canada. With the completion of stations at Port Burwell, Toronto and Kingston, a complete chain will extend from Port Arthur, through the Great Lakes, and along the St. Lawrence to Cape Race.

Vancouver, B.C.—The wiring inspector of Burnaby, Mr. Burns, has been experimenting for some time on a power switchboard for the municipal service. It is not yet complete, but is in use and is found to act very successfully. The features of the board are the means of taking the electric light current, transforming it and charging the storage batteries used in the phone service. Another thing that is said not to be in general use in telephone work except in large installations, is the construction of an artificial line, by which by the principle of the Wheatstone Bridge method of testing wires, it will be possible, in the event of trouble occurring on any line, to measure its exact distance from the municipal hall, and also to determine the nature of the trouble, thereby saving time and unnecessary work. Another outstanding feature of the board is a bank of switches the purpose of which is the coupling together of the storage batteries; and any particular cell may, by means of the switches, be disconnected from the service for charging, repair, or any other purpose. It is also the intention of putting on the board, all repeating coils, induction coils, condensers and other apparatus, so that they will be under observation at all times. The keener protective devices are also on the board, their purpose being to take the first effect of any abnormal currents that come over the system. Coupling and disconnecting switches, by which any particular line may be disconnected for repairing, testing, or other purpose, are also on the board. The use of the board is expected to obviate a great amount of trouble in connection with the working of the municipal telephone system.

Fort William, Ont.—It is probably not generally known that the grain storage elevator capacity of Fort William-Port Arthur has now reached the enormous amount of 41,035,000

bushels, and ranks second among the cities of the world as a grain storing centre, exceeded only by Chicago, Ill., with elevator capacity of 45,300,000. With the additional elevators now under construction and others projected at the Canadian head of the Lakes, it will only be a matter of 12 or 18 months before Fort William-Port Arthur will have the distinction of being the largest elevator storage centre in the world.

Rainy Lake, Ont.—Midway between Port Arthur and Winnipeg, the C.N.R. has been effecting an engineering achievement of no ordinary value. A bridge of solid rock, a great double track causeway of granite almost three miles long and costing approximately one million dollars per mile, will span the Rainy Lake in a not distant future. The contracts were let early in the summer of 1910 and preparations for the work were begun; yet the great task has been conducted so quietly that few people in Canada have been aware of the magnificent and unordinary construction.

Kingston, Ont.—Now that the Hon. Adam Beck is free to further the distribution of power throughout eastern Ontario, Kingston is feeling the cry of need of several of its industries for cheap power to insure their future expansion, and is agitating that arrangements for supply be concluded with the Hydro-Electric Commission.

St. Catharines, Ont.—St. Catharines is struggling with natural barriers towards progress similar to those encountered by Toronto in its primal growth. The Welland Canal and some creeks running through the west and south are preventing expansion in somewhat the same manner as did Garrison Creek and the Rosedale and Don ravines in Toronto. Toronto has now her Riverdale and Rosedale bridges, but St. Catharines is still struggling with her bridge problems.

Edmonton, Alta.—Mr. A. T. Fraser, District Engineer for the C.N.R., is of the opinion that steel on the Canadian Northern main line should reach the summit at the boundary of Alberta and British Columbia about the end of October. On the Brazean branch, construction is very difficult, owing to the great amount of trestling to be done. Steel is within 30 miles of the Brazean coal fields, but it will be December before the line is connected with the colleries. The Peace River branch west of the McLeod River is being graded.

Telkwa, B.C.—Men who went south from here over a week ago to investigate the discovery of placer gold, reported by Price, Ecksley and Pearson, have returned to Telkwa satisfied with the richness of the field. The men who have returned, Colin Munro, Ira McLean and King, state that in no instance where panning operations have been carried on by men on the ground has a single barren pan been found. All showed coarse gold in varying quantities. The new find is on Sibbola Creek, one of the tributories of Tahtsa River, about 110 miles in a south-easterly direction from Telkwa, and about 50 miles from the headwaters of Kemano River, which empties into Gardner Channel. The men who have gone in from here have taken the Morrice River trail. It is hardly necessary to state that the stampede is on in full blast in this locality. In fact, construction work on the G.T.P. may be seriously impeded, as five thousand men are now employed within a radius of 125 miles of the new find. The field can be reached from the outside by boat up Gardner's Channel, thence up the Kemano River, but there is a most difficult country to traverse for over 50 miles. Outside expeditions would have to carry all supplies from the point of embarking. The lack of provisions for men in the field is causing not a little anxiety here, as every pack horse is on the trail coming out.

Montreal, Que.—Many prominent officials of the C.P.R. and Dominion Bridge Companies were present when a made-to-order steel bridge, weighing 2,600,000 pounds was swung across a 270-foot gap in one hour and 25 minutes, a feat accomplished by the Dominion Bridge Co., when placing the third of the four great spans, each 400 feet in length, of the Lachine bridge. The Gazette says in regard to this piece of bridge engineering:—"The admirable manner in which all these great spans have been raised to position, while the regular traffic continued, marks a triumph of engineering. Indeed, the whole double-tracking of the bridge has been accomplished while every train ran on schedule time."

Brighton, Ont.—Water was turned on last week in the new system of supply that has just been completed by J. G. Mill, contractor, Toronto. The water, obtained from Spring Valley, is very pure. The springs have a daily capacity of 700,000 gallons. The water is distributed by gravity, having a two hundred foot head two miles from town. Consulting engineer, T. Aird Murray, Toronto, made a test of the system, which showed 86 pounds pressure on the main street with 100 pounds as the best, and 70 pounds as the worst, pressure throughout the entire town. A reservoir has been constructed in Spring Valley providing storage sufficient to supply six lines of fire hose continuously for twenty-four hours, as well as to accommodate the town's domestic requirements. Brighton, which has a population of 1,600, has not previously had a public water supply.

Vancouver, B.C.—The directors of the Burrard Inlet Tunnel and Bridge Company have decided not to take any action with regard to the Second Narrows bridge project until a definite reply as to the Provincial Government's intentions has been received. The provincial authorities have been asked by the bridge company to assume control of the scheme for spanning Burrard Inlet, and an answer is expected from the British Columbia government within a month when the premier shall have returned from England. Concerning the subsidies sought by the company from the Dominion Government, rumors at Ottawa that the Second Narrows bridge project had been abandoned, have delayed the efforts of the company's agents at the capital; but the president and secretary have denied the reports, and have explained that the company has asked the province to assume control of the enterprise.

Victoria, B.C.—The growth in the establishment of private wireless stations by commercial firms throughout British Columbia has been commented upon by Mr. E. J. Haughton, district superintendent of the Dominion Radio-Telegraph service. In addition to five private installations in Vancouver and twelve in Victoria, which are, for the most part, used by students engaged in the scientific study of radio-telegraphy, there is one firm operating its own plant and sending all its messages to the nearest Government station. The Canadian Explosives Company, on Bowen Island, keeps an operator on duty during working hours, while a high power plant at Cousins Inlet, operated by the Cousins Inlet Pulp Company, transmitted messages to the Government station at Triangle Island until recently. This equipment was of five kilowatt power, owing to the fact that the factory was surrounded by hills, which interfere with wave transmission. Plants have also been proposed for the B.C. Fisheries Company on Queen Charlotte Islands and the Powell River Pulp Company, which, if put into operation, would transmit messages with Alert Bay and Cape Lazo stations respectively. In addition to these wireless plants, a telephone line is now in operation between Suquash Mines and the Government station at Alert Bay, while a second line to transmit telegraph and telephone messages is now under construction between Masset and Dead Tree Point.

Guelph, Ont.—The Ontario Municipal Electric Union carried unanimously the following resolution by the meeting of its representative held recently in the Guelph city hall:—

"In view of the comprehensive scheme outlined by the Dominion Government for the creation and improving of waterways in connection with the St. Lawrence River, Welland Canal, French River, Sault Ste. Marie, Trent, Ottawa and others involving the large expenditure of public money, and in view of the extensive developments which are possible in consequence thereof, also in view of the power requirements of the province, be it resolved that this association request the Dominion Government to put such water powers under the jurisdiction of the Hydro-Electric Power Commission of Ontario, to be developed by them for the use of the municipalities of the province for the benefit of the people." This step was taken to forestall any action on the part of the Government to hand over the control of such a valuable asset to a private corporation.

Spokane, Wash.—The Pacific Logging Congress, held at Spokane, in the latter part of September, announced that the association will make an endowment of $600,000 for instruction in logging engineering in five state universities and in a university in British Columbia.

Montreal, Que.—This year the city of Montreal has carried out a scheme of work and repair on its pavements and sidewalks unprecedented in extent and thoroughness. Mr. G. B. Garneau, superintendent of repairs, gave the following report to the city's board of control:—"In the three divisions of the city, 54,500 square yards of asphalt and 24,000 yards of granite and scoria blocks, a total of 78,880 yards, were repaired this year. In the same three divisions, 13,000 yards of cement sidewalks, 13,000 yards of asphalt sidewalks, and 13,500 yards of stone flag sidewalks were repaired. In addition must be counted repairs to cuts in the pavement. In the eastern division the following cuts were patched up:—5,250 yards of asphalt and 200 yards of granite and scoria block pavements; 625 yards of asphalt, and 150 yards of cement sidewalks."

PERSONAL.

JORO NAGATO, mechanical engineer, is in Canada as a representative of the Japanese Government, to study recent discoveries and developments in mechanical constructions. All the larger cities of the Dominion will be visited.

F. J. HERLIHY has been appointed supervising engineer of the Montreal aqueduct. Mr. Herlihy comes from Great Falls, Mont., where he was in charge of bridge and building construction for the Great Falls-Lewiston division of the Milwaukee line.

MR. W. B. GAIR, director of the Great Central Railway, England, has reached Canada after an extended trip over several of the important American roads. Mr. Gair is accompanied by several engineers, their object being the study of transportation methods in America. They will travel for some distance over the G.T.R. and C.P.R. to further their researches in respect to the Canadian procedure in the handling of frieght and of passengers.

GUY H. MORTON, B.A.Sc., manager of the Calgary office of the Canadian Westinghouse Company, has been appointed lecturer in electrotechnics by the technical education committee of the Calgary Board of Education. Mr. Morton is a graduate of four years' standing of the University of Toronto. CARL STERNBERG, a graduate in electrical engineering, of the University of Minnesota, is in charge of laboratory work.

A. D. CREER, M.Can.Soc. C.E., A.M.I.C.E., who has been in charge of the investigations and reports of the greater Vancouver sewerage scheme, with R. S. Lea of Montreal as consulting engineer, is now engineer to the recently-formed Burrard Peninsula Joint Sewerage Board. Mr. Creer has specialized in hydraulic work and previous to his coming to this country, some three years ago, he was for 13 years on the staff of the late James Munsergh, F.R.S., past president Inst. C.E.

OBITUARY.

A. L. ADAMS, a prominent engineer of San Francisco, Cal., died at his home a few weeks ago. Mr. Adams was well known in Victoria, B.C., where he made several reports in connection with the city's waterworks system.

THE REGINA ENGINEERING SOCIETY.

The first meeting for the season of the Regina Engineering Society, took the form of a banquet at the Hotel Metropole, Regina. The speakers included Lieut.-Gov. Brown, Hon. J. A. Calder, Mayor Martin, J. F. Bole, A. J. McPherson, R. O. Wynne-Roberts, A. P. Linton, L. S. Cockburn and O. W. Smith.

THE CANADIAN RAILWAY CLUB.

The October meeting of the Canadian Railway Club will be held at the Windsor Hotel, Montreal, October 14th. Mr. R. F. Uniacke, Bridge Engineer, National Transcontinental Railway, will deliver an illustrated lecture bearing upon engineering problems encountered in the construction of the N.T.R.

COMING MEETINGS.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth annual meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

RAILWAY SIGNAL ASSOCIATION.—Annual meeting will be held at Nashville, Tenn., October 14th to 16th. Secretary, C. C. Rosenberg, Times Building, Bethlehem, Penn.

NATIONAL SOCIETY FOR PROMOTION OF INDUSTRIAL EDUCATION.—Annual convention to be held at Grand Rapids, Mich., October 19th to 25th. Secretary, C. A. Prosser, 105 E. 22nd Street, New York City.

AMERICAN MINING CONGRESS.—Annual convention will be held at Philadelphia, Pa., October 20th to 25th. Secretary, J. Callbreath, Majestic Building, Denver, Colo.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—Annual convention will be held at Montreal, Que., October 21st to 23rd. Secretary, C. A. Lichty, 319 N. Waller Avenue, Chicago, Ill.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20385—September 22—Authorizing C.P.R. to construct a switching lead across Lots 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26 and 27 northerly of Vine St., Toronto, Ont.

20386—September 23—Authorizing C.P.R. to operate its trains over seventeen (17) bridges, Lake Superior Div.

20387—September 22—Extending, until November 30th, 1913, time within which C.P.R. install gates at Osler Ave., North Toronto; pending installation, crossing be protected by day and night watchmen employed and paid by railway company.

20388—September 22—Authorizing C.P.R. to construct spurs for Dominion Bridge Co., Limited, on Saskatchewan Ave., Winnipeg, Man., subject to and upon certain conditions.

20389—September 22—Authorizing C.P.R. to construct road diversion in Sec. 15-18-15, W. 2 M., said road diversion to cross proposed double tracks of company's main line at Station 877, Moose Jaw Subdivision, Sask.

20390—September 24—Authorizing C.P.R. to open for traffic portion of new second track from Iberville Jct., to Iberville Station, mileage 18.7 to mileage 19.2, Quebec.

20391—September 23—Approving and authorizing clearances, as shown on C.P.R. plans, of new train shed at Windsor St., in city of Montreal, Que.

20392—September 22—Authorizing Dominion Atlantic Ry. Co., to construct North Mountain Ry. Branch across Burgess Road, Grafton Road and Chute Road, between Centreville and Weston, N.S.; and rescinding authority granted under Order No. 16582, dated May 22nd, 1912, to cross said road.

20393—September 23—Amending Order No. 20075, dated August 15th, 1913, by adding following words—namely, "the said crossing to be used for construction purposes only and not for the operation of trains after the road is opened for traffic."

20394—September 23—Approving, subject to certain conditions, plan dated September 18th, 1913, showing proposed changes in Algoma Steel Corporation, Limited's power canal at Sault Ste. Marie, where it crosses bridge of C.P.R., at mileage 181.49, Lake Superior Div., Algoma Subdivision.

20395—September 24—Authorizing Lake Erie and Northern Ry. Co., to use, pending installation of interlocking plant required under Order No. 19248, dated June 4th, 1913, the crossing of Grand Valley Ry. at Station 1059.06, for construction purposes only; applicant's trains and cars of Grand Valley Ry. to be flagged over crossing by signalmen provided at cost of applicant company.

20396—September 24—Authorizing C.P.R. to open for traffic portion of its Estevan North West Branch from Estevan, mileage 0.00 to Neptune, near mileage 54.0; provided speed of trains over said portion of railway be limited to a rate not exceeding twenty (20) miles an hour.

20397—September 22—Directing C.P.R. cause its Western Official, or officials, to issue a circular to company's employees, similar in terms to Circular No. 34, issued by Eastern Officials of company and applying to eastern lines.

20398—September 24—Authorizing C.P.R. open for traffic portion of its double track between Roberts and Ramsay, mileages 60 to 70.9, Chapleau Subdivision, Lake Superior Div.

20399—September 24—Authorizing Algoma Central and Hudson Bay Ry., to use overhead bridge between Cathcart St. and Wilde Ave., Tagona, in municipality of Steelton, Ontario.

20400—September 23—Approving revised location G.T.P. Ry. Co.'s main line, through Lot 2012-A, mileage 360, east of Prince Rupert, Rge. 5, Coast District, B.C.

20401—September 23—Authorizing G.T.R. to use subway carrying Coxwell Ave., Toronto, Ont., underneath tracks of applicant company.

20402—September 24—Authorizing Board of Highway Commissioners for Sask., at its own expense, to construct highway over G.T.P. Ry., in N.E. ¼ Sec. 18-14-18, W. 2 M.

20403—September 24—Authorizing C.P.R., to construct spur into premises of J. B. Tudhope and R. A. Carman, situated on Lots 31 to 40 inclusive, Block 200; and to change location of siding already constructed for International Harvester Co., of America, in said Block 200, city of, Regina, Sask.

20404—September 24—Approving location C.P.R. stations at Strathmead, N.E. ¼ Sec. 14-22-27, W. 4 M., and at Strangmuir, S.W. ¼ Sec. 23-22-25, W. 4 M., Alberta.

20405—September 24—Approving C.L.O. and W. Ry. plan showing general layout and masonry details at Bridge No. 87.14 over Sidney St., town of Trenton, Ont.

20406—September 24—Authorizing C.N.R., to construct, subject to terms of consent of village of Findlater, branch line to gravel deposit on S.W. ¼ Sec. 22-21-25, W. 2 M., near Findlater, Sask., and cross surveyed road between stations 21.66 and 22.33.

20407—September 23—Directing that Kettle Valley Ry. Co., provide and construct two farm crossings where is crosses farm of M. W. Smith, Beaverdell, B.C., one near Eastern Boundary of his property at station 1422-50, and one near Western Boundary of farm at station 1451-80.

20408—September 24—Permitting N.Y.C. & H.R.R. Co., operating in Canada the O. & N.Y. and the St. Lawrence and Adirondack Rlys., to use on its locomotive engines wire mesh netting with openings 3/16-in. in width and ¾-in. in length, made of wire not less than .135-in. in diameter, in lieu of requirements with respect to wire mesh netting contained in General Order No. 107.

20409—September 24—Authorizing C.P.R. to take certain lands for purposes of completing diversion of Nine Mile Road, in Lots 6 and 7, Con. 9, Tp. South Gower, Co. Grenville, Ont., as provided by Orders Nos. 18958 and 20267, dated respectively April 1st, and September 4th, 1913.

20410—September 25—Authorizing C.P.R. to construct passing track across road allowance between S.W. ¼ Sec. 27, and S.E. ¼ Sec. 28-16-25, W. 2 M., Saskatchewan.

20411—September 23—Directing that within ninety days from date of this Order, C.L.O. & W. Ry. (C.P.R.), and G.T.R. each install an improved type of automatic electric bell at crossing of road allowance between Lots 16 and 17, Con. "A", Tp. Haldimand, Co. Northumberland, Ont. Each company to maintain its own bell.

20412—September 25—Relieving C.P.R. from providing further protection at crossing of highway at west end of platform at Moffatt Station, between Lots 15 and 16, Con. 2, Tp. Nassawagaweya, Co. Halton, Ontario.

20413—September 24—Amending Order No. 18761, dated February 20th, 1913, to provide that C.L.O. & W. (C.P.R.) build only that portion of diversion north of south boundary of its right-of-way; amending Order No. 19381, to provide that C.N.O.R. construct that portion of diversion south of C.L.O. & W. Ry. right-of-way. And that revised plan and profiles of C.N.O.R. dated Toronto, August 13th, 1913, drawing No. 8566, showing road crossing and proposed diversion of public road between Lots 12 and 13, Con. 4, Tp. Scarboro, be approved.

20414—September 25—Establishing delivery limits of Dominion Express Co., in town of Bassano, Alta.

20415—September 24—Rescinding Order No. 20246, dated August 30th, 1913, suspending, for a period of 30 days from date of Order, effective date of advanced rates in Supplement No. 24 to Tariff C.R.C. No. W-1713, filed by C.P.R.

20416—September 25—Authorizing Algoma Central and Hudson Bay Ry. Co., to open for traffic main line from mileage 30.08 (Franz), to mileage 81 (Oba), Ontario.

20417—September 25—Authorizing Algoma Eastern Ry. to open for traffic main line from mileage 60.76, (West River), to mileage 80.49, (Goat Island), Ontario.

20418—September 25—Authorizing C.N.R. to construct across seven (7) highways on Alsask Southeasterly line, Sask.

20419—September 25—Approving proposed revision of grade on C.N.O.R. Montreal-Hawkesbury Line from mileage 46.69 to mileage 48.62 from Hawkesbury, Tp. Cartierville, Co. Jacques Cartier, Que.

20420—September 25—Authorizing G.T.R. to construct siding across Wellington St., city of Berlin, Ont.

20421—September 25—Authorizing G.T.P. Branch Lines Co., to construct spur for International Harvester Co., of Canada, Limited, turning out from its Yorkton Branch in a northerly direction, across Broadway, in Sec. 35-25-4, and Sec. 2-26-4, W. 2 M., town of Yorkton, Sask.

20422—September 25—Approving amended location of station of G.T.P. Ry. at McBride, mileage 1134.2, Lot 5316, Cariboo District, B.C.; and rescinding approval of said station under Item 1 in Order of Board No. 19643, dated June 16th, 1913.

20423—September 25—Granting leave to corporation of city of Ottawa to construct bridge and concrete sewer across lands of C.P.R., comprising Broad St. yard of company, and under company's tracks and rails situate in said yard. Work on C.P.R. property be done under supervision of an Inspector or Engineer appointed by Ry. Co. City indemnify Ry. Co. against any loss or damage it may suffer by reason of construction of said sewer.

20424—September 25—Approving Michigan Central R.R. plan showing bridge No. 27.74 proposed to be constructed over the Alexander Drain, between Comber and Ruscomb, Ontario.

20425—September 25—Approving location C.P.R. station in Lot 17, Con. 7, Tp. Mara, Co. Ontario, Ont., at Schepler, at mileage 51.4 on Fort McNicoll Subdivision, Ontario Div.

20426—September 25—Authorizing G.T.R. to construct siding into premises of S. L. Lambert, town of Welland, Ont.

20427—September 26—Authorizing C.P.R. to construct two tracks of a wye, at Balgonie, Sask., across highway adjoining the southern boundary of company's main line right-of-way in Sec. 3-18-17, W. 2 M.

20428—September 18—Authorizing city of Toronto to reconstruct Gerrard Street Bridge over tracks of C.P., G.T., and C.N.O.R. Cos., and the Toronto Industrial Siding.

20429—September 24—Authorizing Bell Telephone Co., of Canada, to construct, for purpose of operating its telephone service, pole sand wires upon, along, across, or under highway, in city of Montreal, known as De Biencourt St., on north side, from Boulevard Monk to Raxilly St., Emard Ward.

20430—September 27—Approving revised location C.L.O. & W. Ry. (C.P.R.) until Nov. 1st, 1913, to enable Ry. Co., to remove sheds owned by Crossen Car Co., after which date proposed revision be abandoned and Ry. Co., revert to its location approved April 14, 1913. 2. Authorizing C.L.O. & W. Ry. to cross east leg of G.T.R. Co.'s "Y": crossing to be protected by a watchman appointed and maintained by and at the expense of Applicant Company; and 3. C.L.O. & W. Ry. submit new plans for approval, showing land required to be taken from G.T.R.

20431—September 26—Approving revised location G.T.P. Branch Lines Co.'s Brandon Branch in Secs. 4 and 5-12-15, W. 1 M., mileage 0 to mileage 0.46, Dist. Brandon, Man. 2. Authorizing Co. to construct said Brandon Branch, as revised, across Government Road Allowance between Secs. 4 and 5-12-15, W. 1 M. And 3, Authorizing Company to construct and operate junction between its Brandon Branch and G.T.P. Ry. Co.'s main line, in Sec. 4-12-15, W. 1 M., Manitoba.

20432—September 26—Authorizing G.T.P. Branch Lines Co. to carry traffic over portion of Tofield-Calgary Branch from mileage 107.7 to mileage 20.15 (Calgary), subject to following conditions:—1. Crossing of highway at mileage 107.8 be protected by an electric bell, and that, pending installation of said bell, all trains running in either direction be brought to full stop seventy-five feet from crossing and proceed over crossing under control, prepared to stop at any moment. 2. That temporary station or platform be provided on said line, at Calgary, before operating said line, and 3, speed of trains be limited to a rate not exceeding ten miles an hour through thickly settled portions within limits of city of Calgary.

20433—September 26—Authorizing G.T.R. to construct sidings into premises of Otis-Fensom Elevator Co., Limited, Hamilton, Ont.

20434—September 26—Authorizing C.N.O.R. to construct across public road in Lot 7, Con. "A," Tp. Etobicoke, Co. York, Ont.; said public road to be connected with Islington Ave., north of C.N.O.R. tracks.

20435—September 26—Approving location Moncton and Northumberland Strait R. from Richibucto to Buctouche, N.B., a distance of nineteen (19) miles.

20436—September 27—Authorizing C.P.R. to construct Forsyth St. Branch across Montreal Tramways Co. on Davidson St., Montreal, P.Q., mileage 0.42. Provided Mont. Tramways Co. change location of tracks at point of crossing, to provide safe clearance between sides of cars and vertical support of overhead structure; cost to be borne by C.P.R.

20437—September 23—Authorizing Corporation of city of Toronto, to construct viaduct carrying Bloor Street across property of C.P.R., C.N.O.R., and G.T.R., to connect existing highway with Danforth Ave., east of River Don, subject to conditions that piers shown on said plans be moved 45 feet to the east, and providing there be room between river and pier D when so moved to enable C.N.R. to place tracks.

20438—September 24—Extending free collection and delivery area, in town of Walkerville, Ont., prescribed by Order No. 19534, dated June 9th, 1913, by inserting following paragraph between second and third paragraphs of mandatory portion of said Order, namely; also, in St. Luke Road from Edna St. southward to and including plant of Tate Electric Company.

20439—September 26—Authorizing Montreal and Southern Counties Ry., subject to terms and conditions of agreement, to run and operate its trains and cars, with passengers, baggage, express, and other traffic carried thereon, over and upon line of railway of Central Vermont Ry. Co., between Richelieu and Marieville, Que.; and to use Central Vermont Ry. Co.'s passenger and freight stations, station yards, and other facilities at and between said points.

20440—September 27—Authorizing C.P.R. to construct bridge No. 75.6 on Havelock Subdivision, Ont. Division.

20441—September 27—Approving, temporarily, G.T.P. Ry Standard Freight Mileage Tariff, C.R.C. No. 19, incorporating and superseding C.R.C. No. 17 by extension of mileage thereof, to apply between stations in British Columbia, Prince Rupert, to Siding No. 9, mile 301, inc., pending judgment in inquiry into rates charged generally by Ry. Cos. in B.C.; said tariff, with copy of this Order, be published in at least two consecutive weekly issues of "The Canada Gazette."

20442—September 26—Approving location C.P.R. station at Regent, on its Boissevain-Lauder Branch, Manitoba.

20443—September 30—Extending until April 30th, 1914, time within which C.P.R. complete branch lines for P. Burns and Company, Limited, Calgary, Alta., authorized under Order No. 19761, dated July 5th, 1913.

20444—September 30—Approving location C.P.R. station at Foremost, Alta., on its Weyburn-Stirling Branch, on centre line of North and South road allowance, between Secs. 16 and 17-6-11, W. 4 M.

20445—September 29—Directing that C.P.R. fence its right-of-way from mileage 91.3 to mileage 91.8, north of Rutter Station, on both sides of track; and from mileage 89.8 to 89.3, south of Rutter Station, on west side of track only.

20446—September 30—Authorizing C.P.R. to construct a diversion of the road allowance in Sec. 7-22-25, W. 4 M., Alta. Also authorizing company to construct, by means of grade crossing, its Gleichen-Shepard Branch Line across said diversion at mileage 19.00 of said branch. After diversion is made and crossing constructed thereon, in accordance with Regulations of Board, company may close that portion of road allowance between Sec. 7-22-25, and Sec. 12-22-26, W. 4 M., to be diverted as aforesaid, within limits of its right-of-way.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+ —Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Cap Chat, Que., training pier	Oct. 22.	Oct. 2.	80
Fraser River, B.C., wing dam	Oct. 21.	Oct. 2.	80
Halifax, N.S., railway terminals	Oct. 15.	Sept. 18.	88
Halifax, N.S., Lennox Passage bridge	Oct. 11.	Oct. 2.	78
Halifax, N.S., quay wall, &c.	Oct. 15.	Oct. 2.	80
Kingston, Ont., rifle range	Oct. 11.	Oct. 2.	86
Little Dipper Harbor, N.B., breakwater	Oct. 15.	Sept. 25.	80
Mace's Bay, N.B., breakwater	Oct. 14.	Sept. 25.	80
Newcastle, Ont., repairs to pier	Oct. 15.	Sept. 25.	80
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Poupore, Que., training pier, &c.	Oct. 27.	Oct. 2.	80
Roy's Beach, B.C., wharf	Oct. 9.	Sept. 25.	82
Regina, Sask., power house equipment	Oct. 25.	Sept. 11.	86
Ste. Anne de Monts, Que., wharf.	Oct. 22.	Oct. 2.	80
Summerland, B.C., wharf	Oct. 31.	Oct. 2.	82
Taghun, B.C., bridge	Oct. 14.	Sept. 18.	78
Welland, Ont., section No. 2, ship canal	Oct 15.	Sept. 25.	86
Wellington, Ont., harbor improvements	Oct. 29.	Oct. 2.	88

RAILWAYS—STEAM AND ELECTRIC.

Brandon, Man.—Mr. Gibson of the Grand Trunk Pacific, has stated that, in spite of rumors to the contrary, the company has received a special grant from both the provincial and Dominion Governments to build its line into Brandon, and that, though at present there is a delay caused by certain property owners, the line will be constructed eventually to come into the city.

Cardston, Alta.—Considerable satisfaction is being expressed by those who will be benefited by another line announced by the G.T.P., to run through the Pas to the Western Coast. The country is an important one financially for railways and the building of the new line, which will run westward from Medicine Hat and Lethbridge, will start early in the coming spring.

Edmonton, Alta.—Mr. H. D. Thompson, owner of Lot 96, Block 11, H.B.R., has asked permission from the city and railway commission board to have a spur track run down the lane to his building, which is erected on the above mentioned track.

Fredericton, N.B.—It is reported that favorable progress has been made with track laying on the Valley Railway, and that the first sixteen and a half miles to Kelly's Creek will be ready for the steel. This part of the work is being done by the Hibbard Construction Company. Messrs. Scott and Kelly, the local contractors, who have the Woodstock-Meductic section of the line, have their portion almost in readiness for steel. The Valley Railway will enter into an arrangement with the C.P.R. for the use of its trackage in Fredericton.

Montreal, Que.—The annual meeting of the shareholders of the Candian Pacific Railway Company ratified the proposals of the board of directors in the matter of building new connecting lines in the northwest aggregating about 750 miles, and including both a branch line running from a point near Swift Current on the Saskatchewan main line to Sedgewick, a distance of 290 miles, and the Weyburn branch line, a distance of 436 miles.

+—Montreal, Que.—The contract for the electrification of the Mount Royal tunnel has been awarded to the CANADIAN GENERAL ELECTRIC COMPANY. Particulars concerning the service which has been planned between Montreal and Mount Royal appear elsewhere in this issue.

Moose Jaw, Alta.—Permission has been granted the C.P.R. Company to lay spur tracks crossing Twentieth Avenue West, within 500 feet of its right of way, for the accommodation of the linseed oil plant.

Port Arthur, Ont.—An extension to the Port Arthur street car system is being constructed on Hodder Avenue. The roadbed is being made ready for the rails and ties are down on a portion of the way.

Port Arthur, Ont.—The C.N.R. are endeavoring to improve the condition on the Pee Dee railway. The road bed from Slate River as far as Silver Mountain is being newly ballasted and many new ties are being placed.

Regina, Sask.—The G.T.P. Railway Regina-Boundary line has been completed and connected with the Great Northern Railway. It is soon to be inspected by railway officials and Regina business men.

Vancouver, B.C.—In the opinion of Mr. R. N. Morrow, of Seattle a former resident of Vancouver and Victoria, a railway connecting Vancouver Island and the mainland will be a certainty in the next few years. The project would be one entailing an expenditure of millions of dollars, since it would mean the construction of a bridge several miles in length at a point on the Seymour Narrows where the separation between the island and mainland is least, where the water is shallow, and where there would be solid rock foundation. It would mean, moreover, one of the greatest of engineering feats in bridge building of modern times, but expert engineers in railway employ admit, that when the freight traffic demands this outlet and port of entry, this railway extension and bridge will be established.

GARBAGE, SEWAGE AND WATER.

Calgary, Alta.—The ratepayers have passed a by-law authorizing the expenditure of $63,140 for sewers for Ogden.

Calgary, Alta.—The Board of Control are of the opinion that when city pipe line carries Shoal Lake water into the corporation, there will be no more danger of shortage in water supply. From all indications the Shoal Lake district will furnish a water supply of great duration.

Fort William, Ont.—Tenders will be received up till October 10th, 1913, for tile sewer. Plans and specifications may be obtained from M. McCulloch, Fort William, Ont.

Kerrisdale, Point Grey, B.C.—In connection with the joint water main that is being constructed by Vancouver and Point Grey to supply water to the district from Capilano Creek, authority has been granted Engineer Cameron of Messrs. Cleveland and Cameron by the council, to sink one test bore in the bed of False Creek, in order to ascertain the nature of the foundation available for the water main.

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+—**Lindsay, Ont.**—The contract has been awarded GEO. H. LINDSAY by the town council for the construction of a sewer on Queen Street.

Mawer, Sask.—A flowing well has been discovered at the town of Mawer, about 90 miles from Regina, and at the end of the steel of the Grand Trunk Pacific Regina-Moose Jaw Northwestern branch. The town will construct a reservoir to hold the supply for its use. The water is soft and contains no trace of alkalinity.

Ottawa, Ont.—Sir Alexander Binnie's report on the Gatineau water supply scheme was handed to Mayor Ellis yesterday afternoon. City Engineer Currie also presented a report on the feasibility of using the Ottawa River water, with filtration. Both reports will be made public.

+—**Outremont, Que.**—The contract for the new sewer on Wiseman Avenue from Ducharme to the Canadian Pacific Railway tracks has been awarded TOWN ENGINEER DUCHASTEL, his estimate of $1,532 being the lowest offered.

Toronto, Ont.—Plans for one of the greatest public works undertaken in Toronto have been completed by the works department. Ninety miles of sewers are to be laid in the northern half of the city, including old North Toronto, Moore Park and Cedarvale, estimated at a cost of several million dollars. The scheme designed for the North Toronto section will be the most costly, involving an expenditure of at least between two and three million dollars. It provides for a system of storm sewers and domestic sewers that will be adequate for North Toronto when thickly settled. A domestic sewage system was installed in this section two years ago, but it is now inadequate and must be enlarged and extended, while a complete new system of storm sewers will have to be laid. It is proposed to construct first the Moore Park section at a cost for the eastern section of $88,000; for the western section, $460,000. A huge trunk sewer, seven feet in diameter, is to be built on Summerhill Avenue which will provide for the sewage of both Moore Park and Cedarvale. Waste matter will be carried down the Don Valley to Ashbridge's Bay.

Vancouver, B.C.—Financial arrangements are about completed by the Burrard Joint Sewage Commission, which will enable a start to be made on either the Clark Drive and Canoe Creek portions of the proposed trunk sewer system for Greater Vancouver. It is expected that tenders will be called for soon that the work may be begun without delay.

Vancouver, B.C.—With a view to settling the location of the Vancouver and Point Grey water main, City Engineer Fellowes is drawing up plans and specifications and giving an estimate of the cost of the route he proposes across False Creek to the Kitsilano reserve, while Municipal Engineer Cameron has been instructed to submit like plans and estimate for the route which be proposes from the end of Bute or Thurlow streets. These will be submitted to and passed upon by the civic water committee.

+—**Windsor, Ont.**—The contract has been awarded BENJAMIN OLDANI, of Windsor, and WALTER C. WIGLE, of Amherstburg, for the construction of the Long Marsh drain, to commence at the turnpike road in Malden and run into the Canard River in Alderdon, a distance of about eight miles. The tender accepted was $13.84 per rod, or $38,000 for the entire work.

+—**Winnipeg, Man.**—The contract has been awarded the DOMINION CONSTRUCTION COMPANY of Winnipeg, by the municipality of Kildonan, to construct a sewer on Oakview Ave. The contract price is $5,232.70.

Winnipeg, Man.—Ratepayers have unanimously endorsed the $13,500,000 by-law of the Greater Winnipeg water district. This means that work will be commenced at once on the Shoal Lake project.

LIGHT, HEAT AND POWER.

+—**Abitibi, Ont.**—The Abitibi Pulp and Paper Co., have given the CANADIAN GENERAL ELECTRIC CO., LIMITED, the contract for electric motors ranging from 400 horsepower downwards, and aggregating 2,165 horsepower for their new mills at Iroquois Falls, Ont.

+—**Donnaconna, Que.**—The Donnaconna Paper Co. has placed an order for electric motors ranging from 150 horsepower downwards, and aggregating 1,330 horsepower, with the CANADIAN GENERAL ELECTRIC CO., LIMITED.

Elko, B.C.—The work of piping the water of Silver Spring Lake for the use of Elko's waterworks system, has commenced. The water is to be delivered by the gravity supply system, and an initial outlay of $22,000 is contemplated. In the opinion of engineers, this will mean the establishment of many industries here to avail themselves of Elko's immense water power resources.

Estevan, Sask.—The by-laws, approximating almost $36,000, which provide for standard street lighting, extension to power plant and light service, and for sewer expansion, were passed by large majorities. Work is to be rushed, so that all improvements will be completed this fall.

+—**Hamilton, Ont.**—The contract for the Hughson Street sub-station electrical equipment was awarded by the Hamilton board of control to the WESTINGHOUSE COMPANY, the contract price being $17,000.

Medicine Hat, Alta.—Tenders for the installation of the third unit for the municipal power plant have been called, and must be in by October 10th. This unit is to be set in operation with the least possible delay, since the two units supplying the city's electric power are almost taxed to their capacity.

Moose Jaw, Sask.—The chairman of the Light and Power committee of the city council has stated that 63 new street lights are to be installed throughout the city.

Newmarket, Ont.—Considerable criticism is being heard in Newmarket concerning the delay in solving the problem of electric power. It will be remembered that the ratepayers voted down a contract made between the town council and the Toronto and York Radial Railway Company for the supply of power to the municipality.

Ottawa, Ont.—Tenders will be received up till October 8th for water supplies in three New Brunswick towns. Plans and specifications may be obtained from L. K. Jones, Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till October 16th, 1913, for the heating and ventilation of the post office building, Quebec, P.Q. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—The council for the village of Eastview has decided to install 18 new street lights in the municipality.

Regina, Sask.—The installation of an artificial gas plant is being agitated at Regina. At the commencement of the year the city council committed itself to the project by setting aside $25,000 to be used for laying gas mains at lane intersections of streets where pavement was being laid. It is believed now that a plant will be installed at the commencement of the coming year.

Regina, Sask.—To increase further the lighting of Regina streets is the aim of the business men and city council, but difficulty is being met in coming to a definite decision upon the system to be employed. Meetings are being held for the purpose of discussing the merits and demerits of arc lamps and the standard pillar tungsten system of lighting.

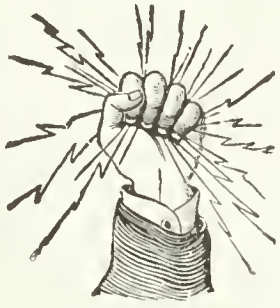
+—**Toronto, Ont.**—The contract has been awarded the CANADIAN GENERAL ELECTRIC CO., LIMITED, by the Hydro-Electric Power Commission of Ontario for six transformers, each 3,500 k.w., 46000/2300 volts.

+—**Vancouver, B.C.**—The Canadian Collieries, (Dunsmuir), Limited, have decided to install an extensive electric-driven pumping plant. There will be four separate units, two of which will be driven by 75 horsepower a. c. motors, a third by a 75 d. c. motor, each unit being capable of delivering 350 gallons per minute against a head of 370 feet. The fourth unit will consist of two pumps working in series which will deliver 350 gallons per minute against a head of 740 feet. The pump will be built by the CANADIAN ALLIS-CHALMERS, LIMITED, and the motors by the CANADIAN GENERAL ELECTRIC CO., LIMITED.

Winnipeg, Man.—Tenders will be received up till October 8th, 1913, for the supply and installation of the necessary apparatus for gas testing stations. Plans and specifications may be obtained from M. Peterson, Esq., Secretary, Board of Control, Winnipeg, Man.

Winnipeg, Man.—Tenders will be received up till October 13th, 1913, for the supply of carbon flame arc lighting equipment. Plans and specifications may be obtained from the City Light and Power Department. Signed, M. Peterson, Secretary, Board of Control, Winnipeg, Man.

PHILLIPS



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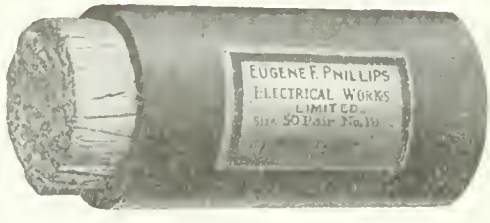

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BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—In view of the fact that the by-law for paving the Nose Creek Road has been defeated, the Commissioners have decided to gravel the road and roll it, making a sort of macadam, to serve the present needs of the city's sanitary department. The cost of carrying garbage to the Nose Creek incinerator on the heavy trucks and wagons of the department will be decreased by the improved condition of the road.

Fredericton, N.B.—The international commission, to which the United States referred the matter of spanning the St. John River with a railroad bridge, has reported to the secretary of war for the United States and, to the Minister of Public Works for the Dominion of Canada, favoring the building of the bridge to connect Van Bureu in Maine with St. Leonards in New Brunswick. The commission holds, moreover, that the construction of the bridge will not violate the terms of the treaty of 1842 between Great Britain and the United States.

+—Montreal, Que.—The contract has been awarded JOHN S. METCALF CO., LIMITED, constructing engineers, Montreal and Chicago, by the Canadian Pacific Railway Company for the extension of the Glen Arch at Westmount, Montreal, to provide for a width of four tracks at an estimated cost of $50,000.

Montreal, Que.—The Board of Control is already at work upon its program for next year's paving operations, and it is expected to amount in extent and cost to the work done on pavements this year, aggregating around 2,500,000 dollars of expenditure.

North Vancouver, B.C.—A road which will cost approximately $25,000 is to be constructed by the Provincial Government. It will be of macadam, and will run along the waterfront, thus providing a through road from the city to the district in the east on a low level, avoiding the steep grades which residents now have to ascend.

Saskatoon, Sask.—Good progress is reported upon the new bridge under construction here, and it is expected that all of the piers will be placed during the fall and winter.

+—Vancouver, B.C.—Arrangements have been made with the CANADIAN MINERAL RUBBER COMPANY for paving Gorge Road when they have completed the work on Douglas Street. As in the agreement for Douglas Street paving, the city will do the underground work, and the company the surface work. The work is to proceed without delay.

Victoria, B.C.—The plans for the C.N.P. railway bridge over Selkirk water have been filed. They call for a bridge of the Bascule type to be constructed with pile trestles 15 feet apart, with the exception of two openings of 60 feet and 25 feet respectively for the passage of boats. The clearance of the bridge above extreme low water will be 23 feet.

Winnipeg, Man.—A new system of roads giving the settlers on the east shore of Lake Manitoba access to railway lines and to the main north and south road, known as the Fairford Road, is now complete from Oak Point north to Fairford.

INDUSTRIAL WORKS.

Brantford, Ont.—The excavation work on the island above Lorne Bridge has been examined by an engineer of the Dominion Railway Board, and is reported as by no means finished. Four feet of excavation below the surface of the water is still to be made.

▲—Halifax, N.S.—Tenders will be received up till October 22nd, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations of buildings, sewers, dredging of harbor and filling reclaimed areas. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa. L. K. Jones, Assistant Deputy Minister and Secretary.

Medicine Hat, Alta.—The work of repairing the concrete floor of the new filtration plant, which was damaged some time ago by the buckling of a large water pipe which flooded and washed away the ground beneath the floor, allowing it to sag so that it cracked, is progressing slowly but surely. It has been necessary to break holes through the concrete floor to locate the course taken by the water, and this has taken considerable time. A special kind of pump has been installed with which concrete is being forced at a pressure of 100 pounds to the square inch into apertures to fill up the voids beneath the floor caused by the erosion of the water. The city engineer has no doubt but that the new filtration plant and power station will be in use this fall.

Montreal, Que.—Superintendent Lesage of the city waterworks, has announced that, in addition to the two new twelve-million gallon pumps which are being installed at the pumping station this autumn, the great increase in Montreal's water consumption has already made necessary the preparation of plans for two more pumps of the same capacity which are to be delivered next June.

Ottawa, Ont.—Tenders will be received up till October 15th, 1913, for the construction of breakwater at Little Dipper Harbor, N.B. Plans and specifications may be obtained from F. G. Goodspeed, Esq., District Engineer, St. John, N.B. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received up till October 29th, 1913, for the construction of a breakwater at Kincardine, Ont. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till October 27th, 1913, for the construction of a training pier and revetment wall at Poupore, Labelle Co., Que. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till October 28th for the construction of wharf improvements at St. Jean Port Joli, L'Islet Co., Que. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till October 29 for the construction of an extension to the wharf and dredging at Chocolate Cove, N.B. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till October 29th for harbor improvements at Thornbury, Grey County, Ont. Plans and specifications may be obtained from J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—The work on the St. Lawrence channel at the Traverse below Quebec has been completed. The result is that a widening of 250 feet with a depth of 30 feet at low water has eliminated one of the few remaining obstacles to easy navigation on the river.

Ottawa, Ont.—Tenders will be received up till October 15th, 1913, for the construction of a breakwater at Comeau's Cove, Digby Co., N.S. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Sault Ste. Marie, Ont.—A further step towards the improvement of navigation on Canada's inland waterway is shown in the announcement of the Hon. Mr. Cochrane, that land is being expropriated at the Soo for a new canal. To deepen the Welland Canal to 31 feet and to leave the Soo Canal at its present depth of 21 feet would be no gain to transportation.

Vancouver, B.C.—Mr. H. H. Stevens, M.P., has stated that the Dominion Government has completed arrangements for a dock on the Indian Reserve, north shore. This is a 500,000 dollar project, and the progress of plans now rests with the provincial government.

Vancouver, B.C.—Instructions have been put into operation for the widening of the First Narrows by a distance of 200 feet on the north side, and for increasing the depth 40 feet. Then the necessary slope will be cut for a water main pipe to run down and to have its skidway extended backwards for 400 feet. The extra length of skidway is to be constructed at once, so that when the weather and tides permit, the two 18-inch mains may be pulled across. The two sections of pipe now built have been disconnected to allow for the dredging being done without intereference from the pipe.

West Vancouver, B.C.—A by-law is to be submitted to ratepayers to provide for the expenditure of money required for the construction of a wharf at the foot of Twenty-Fifth Avenue.

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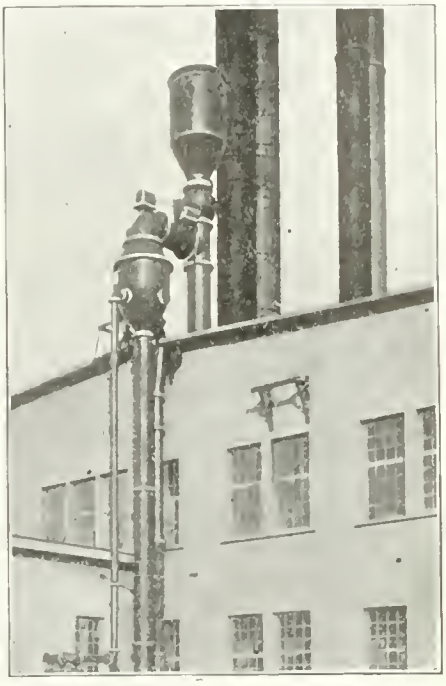

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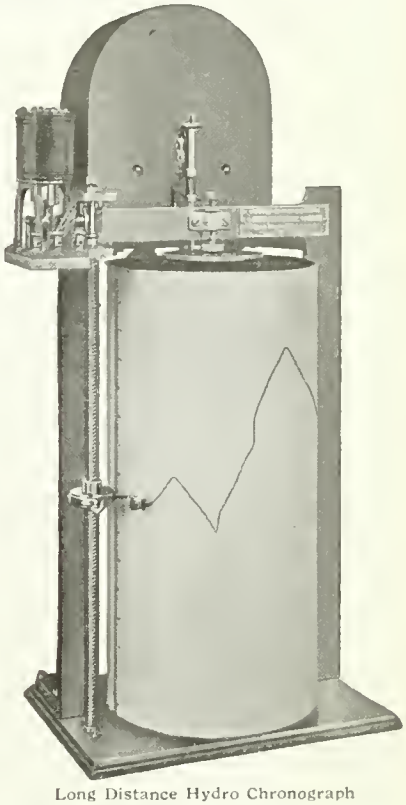

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MISCELLANEOUS.

+—Brandon, Man.—The contract for the steel work at the street car barns has been secured provisionally by the BRANDON MACHINE AND IMPLEMENT WORKS, the contract tender being $12 per ton.

Calgary, Alta.—The Calgary ratepayers have carried a by-law authorizing the issuance of $350,000 in bonds for the establishment of stock yards; a by-law providing for the construction of a building for infant industries to cost $250,000; and a by-law for the building of a $30,000 hospital for tubercular diseases.

Claresholm, Alta.—It is reported that favorable progress is being made upon the Alberta Farmers' Co-operative elevator under construction at Claresholm.

Nanaimo, B.C.—Plans for the proposed improvements to the Nanaimo post office and customs building have arrived from Ottawa, and it is expected that within a few days tenders will be called for the proposed addition, for which a grant of $25,000 was secured from the Dominion Government.

Newcastle, N.B.—It is stated that steel from England has arrived for the construction of the 500-foot tower to be erected at the new wireless station at Newcastle. The foundation is complete, and the construction of the six 300-foot wooden towers is well under way.

Port Arthur, Ont.—An English syndicate is having prepared plans for a fireproof theatre with a seating capacity of 1,200, for which Rutton and Co. are the agents and Hood and Scott, the architects. Tenders for construction will be called in a few weeks.

Regina, Sask.—The Regina Plumbing and Heating Company has decided to erect an addition to its building at Regina. Storey and Van-Egmond, architects, are preparing plans.

+—Saskatoon, Sask.—The contract for the construction of the first unit of the Dominion Government interior storage elevator has been awarded to the BARNETT McQUEEN COMPANY of Fort William, their tender of $1,000,000 being the lowest received. This unit will have a capacity of 3,500,000 bushels, and is to be completed by December, 1914.

+—Stratford, Ont.—The contract has been awarded MESSRS. POUNDER BROTHERS, by W. J. McCully, for the erection of a concrete storehouse, 70 feet by 30 feet, and two stories in height.

Vancouver, B.C.—The Vancouver Industrial Sites, Limited, has taken over the real estate of the Imperial Car and Drydock Co., for the equivalent value granted in fully paid-up stock in the new company, and have assumed all the liabilities of the old company. The Vancouver company have purchased from the Vancouver Industrial Sites, Limited, a site of 12 acres for the sum of $200,000, and will begin at once the erection of dry kilns and an addition to the saw mill already on the property. The Vancouver Industrial Sites, Limited, are now owners of about 450 acres of property at Roche Point across the Inlet with a water frontage of 6,000 feet. This they propose to sell exclusively for manufacturing sites.

Vancouver, B.C.—Tenders will be received up till October 9th, 1913, for the supplying of fuel oil to the B.C. Dredging Fleet for a period of three years. Plans and specifications may be obtained from J. L. Nelson, Esq., Superintendent of Dredges, Rm. 40, Post Office Building, Vancouver, B.C.

Vancouver, B.C.—Reeve Bridge has interviewed the government with regard to making a special survey of the upper end of Lulu Island. Surveys which have been made since the original stakes were burned, have been taken from an incorrect base line, and the whole survey of that end of the island is at fault.

Vancouver, B.C.—Expert engineers are of the opinion that the paraffin oil struck at Pitt Meadows is of high grade quality and also of great quantity. But, owing to the large quantity of water in the 1,300-foot well already bored, preventing the oil from reaching the surface, the promoters have decided to cover this well and to drill immediately another.

Victoria, B.C.—Towards Christmas, tenders will be called for the construction of the new Jubilee Hospital, according to Mr. Loring P. Rixford of San Francisco, the architect. The estimated cost of all buildings included is $399,840.

Winnipeg, Man.—Tenders will be received up till October 10th, 1913, for the manufacture, delivery, installation, and testing in the Grand Trunk Pacific shops at Transcona, of transformers and switching apparatus. Plans and specifications may be obtained from M. Peterson, Esq., Secretary, Board of Control, Winnipeg, Man.

+—Winnipeg, Man.—The contract has been awarded the JOHN DOLMAN COMPANY, Winnipeg, for the installation and bricking in of the boilers to be placed in the new power plant at a cost of $5,700.

Winnipeg, Man.—Tenders will be received up till October 10th, 1913, for the manufacture and delivery of two 44 K.V.A. induction feeder regulators and accessories. Plans and specifications may be obtained from M. Peterson, Secretary, Board of Control, Winnipeg, Man.

CURRENT NEWS.

Calgary, Alta.—D. C. Coleman, Esq., general superintendant of the Alberta division of the C.P.R., announced, after inspecting the work on the new Lethbridge-Weyburn line, that that piece of railway will be sufficiently complete to allow the movement of grain on that branch this season.

Cambie, B.C.—It is proposed to place an emergency water main across the Lulu Island bridge to guard against an interrupted supply of water in the event of a break in the pipes on the bed of the stream. The pipes are to be carried over the bridge as far as the draw span, then submerged, the bed of the river being dredged there so as to place them on a solid foundation about four feet below the river bed. This will prevent an undermining of the pipes by the current, the chief cause of breaks in the present system. The pipes used will be solid jointed steel pipes.

Castor, Alta.—The gas well at Castor has proven itself a complete success. The well has been safely capped, and the first time after 18 hours registered a pressure of 262½ pounds to the square inch; the second, when leaks in the pipe had been stopped, a pressure of 270 pounds to the square inch. This is a pressure greatly in excess of the Vegreville gas well, which, after 24 hours, registered only 167 pounds to the square inch.

Edmonton, Alta.—Though the city engineer and superintendant of the street railway department are of the opinion that the measures taken to guard against accidents on the high level bridge are sufficient, yet the matter is being given much consideration by citizens, and has been brought before the city commissioners, requesting them to provide further precautionary measures.

Edmonton, Alta.—Messrs. F. G. Clapp and L. G. Huntly, gas experts of Pittsburg, have submitted a report concerning the delivery of natural gas to Edmonton consumers. They visited the districts of Vegreville, Pelican Falls, Wetaskiwin, Morinville, Tofield and Athabasca, and reported the first-mentioned as the most promising, though all possess merit. They stated that gas can be delivered from Vegreville at 9 cents per 1,000 cubic feet, owing to the short distance to be covered by the pipe line. The pipe line and plant they considered would cost about $3,850,000.

Fort William, Ont.—Inside of three weeks, the formal opening of the bascule bridge for railway, vehicular, and pedestrian traffic, is expected to take place. The nature of the opening ceremony is not yet determined.

Guelph, Ont.—The Eramosa hill road has been completed at a cost $2,045.61 less than the estimate, and the construction is declared to be entirely satisfactory. Storm drains were installed for $1,948.31, and the cost of the roadway itself was $7,300.

Hamilton, Ont.—Considerable agitation is being raised over the removal of sand from the beach near the filtering basin, and City Solicitor Waddell has been authorized to obtain an appointment with the Hon. Mr. Hurst to endeavour to get final authority in restraining the people from removing the sand.

Kingston, Ont.—The Board of Health have taken up the matter of the city's drainage, with the result that efforts are beginning to be made by the city officials to produce an adequate drainage system.

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2

Lindsay, Ont.—The Trent Valley Canal, according to plans scheduled, is to leave Lake Couchiching about a mile to the west of Washago, and cut across to a point below Severn Bridge. The residents of Washago have suggested an alternative route, by which the canal would leave the lake near that village, but small hope for the change in plans can be entertained, since the latter route involves rock cutting for most of the way.

MacLeod, Alta.—It is the opinion of elevator authorities that the Alberta Pacific Elevator Company will construct one of the terminal elevators proposed to be erected, at MacLeod. The present elevator located here is being worked to its full capacity.

Montreal, Que.—The Electrical Service Commission has communicated to the Board of Control that all overhead wires and cables on St. Catherine and Bleury Streets will be underground by May 1st of next year. It also suggests the adoption of a city by-law by which all buildings under construction and those constructed in future be so wired as to permit of underground connections being eventually made.

Montreal, Que.—The C.P.R. have announced that the opening of the new six million dollar dam at Bassano, Alta., will take place on October 1st. The dam has been constructed in connection with the project of checking the Bow River for the irrigation of the land of that vicinity of Western Canada.

New Westminster, B.C.—The first freight train has been operated over the section of the C.N.R., between the centres of Port Mann and Hope. A twice-a-week service is to be operated on this line for the accommodation of the company and nearby residents.

North Vancouver, B.C.—The company of Royal Engineers has finished the construction of a suspension bridge on the Fidler system over the mouth of Mosquito Creek. The bridge is of one span, 90 feet in length, suspended from wire cables, supported on both banks by heavy buttresses, and is capable of carrying a weight of 14 tons without straining.

Ottawa, Ont.—The St. Lawrence Power Company, Limited, capitalized at $5,000,000, and with headquarters at Toronto, have been granted letters patent by the Dominion Government. The company is inaugurated to develop power and to carry on the varied enterprises connected therewith.

Ottawa, Ont.—The foundations of the new Canadian Northern Railway shops have been laid, and the works at Rideau Junction will doubtless be finished early in the spring.

Ottawa, Ont.—A semi-official statement has been made announcing that the section of the National Transcontinental Railway from Cochrane to Winnipeg will be taken over by the Grand Trunk Pacific in the spring. According to the agreement made under the Laurier Government, the G.T.P. are not compelled to take over the line until it is absolutely complete. Trains can now be run over the line, but only for freight purposes, many bridges as yet being only temporary constructions, and several sink holes still needing further filling and grading.

Peterboro, Ont.—The city's sewage disposal scheme must be postponed until it has been conformed to the alterations suggested by Provincial Board of Health.

Regina, Sask.—The city council is drawing up plans for extensions to the local improvement works, particularly in the south and south-west sections of the city, and in the warehouse section. By-laws providing for the raising of $650,782 to be used in paving construction and for the sale of $110,427 of debentures for concrete sidewalks have been approved by the council. Though some suggestions have been made that the work involved be done by day labor, instead of by contract, it is not probable that the city council will not approve of such an arrangement.

St. John, N.B.—A new water main, which will solve the water problem of Partridge Island, is being laid by the Department of Public Works. The new main is a flexible bronze pipe in sections of from 30 to 40 feet in length and 4 inches in diameter. Up to the present 1,000 feet have been laid, and though about 2,000 feet more must be laid, the work will be completed inside of three weeks.

Vancouver, B.C.—Mr. Cottrell, the district superintendent, announces rapid progress on the transforming of locomotives on the Canadian Pacific subdivision between Vancouver and North Bend into oil burners. Out of 40 locomotives on the division, half have been adapted for the new order of fuel.

Vancouver, B.C.—The following resolution, agreeable to both the bridges and railways committee and Mr. Bolschweller of the B.C. Telephone Company, regarding the conduits to be placed on the Georgia-Harris bridge, has been passed:—"That in the construction of the Georgia-Harris Street viaduct, inserts and manhole castings be installed by the company under the supervision of the city's engineer, according to the plans submitted by the B.C. Telephone Company, it being distinctly understood that no permission is to be construed from the passing of this resolution giving the right to the company to install conduits in such inserts and manhole castings, and such conduits shall only be installed on such condition as the city may approve in the future."

Vegreville, Alta.—Messrs. Clapp and Huntley, gas experts, who have been investigating the possibilities of gas fields within a radius of some 200 miles of Edmonton, have reported that Vegreville is the centre of the best gas-producing district in Northern Alberta, and have advised the city of Edmonton to acquire lands there and to bore for gas. They advise that the city should lay aside $100,000 to be used at once in boring four wells south-east of Vegreville, on four specific locations minutely described in the report. These wells, it is recommended, should be drilled to a depth of at least 2,000 feet, and the first well, if necessary, should be sunk to a depth of 2,200 feet. The experts are confident gas will be found in large quantities in these locations.

Victoria, B.C.—The city of Victoria is considering the project of a number of its prominent business men to incorporate a motor bus company, in which every citizen may be a shareholder. It is proposed to capitalize the company at $500,000, with shares of $10 each.

TRADE ENQUIRIES.

The following trade inquiry relating to Canadian trade was received at the branch for city trade inquiries, 73 Basinghall Street, London, E.C.—A Scottish firm manufacturing wire rope would like to arrange for its sale in Western Canada.

MONTREAL MARKET LETTER.

The final passage of the United States tariff legislation has removed a prolific cause of uncertainty, not only in the financial market, but in iron and steel and general commercial circles throughout the United States. It has been claimed that the scarcity of contracts has been in a large part due to the uncertainty concerning what might take place with respect to the tariff on iron and steel, and that railways were delaying the placing of their orders so that they might be able to take advantage of any decline which might follow. This, it is claimed, has largely been accountable for the disappointment which has been experienced by the steel companies. It was expected that orders for steel rails and other railway equipment during the month of September would show a very considerable increase, whereas, the contrary was the result. Now that the tariff legislation has been finally settled, one might expect that orders would come out freely or that imports would shortly begin. It will doubtless take some little time for matters to adjust themselves and for new trade channels, whatever they may prove to be, to define themselves. It is claimed that the United States will be able to retain her trade in the face of any opposition which may be offered from Germany or other countries; and this doubtless will be the case if the statement that the cost of production of the United States is lower than other countries, is actually true.

Canada is deeply interested in the working out of the situation on the other side of the border and there can be little doubt that trade here has been awaiting, to some extent, the result. Seeing the delay of the United States, buyers in Canada have also been holding off, to this effect that, if prices across the border decline to any considerable extent, it will probably mean a readjustment, which will result in increased imports from the United States or a reduction in prices asked by Canadian furnaces and mills. Meantime, no price changes have been taking place in Montreal and none are likely to take place for a few days to come. Small orders are being placed right along, but it is thought that the larger contracts are being held back to a considerable extent awaiting the outcome of the readjustment on the other side of the border.

When designing

structures do you pay sufficient attention to the various matters that govern insurance ratings?

Not only can you add greatly to the fireproofness of buildings by adopting our suggestions, but it is very likely that you can do so without the improvements costing anything ultimately. They will be paid for by the lower insurance rates.

Correspondence solicited. We have a staff of engineers and inspectors trained in this highly specialized line. Make use of our services.

E. M. SELLON & CO.
LIMITED

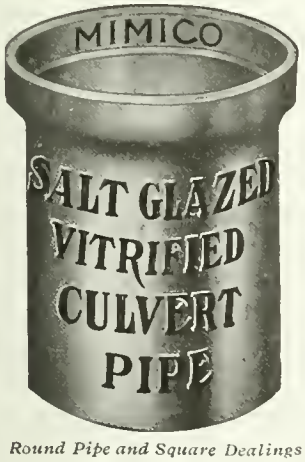
INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

Cost of pipe = 20% cost of work
Saving by using poor pipe = 20%
Saving on total cost = 4%

IS IT WORTH WHILE?



If the sewer is to cost $10,000, for instance, MIMICO pipe would likely not cost more than $2,000, probably considerably less. Not more than $400 could be saved on this pipe cost by purchasing a poor grade of pipe. You would then have a poor sewer costing $9,600, when for $10,000 you might have had the very best sewer possible to build. Is it worth while to buy poor pipe? No! Then buy Mimico Brand and put an end to sewer troubles

Write for 1913 catalogue

Round Pipe and Square Dealings

The Ontario Sewer Pipe Co.
LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

Renouf Publishing Co.

25 McGill College Ave.
MONTREAL

Concrete Costs.

Tables and Recommendations for Estimating the Time and Cost of Labor Operations in Concrete Construction and for introducing Economical Methods of Management.

By FREDERICK W. TAYLOR, M.E., Sc.D., and SANFORD E. THOMPSON, S.B., Mem. Amer. Soc. C.E., Consulting Engineer. Small 8vo, xxii+709 pages, 82 figures. Cloth $5.00 net.

In this volume the authors have carefully described the best methods of dealing with the component parts of a construction job, and have so devised their cost tables that it will be possible by their use to estimate the cost of a proposed job much more accurately than by any method heretofore employed.

SECOND EDITION, Revised and Enlarged.

Concrete, Plain and Reinforced.

By FREDERICK W. TAYLOR and SANFORD E. THOMPSON. 8vo, xli+821 pages, 249 figures. Cloth, $5.00.

In this edition is included the developments in the design and construction of reinforced concrete since the issue of the first edition.

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By IRA OSBORN BAKER, B.S., C.E., D. Eng'g., Professor of Civil Engineering, University of Illinois. 8vo, xv+745 pages, over 100 tables and 244 illustrations. Cloth, $5.00.

NINTH EDITION, Re-written.
TOTAL ISSUE—14,000.

The Theory and Practice of Modern Framed Structures.

JOHNSON—BRYAN—TURNEAURE

In three parts. Part I—STRESSES IN SIMPLE STRUCTURE. 8vo, xii+326 pages, illustrated with cuts throughout the text. Cloth, $3.00 net.
Part II—STATICALLY INDETERMINATE STRUCTURES AND SECONDARY STRESSES. 8vo, xvi+538 pages, 313 figures. Cloth, $4.00 net.
Part III—DESIGN. (In preparation.)

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned, and endorsed "Tender for Breakwater at Kincardine, Ont.," will be received at this office until 4 p.m. on Wednesday, October 29, 1913, for the construction of a Breakwater at Kincardine, Bruce County, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of H. J. Lamb, Esq., District Engineer, Windsor, Ont.; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Kincardine, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 %) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, September 30, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—46683.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Harbor Improvements at Wellington, Ont.," will be received at this office until 4 p.m., on Wednesday, October 29, 1913, for the construction of Harbor Improvements at Wellington, Prince Edward County, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Wellington, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, September 30, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—46303.

EXTENSION OF TIME.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

CANADIAN GOVERNMENT RAILWAYS.

Halifax Ocean Terminals Railway, Halifax, N.S.

Sealed tenders addressed to the undersigned and endorsed "Tender for docks, First Unit, Contract No. 3, Halifax Ocean Terminal," will be received at this office until twelve o'clock noon, Wednesday, the twenty-second day of October, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor to a depth of 45 feet at low water, and filling reclaimed areas.

Plans and specifications and form of tender may be seen and full information obtained at the office of the General Manager, Moncton, N.B., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Halifax, N.S.

The right is reserved to reject any or all tenders.

By order, L. K. JONES,
Assistant Deputy-Minister and Secretary.

Department of Railways and Canals,
Ottawa, September 2nd, 1913.

CANADIAN RAIL PRODUCTION.

The following table shows the production of steel rails in Canada during the past 18 years:—

Years.	Gross tons.	Years.	Gross tons.
1895	600	1904	36,216
1896	600	1905	178,885
1897	500	1906	312,877
1898	600	1907	311,461
1899	835	1908	268,692
1900	700	1909	344,830
1901	891	1910	366,465
1902	33,950	1911	360,547
1903	1,243	1912	423,885

STABILITY IN AERONAUTICS.

This is a title of a paper to be presented at the October 14th meeting of the American Society of Mechanical Engineers in New York, by Albert A. Merrill of Boston, the founder of the Boston Aeronautical Society, and a lecturer upon the subject of aeronautics at the Massachusetts Institute of Technology.

One of the most important questions in aviation is that of stability. Mr. Merrill has analyzed the forces involved in order to determine if, by a change in design, it is possible to increase the safety of the flying machine; and his paper is based upon the results of his research.

Experiments made to bring aluminum to a liquid condition, so that it may be spread when cold over any dry service, have been sucessful in Germany. The composition is applied like a paint with a brush, and looks, when spread, like a dull silver coating. It is said to be an excellent preventive of rust, to be resistant to heat, elastic, durable, and resistant to atmospheric influences, and to form an excellent substitute for tin in plating.

MEXICAN EAGLE ASPHALT

TRADE MARK

Mountain Street, Winnipeg, Man., paved with Mexican Eagle Asphalt.

Mexican Eagle Asphalt is the purest asphalt on the market. It is also a favorite among city engineers for its high cementing value and ductility. That means that sheet asphalt pavements constructed with Mexican Eagle Asphalt take first place among permanent pavements. Because there is no doubt but that sheet asphalt is in general the most satisfactory pavement. Read the experiences of a few Canadian cities:

OTTAWA, ONT.

Five-sixths of the thirty miles of permanent pavement in Ottawa is sheet asphalt. The principal business and residential streets are paved with it. The city engineer's department says that, if properly constructed, asphalt has been found to be about the best pavement they can have. Ottawa has a great many streets constructed with Mexican Eagle Asphalt.

WINNIPEG, MAN

Winnipeg has laid eighty-one miles of sheet asphalt since 1897, for all kinds of traffic. City Engineer Ruttan installed the first municipal asphalt paving plant in Canada. In their experience the asphalt has worn uniformly and has been extremely satisfactory, particularly the pavements constructed with Mexican Eagle Asphalt.

VICTORIA, B.C.

Sheet asphalt is practically the only kind of pavement laid in Victoria, only four out of the forty-eight miles of permanent paving being of any other type. It has been Victoria's experience that no repairs at all are necessary in the first five years, and extensive repairs are necessary only after ten years' wear.

TORONTO, ONT.

As in most cities, asphalt predominates in Toronto, over 157 mile of sheet asphalt pavement having been laid since 1887. The average cost of maintenance per square yard during ten years has been only slightly over five cents a year. For both residential and business streets it is the principal pavement. Many Toronto streets are laid with Mexican Eagle Asphalt.

LONDON, ONT.

The city engineer of London says that asphalt pavements in London that have been down nine years are in good shape and will likely be so for another four or five years. Of less than nine miles of pavement in London, over five miles are sheet asphalt.

HAMILTON, ONT.

Thousands of tons of Mexican Eagle Asphalt have been used in Hamilton during the past five years. Asphalt greatly predominates there, two-thirds of the thirty miles of permanent paving being sheet asphalt. The principal business streets are paved with it. The average cost of maintenance per square yard for the first five years has been two cents a year.

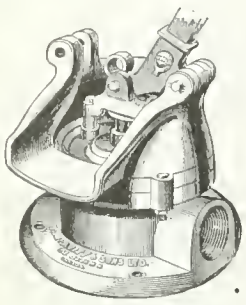
For prices, analyses, samples, etc., please address

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

SECOND-HAND MACHINERY



3" stroke 3" suction
Capacity 3500 gals. per hour

Contractors' Diaphragm Pumps

Especially adapted for use by contractors, pumping out excavations, cellars, trenches or sewers, discharging water containing sand, gravel, mud or any semi-fluid substance.

Send for our illustrated catalog

H. W. PETRIE, LIMITED
General Machinery Dealers
TORONTO, Ont.

GAS AND GASOLINE ENGINE, ten horsepower, Fairbanks-Morse; excellent condition; bargain. Can be seen in operation. Review Company, Bridgeburg, Ont.

FOR SALE.—Three to five-ton tandem steam road roller. Machine is in excellent condition and will be sold cheap for cash. Address Box 146, *The Canadian Engineer*, Toronto.

WANTED.—Second-hand locomotive crane. Must be in good working order and capable of lifting 8 tons at a radius of 50 feet. Address Box 148, *The Canadian Engineer*, 628 Board of Trade Building, Montreal.

FOR SALE.—Contractor's machinery, including hoisting engine, 16 dump cars, 1 Ransome mixer, 21 concrete buckets. Address Box 150, *The Canadian Engineer*, Toronto.

NEW INCORPORATIONS

Nanaimo, B.C.—Arlington Shingle Co., Limited, $15,000.

New Westminster, B.C.—McAllister's, Limited, $250,000.

Pilot Butte, Sask.—McClinton Lumber Co., Limited, $25,000.

Fleming, Sask.—The Fitzsimons Gas Co., Limited, $55,000.

Kamsack, Sask.—Kamsack Brick and Tile Co., Limited, $20,000.

Medicine Hat, Alta.—Alberta Clay Products Co., Limited, $700,000.

Edmonton, Alta.—D. Blais Contracting and Mfg. Co., Limited, $10,000.

New Westminster, B.C.—Canadian Coast Chemical Co., Limited, $100,000.

Prince Albert, Sask.—The Prince Albert Mining and Developing Co., Limited, $20,000.

Megantic, Que.—The Megantic Broom Mfg. Co., $49,000. E. Loubier, V. Cliche, P. Cliche.

Prince Rupert, B.C.—Railway Employees' Investment and Industrial Association, Limited, $100,000.

Toronto, Ont.—The Burnham Engineering Co., Limited, $40,000. J. H. Ronan, B. Folliott, E. Heyes.

Sarnia, Ont.—Perfection Stove Co., Limited, $1,000,000. R. V. LeSueur, A. I. McKinley, N. L. LeSueur.

Saint Victor de Tring, Que.—The Victor Lumber Co., Limited, $20,000. T. Pepin, P. Fortin, N. Gagne.

Gentilly, Que.—La Compagnie Hydraulique Electriquede Levrard, Limited, $20,000. L. Carignan, A. Roux, A. Roux.

London, Ont.—Robinson, Little and Co., Limited, $2,000,000. A. T. Little, E. S. Little, G. S. Gibbons.

Windsor, Ont.—Maxwell Motor Co., of Canada, Limited, $10,000. W. E. Flanders, W. M. Antony, E. E. Von Rosen.

Winnipeg, Man.—The Inland Oil Works Co., of Canada, Limited, $5,000. A. J. Ferguson, D. J. Ferguson, C. W. Kelsey.

Montreal, Que.—Specialties, Limited, $200,000. E. R. Bouchard, D. R. Kennedy, J. R. Perreault. Durbin Train Pipe Connection Company, Limited, $300,000. R. W. Hart, A. Chenier C. McNaughton.

Toronto, Ont.—Gravenhurst Crushed Granite Co., Limited, $100,000. J. J. Flint, C. W. O. Goshorn, H. A. Hall. The Canadian Krantz Electrical and Manufacturing Co., Limited, $160,000. W. N. Ferguson, H. Ferguson, J. T. White.

Victoria, B.C.—Nelson Benneck Construction Co., Limited, $10,000. The Canadian Vending Machines, Limited, $100,000. Rubidge Mining Co., Limited, $10,000. Murphy Electric Co., Limited, $10,000. Victoria Motor Country Club, Limited, $50,000.

Vancouver, B.C.—Armstrong-Kerr Co., Limited, $50,000. The Automobile Wheel Helps Co., Limited, $250,000. Grief Point Shingle Mill and Development Co., Limited, $25,000. The Donaldson McDonald Co., Limited, $10,000. Navigation Dredging Co., Limited, $50,000.

Calgary, Alta.—Alberta Oil, Gas and Development Co., Limited, $50,000. Southern Alberta Oil Co., Limited, $100,000. Peerless Oil Works, Limited, $50,000. The Paraffin Oil Co., of Calgary, Limited, $500,000. Western Canada Oil Co., Limited, $75,000. Rocky Mountain Oil Fields, Limited, $100,000.

PATENTS.

October 6th, 1913.

The following is a list of patents for Canada recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Harrison A. Stringer and George R. Gamble, pumps for oil and gas wells; Harry A. Gaydon, sound producing devices; Fred. Gilbert, bronzing apparatus; Fred. T. Quirk, bellow springs; David J. Hurley, controllers for doors and like movable structures; Oswald Silberad, chlorate explosive; Ferdinand Weinberg, machines for moulding concrete pipes.

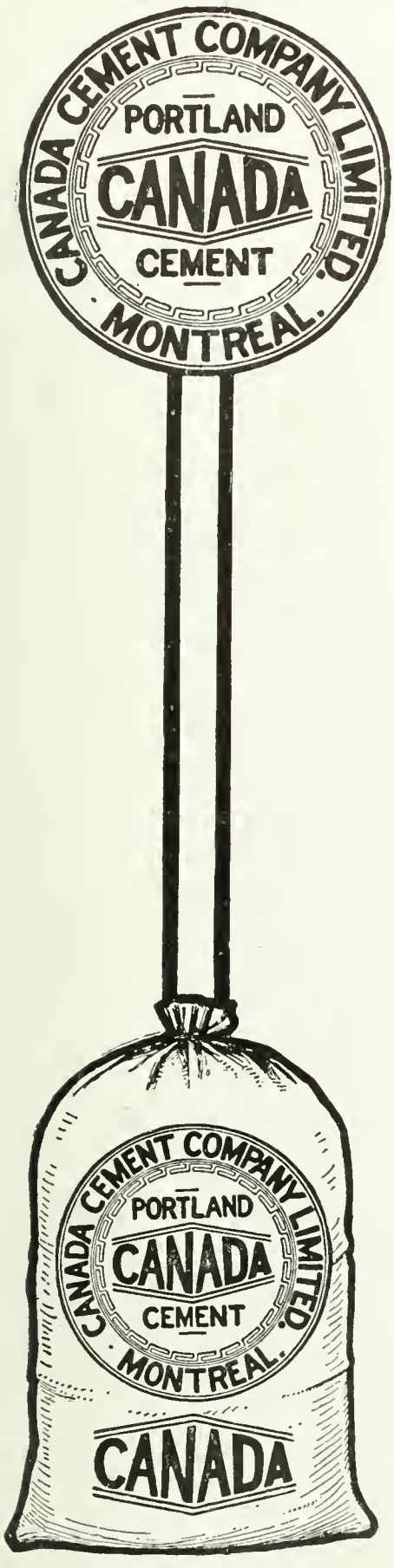
Special Wire Goods for Engineers, Contractors and Manufacturers

FOR FURTHER INFORMATION WRITE US; OR SEE OUR LARGE ADVERTISEMENTS IN LAST WEEK'S AND NEXT WEEK'S ISSUE OF THIS PAPER

Canada WIRE AND IRON GOODS Company
82 King William Street, Hamilton, Ont.

THE LAUZON ENGINEERING CO.
LIMITED
ENGINEERS AND CONTRACTORS
Railway and Municipal Work, Piers, Dams, etc. Design and Construction of all description.
Head Office: 127 Commercial St, Levis, Que.

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

ELECTRICAL ENGINEER.

The City of Prince Albert, Saskatchewan, requires an experienced Electrical Engineer as General Manager. Thorough experience in business organization and management and in the designing of steam stations is essential. Give full particulars and state salary required.

Applications must be received by October 31st.

C. O. DAVIDSON,
City Clerk.

Prince Albert, October 1st, 1913.

CITY ENGINEER.

The City of Prince Albert, Saskatchewan, requires a City Engineer with thorough experience in all branches of City Engineering work. Full particulars of past experience and positions held are requested.

Salary $4,000 per annum. Applications by October 31st.

C. O. DAVIDSON,
City Clerk.

Prince Albert, October 1st, 1913.

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES—IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

AN ASSOCIATE Member Institute Civil Engineers, at present in position in London (England), wants berth in United States or Canada. Experience in railways, bridges, workshops, etc. Good draughtsman and surveyor. Moderate salary required. Disengaged shortly. Will pay own travelling expenses. "Engineer," 383 Selby Street, Westmount, Montreal.

WANTED position as resident engineer, instrument man or draftsman. Experience on railroad location, construction and maintenance and general reinforced concrete construction. Location immaterial. W. T. Guedry, Box 241, Aurora, Ont.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

TAKE NOTICE that the undersigned are prepared to grant licenses, at a reasonable price, to anyone desiring to use the method of producing electric oscillations described and claimed in Canadian Letters Patent No. 119,908, issued on the 10th day of August, 1909, to Roberto Clemens Galletti. They are also prepared to receive offers for the purchase of the patent. Ridout and Maybee, 59 Yonge Street, Toronto, attorneys for Roberto Clemens Galletti.

FLANGES AND FLANGE FITTINGS—AMERICAN STANDARD.

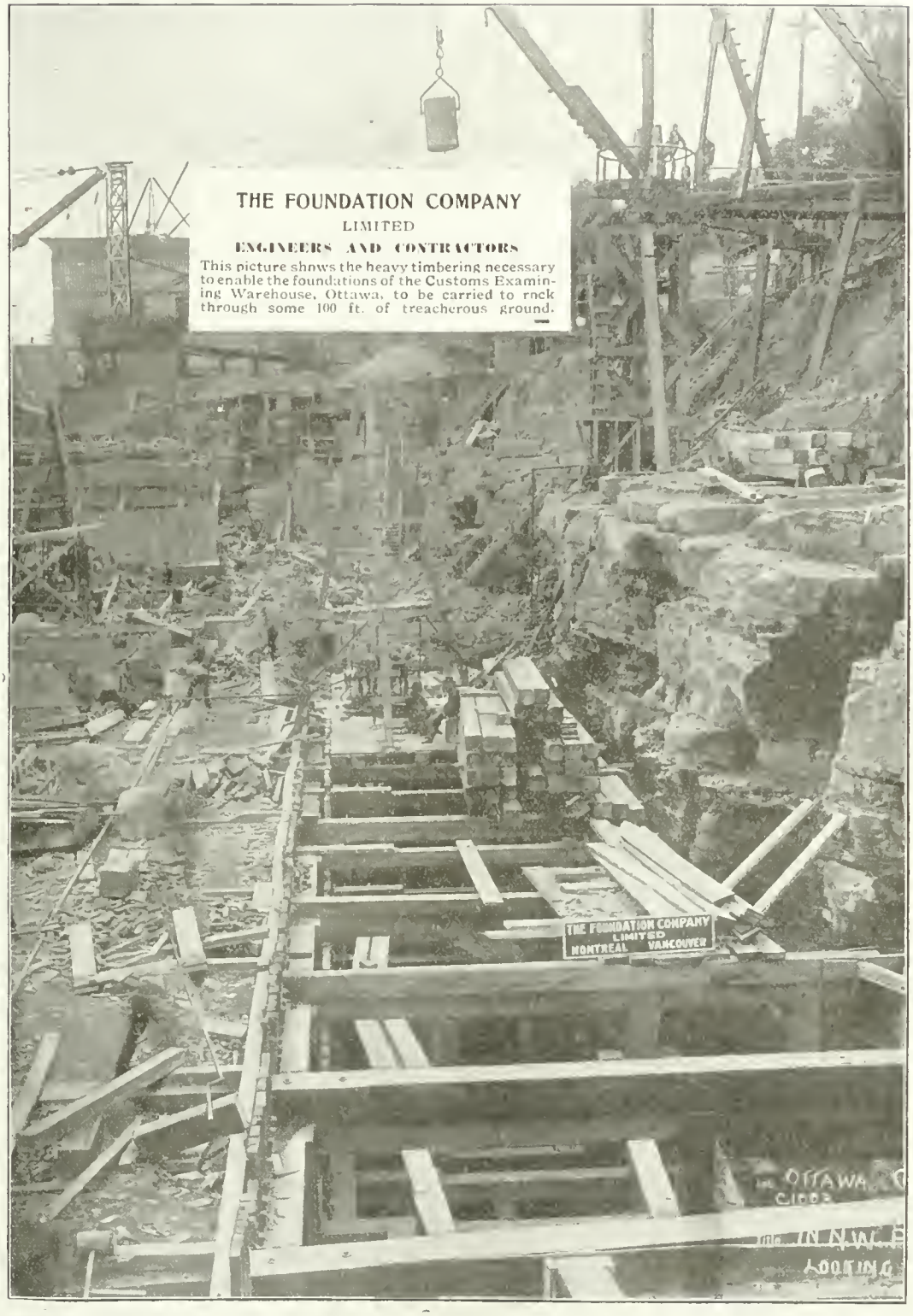
The use of flanges and flange fittings has been increasing quite rapidly of late years. In fact, a flange joint is the standard form of connection in many classes of piping. For most purposes the ordinary screw connection should not be used above 6 ins. pipe size on account of the difficulty of making and breaking joints. As the flange fitting business grew, each manufacturer made up patterns for whatever sizes were called for, to his own personal ideas or knowledge at that time. These dimensions were later published in catalogues and a wide variation in dimensions was found. The variation in the diameter and thickness of flanges as well as the bolt circle, size and number of bolts on standard weight material, caused the users and manufacturers considerable confusion and expense.

This brought about the movement by the American Society of Mechanical Engineers and the Master Steam and Hot Water Fitters Association, assisted by the manufacturers of these lines, the result of which was the adoption of what is known as the A.S.M.E. Standard of 1894. This covered flange dimensions and bolting only. A few years later the manufacturers began to realize that the extra heavy 250 pound flanges and bolting were in the same state of confusion. This resulted in the adoption of what has been known as the Manufacturers Standard of 1901.

It became evident in the past few years that the centre to face and face to face dimensions of all flange fittings, including low pressure, standard pressure, and extra heavy pressure, should be established. After considerable work, a standard known as the 1912 U.S. Standard was adopted, which opened quite a discussion among those interested in the subject. It was found that the dimensions presented in the 1912 U.S. Standard differed from the dimensions which had been quite universally used by manufacturers and which covered a large majority of the fittings made.

At a meeting of manufacturers held in New York City, July, 1912, a standard known as the Manufacturer's Standard was adopted by them. This left the flange fitting subject in the unfortunate position of there being two standards. When this condition came before the committee of the A.S.M.E., an effort was made by this committee with that of the manufacturers' committee to harmonize, if possible, the differences then existing between these two standards. After considering the various phases of the subject covering uniformity of design, strength of fitting, strength of bolting as well as the commercial features, a compromise was made. In this compromise the bolting was increased where it was thought necessary. Additional size flanges were added and the centre to face and face to face dimensions were altered to conform to these requirements.

The result is a new American standard for flanged fittings, standard and extra heavy pressures, adopted September 17th last by the committee of manufacturers on standardization of fittings and valves. It becomes effective January 1st, 1914. A pamphlet, "Flanges and Flange Fittings," published by the committee, has just been issued, covering the new regulations.


THE FOUNDATION COMPANY
LIMITED
ENGINEERS AND CONTRACTORS
This picture shows the heavy timbering necessary to enable the foundations of the Customs Examining Warehouse, Ottawa, to be carried to rock through some 100 ft. of treacherous ground.
THE FOUNDATION COMPANY LIMITED MONTREAL VANCOUVER

MARKET CONDITIONS

Montreal, October 4th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1 40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3 45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3 15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots. Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25 lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4 30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 56 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2 10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, October 8th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and huff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, nr Quehec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto: 40 per cent., 16½ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10 case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3 55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot.....	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long ...	1.00	1.60	2.60	4.00	13.00
Double junctions.....	1.25	2.00	3.25	5.00	16.25
Increasers and reducers.....	...	1.60	2.60	4.00	13.00
P. & H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, October 7th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7.16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4 25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in. $3.35 base; machinery, $3 base; share, $4 50 base; share crucible, $5.50; cast share steel, $7.50; toe caulk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Oct. 16, 1913

Contents of this issue on page 591

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

AN EXAMPLE OF DIFFICULT TUNNELING

THE COMBINED USE OF SHIELD AND COMPRESSED AIR ON WORK SUBJECTED TO UNUSUALLY COMPLEX CONDITIONS

By J. M. M. GREIG, A.M.I.C.E.
City Engineer's Department, Toronto

THE driving of a sewer tunnel under somewhat unusual circumstances arose in connection with one of the low-level intercepting sewers of the city of Glasgow. Starting from a shaft some 25 feet deep, the tunnel passed beneath the foundations of a very heavy retaining wall (clearing them by a foot or two) into running sand lying below an extensive freight yard bordering on the Queen's Dock. There were only 9 feet of cover between the top of the sewer and the rails, and at one point the centre line approached within 80 feet of the quay wall. To open-cut this section was out of the question owing to traffic conditions, and to drive a tunnel through quicksand with an unlimited supply of water close by was no light task.

It was decided that the tunnel should be driven with cast-iron segments, so as to minimize the ground opening; but, as the railway company had doubts as to the effect of their extremely heavy loads on the roof of the finished iron tunnel, a thick brickwork lining of these segments was insisted upon. This made the section one of great strength, but of an external diameter somewhat out of proportion with the inner diameter, as will be seen by reference to Fig. 1.

There were 420 linear feet of sewer immediately below the rails, and the ground throughout was clean sand, varying in fineness, and full of water.

Work Previous to Arrival of Shield.—A shaft was sunk, and from it the tunnel was driven, at first with cap-and-leg settings of timber and a brickwork lining. This did not prove a satisfactory method, the street showing signs of subsidence, owing, no doubt, to the exceedingly unstable condition of the bottom, rendering effective propping impossible. An attempt to tunnel with iron lining turned out equally unsuccessful, and, after the necessary plant had been put to work, a third trial was made with iron and compressed air.

About 30 feet of tunnel were driven thus under the deep cover of the street, but the openness of the ground and the large area of exposed face caused a great escape of air, little improvement being effected, therefore, in the conditions of the bottom. The air pressure gradually fell from 5 to 2 pds. per sq. in. as the tunnel approached the wall, and mining operations became exceedingly difficult toward the end, only one ring being built per day. It was evident from the disturbance of the surface that the miners were not holding the ground, and that the continuation of this method of tunneling beneath the retaining wall would be attended with great risks; so it was decided to try a shield.

Description of Shield.—The outer shell of the shield consisted of a cylinder of steel plates, the clear inside diameter being 8 ft. 8½ in. and the length over all 7 ft. 10 in. Inside this shell and about 2 ft. behind the cutting edge was a bulkhead or diaphragm formed of plates, stiffened with channels and angle gussets off the front upper portion of the shell, called the hood. This diaphragm had two openings, 1 ft. 7 in. by 4 ft. 8 in., separated by an I-beam in the centre, which, with the side channels, formed two sets of grooves, into which stop-planks might be placed, should it be necessary to close the face or reduce its area. Besides these working openings there were two small hand-holes in the lowest part of the diaphragm through which the sand was forced as the shield drove forward. In very bad ground a great amount of the excavation might have been taken out through them with the larger openings closed.

Below springer level the cutting edge receded from 2 ft. to 4 in. off the diaphragm; thus there was a hood above that portion of the ground being excavated, while it was still possible to reach the ground immediately in front of the lower portion of the cutting edge and so clear the way for the bottom of the shield, thus obviating the possibility of boulders damaging the cutting edge. The hood was stiffened with an additional plate, so that the cutting edge was really formed by the bevelled edges of three plates above springer, and of two below.

Behind the diaphragm there was a cast-iron ring formed of six flanged segments fixed to the shell by taps, while screws running through casting and shell held the ram castings in position. The rams, six in number, arranged symmetrically around the circle, were 4 in. in diameter, and had a maximum travel of nearly 2 ft. There was a sufficient length of shell (8 ft. 8½ in., inside diameter) behind the segments to admit of one ring being erected inside the tail of the shield with about 6 in. of the shell overlapping the iron already erected.

The main hydraulic feed-pipe was fixed to the shield on one side, about springer level, and from it the high-pressure water was separately distributed through smaller pipes to each ram, small valves on these pipes giving independent control of each ram. Thus the shield consisted of a steel shell divided into three portions—the hood with the cutting edge, underneath which the excavation was taken out, the body containing the means of propulsion, and the tail, in which the tunnel rings were built.

To obtain the necessary hydraulic pressure an air-compressor on the surface supplied an air-engine or

pump in the tunnel. This pump was fixed in the side of the tunnel, near the face, and from it wrought-iron piping, with a flexible end-piece, carried the high-pressure water to the receiver on the shield, and a similar arrangement of pipes returned the exhaust water to a small tank below the pump. The whole mechanism was most compact, tank and pump occupying a space of less than 8 x 2 x 4 ft.

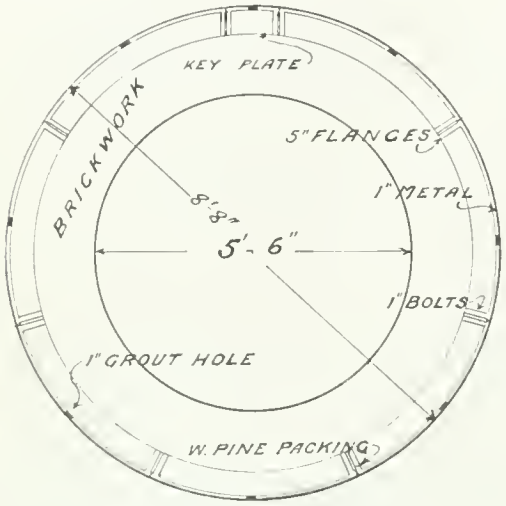


Fig. 1—Section of Sewer.

Erection of Shield.—As the use of a shield had not been contemplated in the original layout, the erection of this shield was carried out, not in a shaft as is usual, but in a specially excavated chamber in the tunnel, which was enlarged for a short distance to a diameter of 11 ft. This shield chamber might have been excavated ahead of the iron had it not been that the face was already very near to the wall; but in any case, it was probably safer to excavate around the outside of the iron—from which temporary propping could be erected—rather than to open up new ground.

In the last length of eight rings, seven were taken out, the eighth being left as a rib to support the longitudinal bars used in poling back. Two plates were broken to obtain an opening in the lining, and the key-plates of the unbroken rings were taken out first, the upper plates being supported by struts from the invert. A crown bar was put in through the lagspace and carried on short props from the leading and ninth rings. The upper plates were next taken out, those along one side at a time, and the ground poled back on bars similarly supported. Below springer the excavation was taken down and timbered outside the rings as far as possible before the removal of the plates.

All this temporary timbering had cement grout under pressure forced into the ground behind it. The bars were then sheeted inside, and the space was pressure-grouted. By this means the top was made practically air-tight, and a fairly good pressure maintained while the bottom was being excavated and poled with 3-in. sheeting.

The shell was taken into the tunnel in pieces and erected round the framework of the bulkhead. The taps fixing the cover-plates to the shell were cut and hammered flush with the inside face to allow the tunnel segments to fit closely. The body segments were also attached to the shell by means of screw taps. Bolts with counter-sunk heads held the angle-stiffeners to the shell and the bulkhead; thus the only variation from a smooth outside surface was the longitudinal cover-plates. A cradle of half-timbers supported the shield at its proper level, and on the completion of erection, the space between shell and walls of chamber was packed with dry brick and grouted with cement under pressure. There was now a set of crown bars held by the shield, forming cantilevers in support of the ground above the leading ring, which was taken down and the shield driven hard to the old face polings. These were bored out in small parts and clay put into pockets excavated ahead around the cutting edge of the shield, new face-boards being put in horizontally to form a circular shutter of timber about 2 ft. less in diameter than the cutting edge, as shown in Fig. 2.

Method of Excavating.—As a rule, the shield was driven forward until the diaphragm was within about 10 in. of the horizontal face poling-boards, these boards being supported during the period of movement by two raking struts off a cross-piece on the second last ring, and butting against two vertical soldiers running across the boards. Fig. 3 shows the shield ready to move ahead, and Fig. 4 shows excavation in progress. When the shield came to rest each poling-board was strutted off the diaphragm with short blocks and wedges. With the face thus supported the rakers and soldiers were taken down and excavation proceeded with by withdrawing the top poling and pulling out the sand with hand-tools.

A pocket or groove was cut out a little beyond and above the cutting edge, and clay rammed in, after which the first poling-board was carried forward and re-erected against the new face with long struts off the diaphragm. In this way each board in turn was carried forward and the face kept continually poled up. Below the lowest board the sand was roughly excavated down almost to the cutting edge, and, after erecting the rakers and soldiers, the struts were removed, leaving the shield again in position to travel ahead. The excavated sand was thrown upon a staging at the level of the sill of the openings, from which it was shovelled into wagons and taken through the air-locks to the shaft.

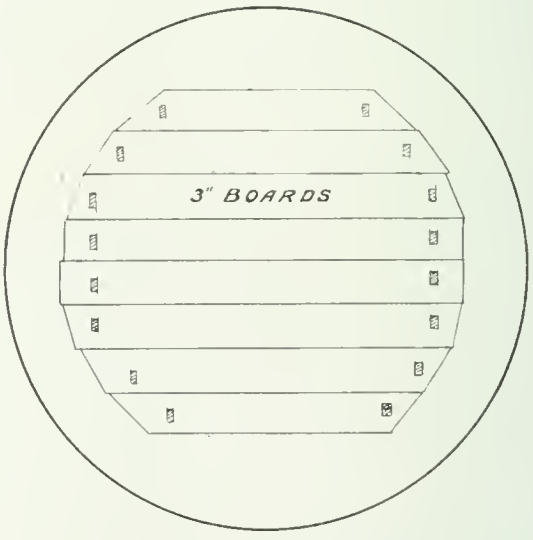


Fig. 2—Poling of Face.

In this ground the shield showed a decided tendency to go downward while in movement, but it was kept to proper level by using the 3 lower rams only during the first part of the movement. After the cutting edge was fairly buried the two upper side rams were brought into action as the first three did not give a force sufficient to drive the shield ahead. During the first period, with three 4-in. diameter rams working under a pressure of 1,500 to 1,600 pds. per sq. in., the total effort was about

24 tons, or 280 lbs. per sq. ft. of skin surface. When the cutting edge was buried the resistance was more than that due to mere skin friction, and, after applying 5 rams and increasing the pressure per sq. in., the total effort rose to about 48 tons. The highest pressure used was 1,900 pds. per sq. in., or a total push of nearly

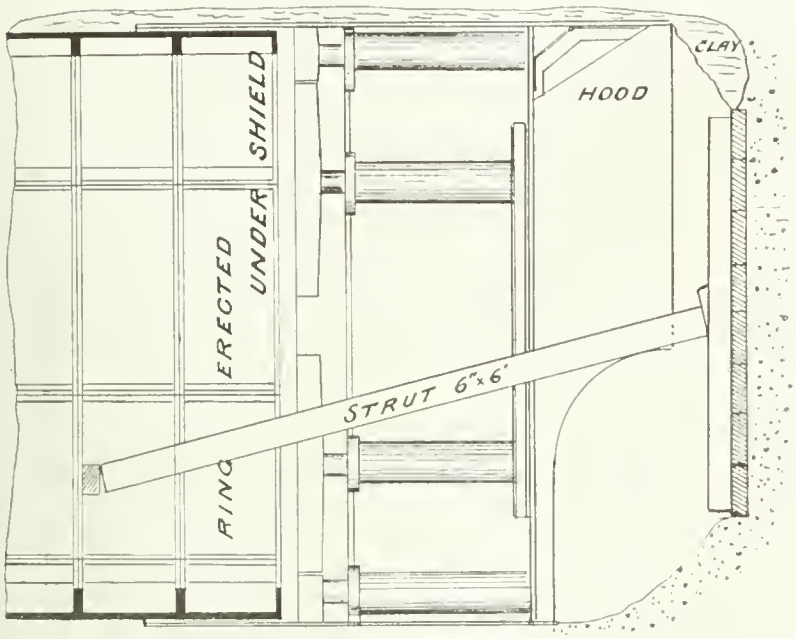


Fig. 3—Longitudinal Section of Shield—Excavation Completed.

60 tons. The average time of travel was 8 minutes in all. Though the air pressure kept the upper portion of the face dry, the bottom was always very wet, but, as it was exposed for a short time only, the water did little harm.

Immediately after the shield had been driven ahead the last ring was grouted with cement under pressure of 40 to 50 pds. per sq. in. Cement grout was used for the lowest plate, but lime grout for the upper portion of the tunnel, where the air pressure kept back the water. There was no escape for this pressure grout at the shield, since wooden buffer ribs, held firmly against the flange of the last ring by the rams, closed any opening between them and the skin. The next ring of iron tunnel lining was not erected until the whole face had been excavated and everything was ready to drive ahead, so the buffer ribs remained sufficiently long enough in position to permit of the mortar partly setting. Five pounds was about the maximum air pressure in the tunnel while beneath the deep cover, but on leaving this it fell to between 2 and 3 pounds, and sometimes less, partly due to slight leakage at the joints over some 50 or 60 yds. of unlined ironwork then exposed.

Grummets of string dipped in red lead and placed around the bolts beneath the washers proved effective in stopping leakage at bolt-holes. All joints had been plastered over with neat cement, previous to the adoption of red lead on grummets, but, as air continued to escape at the bolt-holes, the shield was stopped and brickwork built from the air-locks nearly up to the face, completely sealing the tunnel behind the shield.

Previous to this point no cement had been used for grouting the lower plate but with its use and the brickwork lining carried forward, another pound of pressure was obtained, making mining operations much easier. This slight increase in pressure probably allowed the grout to more completely encase the iron, for there was very little leakage through unlined ironwork from this point forward.

Mechanical Plant.—While under the deeper cover the air pressure averaged about 5 pds. per sq. in., with the engine running at 60 R.P.M., under 110 pds. of steam; and, in the lighter cover, 2½ pds. air pressure, with the engine running at 70 R.P.M., under the same steam pressure. A "Larmuth" compressor, with steam cylinder of 16-in. diameter and 24-in. stroke, coupled direct to a 15-in. diameter air pump, supplied air to the tunnel. The number of men on each shift was 3 miners and 4 laborers, excavating, setting segments and pressure grouting, with a locksman and two enginemen, 11 in all.

Points in the Use of Compressed Air.—The principal point of escape for the air was undoubtedly the working face, though this was kept as closely poled as possible. When the face was completely closed up and grouted, during the period when the brick lining was being brought up to the shield, the same working air pressure could be maintained with the engine running about half speed. This illustrates one of the many advantages of using a shield, as, even with the comparatively simple shield here described, it was possible to reduce the area through which air might escape to a few square feet of sand, and with more complicated mechanism, still greater control might be exercised over the area of escape. In placing the poling boards against the face it was usual to smear their edges with clay. A neat illustration of the course taken by the air could be obtained

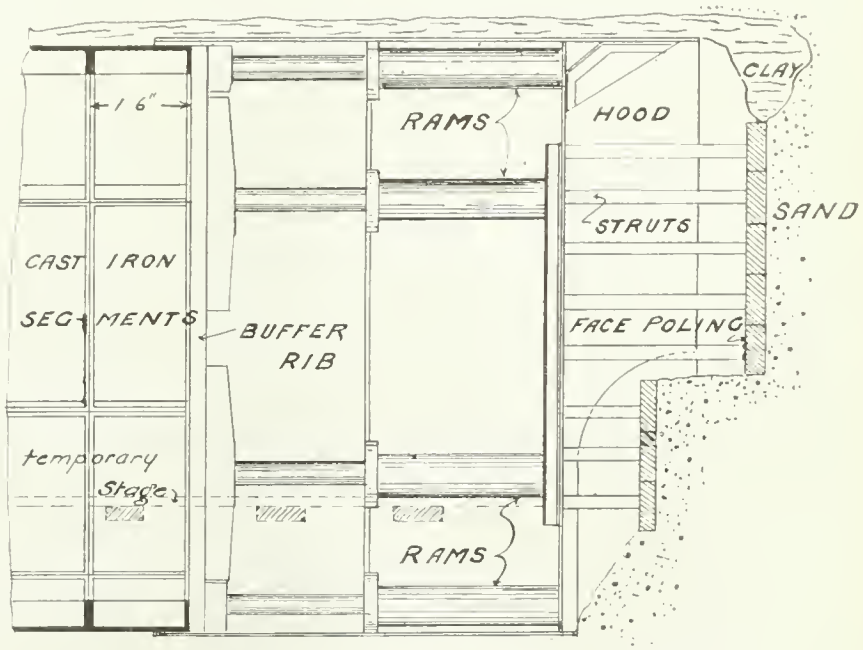


Fig. 4—Longitudinal Section of Shield—Excavation in Progress.

by removing a piece of this clay and holding a candle to the spot, when the flame would be drawn into the joint and extinguished. If the ground is very open compressed air alone may be of little use, especially under light cover, but with it in combination with a shield the most unstable ground can be negotiated.

Compressed air will travel great distances through open ground, and may set up quite unexpected disturbances, as, for instance, by getting into old, leaky sewers. It is never advisable to use a greater pressure of air than that which is just sufficient to balance the weight of water head. The writer has known of the waters of a pond being disturbed by compressed air from a tunnel more than half a mile away. In grouting with 30 or 40 pds. pressure it is quite a common thing to find the cement driven up to the concrete of the roadway from a depth of 20 feet, where pits had been sunk or previous excavation carried out. Of course, the shield has been used much in tunneling without compressed air, and it is a most useful mechanism, which might be more popular with contractors were it not that it has been so much associated with very difficult and expensive tunnels, such as the portion of sewer which is the subject of this article. Though the shield in this case was a costly piece of plant, its use was justified by the safety in which the work was carried out, the excellent progress made amounting to 42 feet per week.

CEMENT IN EGYPT.

The Bulletin Commercial, of Brussels, states that Egypt now offers an important market for cement. In 1911 the imports were 106,670 tons, valued at $800,000, as compared with 87,503 tons in 1910. The great vogue for buildings of ferro-concrete has largely contributed to the remarkable development of the import trade in cement, and this trade seems quite likely to be maintained, in view of the attention which is being given by capitalists to the building industry. The extensive port works recently commenced at Port Said, and those projected at Alexandria, will necessitate the provision of large quantities of cement. The Belgian imports were the largest in 1911, amounting to 50,257 tons, followed by those from England, 35,192 tons. The remainder of the imports came from Austria, France, and Germany. Artificial cement (slow hardening) is imported in barrels of 150, 180, and 200 kilos. gross for net. Sacks are taking the place of barrels owing to the rapidity with which the cement is used. There are, however, cases where barrels are preferred. Natural cement (rapid or semi-slow hardening) is used principally by the natives and also for certain masonry work. It comes mainly from Belgium and is imported in barrels of 140 to 150 kilos. gross for net, and in sacks of 45 to 50 kilos., sacks invoiced. The question of sacks sometimes presents difficulties for the importer. Empty sacks are invoiced to him by the manufactory; if he takes care of them, or returns them only in a bad condition, they are carried to his account. Cement users, however, do not readily agree to these conditions, and the importer eventually suffers the loss. English manufacturers are in the habit of shipping cement in very light bags, which are strong enough for one voyage and for which there is no charge. This method has given excellent results.

The Commission of Conservation, Canada, has prepared a summary of rail production in Canada from 1895 to the beginning of the present year. The increase shown in the intervening years has been from 600 to 423,885 tons.

TRAFFIC CENSUS IN MASSACHUSETTS.

A summary of that portion dealing with the construction and maintenance of roads, of the Massachusetts Highway Commission's report for the year ending November 30th, 1912, was given in October 9th issue of *The Canadian Engineer*. There are a few points in connection with the traffic census outlined in the report, that are of great interest, inasmuch as it is of such importance to have an accurate knowledge of the traffic which any particular road has to carry. As the Commission states "The road must be so designed, built and maintained that it shall be at all times in proper condition to bear the traffic to which it may be subjected, and not only at the least cost to the user, but also at the least ultimate cost to the taxpayers, taking everything into account, viz., interest, sinking fund, yearly maintenance and occasional resurfacing. Without a knowledge of traffic one is really entirely at sea. The road builder is likely to make serious and costly errors by determining upon the wrong kind of construction and by selecting improper or unsuitable materials or methods."

The Massachusetts Highway Commission in 1909 had a census taken upon the State highways at 238 stations, scattered throughout the State; and in 1912 a similar traffic count made at 156 stations.

While the count in 1912 was taken at fewer points than in 1909, it was felt that the percentages of increase and decrease could safely be used to indicate the traffic on other similar roads.

A traffic census was also taken at the same time at quite a number of points around the city of Boston on roadways in the metropolitan and Boston park systems.

The census was made in the following manner: The vehicles actually passing on the road were counted by observers, who were engaged for the purpose. All vehicles were counted for fourteen hours a day (7 a.m. to 9 p.m.) for seven consecutive days in August, 1909, and again for seven days in October, 1909, at 238 stations, the daily census at each station being tabulated on a card. This same census was made again for like periods of time in August and October of this year (1912). At a few important points a count was also made at night, the census at these places covering the whole twenty-four hours.

After the cards were received the number of vehicles observed at each point was tabulated and computed to show the average number of each class of vehicle passing the given point per day, the total number of vehicles and the total of each class, both motor and horse-drawn. When these figures were obtained the percentage of each class of vehicle using the particular road was computed, and the percentage of the total of each class at all stations was computed as well. After these averages were computed for each of the 238 stations in 1909 and for the 156 stations in 1912, the total average number of vehicles at all the various stations was added, the numbers ascertained, and from this was obtained the average number of vehicles passing each day at all the points where the count was made, as well as the average number of each class and kind, and the percentage that the vehicles of each class bore to the average total number.

The increases and changes in traffic from 1909 to 1912 are shown in Table I., which, by the way, shows that the traffic is changing much more rapidly than it is increasing. The figures represent a count taken in 1909 and 1912 for fourteen days of each year, and from 7 a.m. to 9 p.m. of each day. The report goes on to say that the significant feature of the census for the roadman is not the increase of traffic, but the change in the traffic.

It is that which he must consider and for which he must prepare. Another factor which further analysis brings out, and which is also important, is that light, single-horse vehicles decreased 25 per cent.; two-horse vehicles, 14 per cent.; heavy, single-horse vehicles, only 3 per cent., and heavy two or more horse vehicles, only 5 per cent.

Table I.—Increases and Changes in Traffic from 1909 to 1912.

	1909 Census, 238.5 Stations			1912 Census, 156.5 Stations			
	Average Total Number per Day	Average Number per Day per Station	Percentage of Each Class	Average Total Number per Day	Average Number per Day per Station	Percentage of Each Class	Increase or Decrease (per cent.)
Motors:—							
Runabouts	4,958.5	20.8	8.5	5,810.0	37.2	11	+79
Touring cars	17,950 5	75.3	30.5	27,178.5	173.5	49	+130
Trucks	—	—	—	1,800.0	11.5	3	—
Total	22,909.0	96.1	39 0	34,797.5	222.2	63	+131
Horse-drawn vehicles:—							
1-horse, light	17,033 0	71.5	29.0	8,380 0	53 5	15	—25
1-horse, heavy	11,762.5	49.3	20.0	7,458.0	47.6	14	— 3
2 or more horses, light	1,006.0	4.2	2.0	586.0	3.6	1	—14
2 or more horses, heavy	6,205.5	26.0	10.+	3,870.5	24.7	7	— 5
Total horse-drawn	36,007.0	151.0	61.0	20,264.5	129.4	37	—14
Totals of all kinds		247.1			351.6		+42

Weight of Traffic.—In commenting upon the weight of traffic as an important consideration, the report states:—

"After all, it is not numbers which tell the story, it is weight, and it is not weight alone, but the vehicle by which it is transported, whether by horses or by motor. It is not the tractive power alone that makes the difference, but the tires which support the vehicle; whether iron or rubber comes in contact with the road; whether the vehicle is pulled over the road or propels itself, and thus pulls upon the road surface. All of these considerations are probably not so important on many road surfaces as the actual weight imposed upon the road per inch width of tire resting upon the road.

"In other words, heavy loads supported upon narrow iron tires, having a weight of over 600 to 800 pounds for each inch in width of the tire, do vastly more damage to most, if not all of our roads than do very much heavier loads where the weight per inch width of tire is less.

"Such loads carried on such narrow tires will practically destroy any road surface, except a pavement, in a few months if there are many such vehicles using the road every day.

"After careful study they have adopted in England an assumed weight, or coefficient, for each kind of vehicle using the roads, in order to make a fair comparison of the traffic upon different roads where the traffic varies, and to more nearly show what the road must support. It is quite similar to the formula in use in France and on the Continent.

"It is, therefore, used both for want of a better one, and also because it gives a fair basis of comparison. Table II. shows the weight of the road traffic on Massachusetts roads computed in this way, with the coefficient reduced to tons of 2,000 pounds each in every case, both on the English and Massachusetts roads:—

"Here, again, not only are the changes in traffic notable, but the weights are even more important.

"The average weight per station per day of the motor vehicles in 1909 was 197 tons; in 1912 it was 512 tons. For horse-drawn vehicles it was 147 tons in 1909 and only 135 tons a day in 1912.

Table II.—Weight of Traffic on Massachusetts Roads.

	1909			1912		
	Average Number per Day per Station	Assumed Weight (tons)	Weight per Day per Station (tons)	Average Number per Day per Station	Assumed Weight (tons)	Weight per Day per Station (tons)
Motors:—						
Runabouts	20.8	1.43	29.7	37.2	1.43	53.2
Touring cars	75.3	2.23	167.9	173.5	2.23	386.9
Trucks	—	6.25	—	11.5	6.25	71.9
Totals	96.1	—	197.6	222.2	—	512.0
Horse-drawn vehicles:—						
One horse, light	71.5	.36	25.7	52.5	.36	19 3
One horse, heavy	49.3	1.12	55 2	47.6	1.12	53.3
Two or more horses, light	4.2	.54	2.3	3.6	.54	1.9
Two or more horses, heavy	26.0	2.46	64.0	24.7	2.46	60.8
Totals	151.0	—	147.2	129.4	—	135.3
Totals of all kinds	247.1	—	344.8	351.6	—	647.3

"The weight of automobile traffic has increased 160 per cent. in three years, while the weight of horse-drawn vehicles has actually decreased 8 per cent. in the same time. While this is true, note what happened: the motor truck has come in with an average number of trucks of 11½ per station, and their weight is nearly 72 tons a day. The weight of teams decreased 12 tons a day; trucks came in with a weight of 72 tons a day, making good the loss in team weight six times over."

The width of roadway is also given due consideration, as it is manifest that what wears out a road is the actual weight and volume of traffic that has to be sustained by each inch in the width of the road surface. The report contains tables showing the assumed actual weight in tons, per day, passing over each yard in width of the macadam roadway on certain roads in Massachusetts.

Table III.—Average Daily Traffic.

	Light Teams	Heavy Teams, One Horse	Heavy Teams, Two or More Horses	Automobiles a Day
A good gravel road will wear reasonably well and be economical with	50 to 75	25 to 30	10 to 12	100 to 150
Needs to be oiled with	—	—	—	Over 150
Oiled gravel fairly good either hot or heavy cold oil ½ gallon coating (cold oil must be used yearly)	75 to 100	30 to 50	20	500 to 700
Water-bound macadam will stand with	175 to 200	175 to 200	60 to 80[1]	—[2]
Dust-layer will prove serviceable on such macadam with	—	—	—	50 to 100
Macadam will then stand (but the stone wears, of course) with	—	—	—	300 to 500
Water-bound macadam with hot oil blanket coat will be economical with[3]	150 to 200	75 to 100	25 to 30	Up to 1,400
Will stand at least[5]	—	—	—	—
But will crumble and perhaps fall with over	—	100[6]	50[6]	—

[1] Perhaps more.
[2] Not over 75 at high speed.
[3] The large number of automobiles seems to keep the oil rolled down when it would be cut up and crumble without this traffic. Water-bound macadam with a good surface coating of tar will stand a very large number of automobiles, but the commission has not used tar extensively as a surface treatment where there is heavy team travel.
[4] And more with fewer teams.
[5] Fifty motor trucks, probably more.
[6] On narrow tires; or loaded farm wagons, ice and wood teams, etc.

The Commission emphasizes the necessity of a traffic study for the purpose of helping the road engineer determine the type of road to build, and the best method of maintenance. The experience in Massachusetts and elsewhere has shown conclusively that large numbers of swiftly moving automobiles cannot successfully be carried over a water-bound macadam road or over a gravel road. Such a road becomes ravelled very rapidly, rutted and disintegrated. Traffic studies indicate that from 50 to 100 automobiles a day make the use of some dust-layer or binder necessary, and its use would possibly prove economical on a road where there is even less motor

traffic. With the motor traffic which Massachusetts already has it has been found necessary, both for economy and for efficiency, where a road has heavy team traffic as well, to adopt in construction or resurfacing some form of bituminous mixture for the upper two or three inches of the road surface, at least, or some stronger road, like concrete. In many places, the Commission believes, such construction or reconstruction, has been, and will be, economical.

Conclusions Summarized.—A table has been included in the report showing as nearly as may be the results which have been observed after four years of experience with bituminous materials, comparing these results with the traffic going over the road in 1909 and again in 1912. The Commission realizes fully that more experience will undoubtedly cause it to change or modify some of its present opinions, but they are submitted for what they are worth as indicating the result of its experience in Massachusetts.

The standard road is 15 feet in width of macadam, with three-foot gravel shoulder on each side.

RESISTANCE OF THICK CYLINDERS TO RUPTURE.

According to M. Malaval, in "Rev. de Metallurgie," in a tube of the proportions of gun practice, the thickness about equal to the calibre, there are two distinct periods besides the elastic range. This is followed by the range of semi-elasticity or partial failure, which is of sensibly the same duration in stress. With increasing applied pressures the area of overstressed metal widens radially outwards. Thus if the pressure is released the outer elastic zone is prevented from returning completely to its original shape by the permanent deformation of the inner plastic zone. The mutual action causes the unloaded tube to be stressed in tension in the outer region and in compression in the inner, so that it is in the condition of an ideal shrunk composite tube—i.e., one with an infinite number of indefinitely thin components whose mutual pressures are such that under rising internal pressure all parts reach the elastic limit simultaneously and bear equal parts of the load. The semi-elastic period ceases when the outside layer reaches the limit of elastic deformation and is followed by the periods of general failure. During this period, covering an increase of resistance much greater than those of the first two periods, all parts show an increase of resistance, the inner region being in compression and the outer in tension. It follows that the metal, whose capacity for deformation is greater in compression than in tension, can withstand very considerable internal strains. It is concluded that the ordinary shrinking process might be replaced advantageously by one involving initial overstraining of a solid tube. A gun so constructed would withstand a pressure of over 1,500 kilogrammes per square centimetre (213,300 pounds per square inch).

The statistics of the report of Mr. J. McLeish on Economic Minerals and Mining Industries of Canada, contains the following record of production of pig iron:—In Ontario, in 1911, 526,635 tons valued at $7,606,939, in 1912, 589,593 tons valued at $8,176,080; in New Brunswick in 1911, 31,120 tons valued at $69,464, in 1912, 71,520 tons valued at $127,716; in Nova Scotia, in 1911, 390,242 tons valued at $4,682,904, in 1912, 424,994 tons valued at $6,374,910; in Canada, in 1911, 917,535 tons at a value of $12,307,125, while in 1912 an increase is shown in the production of 1,014,587 tons at a value of $14,550,999.

LIQUID, SOLID, AND GASEOUS FUELS FOR POWER PRODUCTION.

IN a paper presented a month ago to the Engineering Section of the British Association, by Prof. F. W. Burstall, of the University of Birmingham, the means by which carbonaceous substances might be treated to render them suitable for the production of power were touched upon. The address has just appeared in extracted form in *The Iron and Coal Trades Review*, and is reproduced herewith:—

The fuel of the world, he said, consisted of two forms—liquid and solid, both of which were closely related inasmuch as they consisted of compounds of carbon and hydrogen, together with small percentages of other substances, such as nitrogen. Most engineers looked upon coal purely from the point of view of fuel to be used in a furnace for the production of heat. It was, however, a complicated substance from which could be extracted a wide range of valuable products.

There were points in the use of gaseous fuel which led to serious difficulties. In order to secure efficiency the main mass of the air must be heated by compression before the principal heat supply was added. The combustible gas might be added before compression began, as in the well-known Otto cycle, but this introduced the possibility of the charge igniting before the correct time. It also required that the gas should be free from any liquid or solid substances, a state of affairs not easy to obtain on a large scale. If the gas were compressed in a separate pump there was a certain loss of heat due to necessary cooling of the pump. With a liquid fuel there was no difficulty in forcing the small amount of oil required into the pre-heated air, and the oil was readily freed from foreign matter; also, there did not appear to be any inherent reason why the oil engine should not be made in the largest sizes, beyond those of weight and cost, where it must always be inferior to the rotary machine.

Passing on to deal with the gas turbine, Prof. Burstall said it could readily be shown that the velocities which had to be dealt with were no greater than those encountered in the steam engine, but there were difficulties which, in spite of innumerable efforts, had so far proved insurmountable. The greatest defect was that, so far, it had not been found feasible to compress the air and gas in the turbine itself. Separate compression considerably increased the losses, so that in place of the negative work being one-third of the gross work it would probably be at least one-half. and perhaps more. The cooling of the rotating disc and blades offered difficulties, and further, no material had been found so far that would withstand the erosive effect of the burning gases. It seemed very doubtful if the gas turbine could be constructed to compete with the reciprocator in the present state of knowledge.

It was important to consider the amount of various fuels raised in various parts of the world. At present about 1,200,000,000 tons of coal of various kinds were brought to the surface every year; crude oil amounted to about 50,000,000 tons per year, and it was doubtful if there were any large oil fields yet to be discovered. It, therefore, followed that the supply of oil was totally inadequate in amount to replace coal for power production on a scale equal to the present steam-power production. The artificial production of oil was at present being considered seriously by engineers, and much yet remained to be discovered in this field. Every engineer was familiar with the fact that when coal was heated in a closed retort gas and tar were given off, and also that the higher the

temperature at which gasification took place, the greater was the yield of gas and the smaller was the amount of tar formed.

Up to the present coal had been gasified with the object of obtaining the highest yield of gas, but it was quite possible to alter the conditions of carbonization so as to obtain a high yield of fuel oils and other compounds of value as by-products, and an important one was sulphate of ammonia, the use of which as a manure was steadily increasing in all countries of the world. Sulphate of ammonia was the most valuable manure where nitrogen was needed, and it was one of the greatest defects of the crude burning of coal that such enormous amounts of nitrogen were not only wasted, but turned into nitric acid in the atmosphere. Of course, the nitric acid was returned to the soil by the agency of rain, but not necessarily where required by the cultivator.

For one ton of coal gasified in a modern gasworks 11,500 to 12,500 cub. ft. of gas were obtained having a calorific value of about 550 B.T.U. per cub. ft., and also about ten gallons of tar and 25 to 30 lbs. of sulphate of ammonia. The gas had to be purified for domestic purposes; also a gasworks had to be near a great town where the working expenses were not so low as in a more rural part. For these reasons it was doubtful if town gas could be supplied under present conditions for much under 10d. per thousand cub. ft. Despite these facts, Prof. Burstall said he held the opinion after mature consideration, that the whole problem of fuel treatment would lie in the direction of heating the coal, peat or lignite in a closed retort; not necessarily under the conditions which were at present forced on to the gasworks, where the primary object was to produce a big yield of gas of a certain standard as laid down by Parliament. If it be granted that the quantity, quality and purity of the gas produced were a secondary matter, the problem of fuel treatment became one of the most fascinating problems which the engineer could encounter. It had long been known that the quantity and quality of the tar was largely influenced by the temperature at which the fuel was carbonized, the lower the temperature the better were the tars in both yield and composition. The amount of sulphate of ammonia recovered from the gas was only some 25 to 30 lbs. per ton of coal, whereas the amount of nitrogen present in the coal would give about 120 lbs. of sulphate of ammonia. In the ordinary process of carbonization some three-quarters of the nitrogen was left behind in the coke. Under present conditions this could not be avoided, but improvements in this direction were possible. If the gas and tar were withdrawn from the heat directly they were evolved from the coal, a set of products would be obtained of a different composition from those usually obtained.

Prof. Burstall then outlined a scheme of fuel treatment which he admitted was at present wholly beyond the region of practical realization. The first step was to obtain a coal field of wide extent yielding a coking coal, the essential point being to obtain a sufficient supply of coal to enable the capital charge to be repaid in a series of years—probably thirty. The works would have to be on a large scale to economize cost of working, but the carbonization plant would be placed near the pit-head, so that the tubs could discharge direct into the bunkers of the retort-charging machines. A convenient size for each plant would be about 2,000 tons per day, and there would be some five to six pits operating over quite a large area. There would be no gain from any point of view in not shipping the coke and sulphate of ammonia direct from the pit-head, as these would be ready for market without further treatment. Tar and gas would be taken by pipe lines to suitable points for their future treatment, depending upon geographical considerations. The tar from the whole of the works would be passed through continuous and automatic stills, where the various fractions would be obtained with the least expense. The fractions, after working with acid and soda, would pass to a second set of automatic stills, this process being continued until the pure produces ready for market were obtained without the necessity for storage and in the least possible time. As to how far the treatment of residuals should be carried, no definite answer could be given, as it depended on the current prices, but on the scale considered, viz., 120,000 to 140,000 gallons of tar per day, it would certainly be advantageous to treat the products to a finish.

That portion of the gas not required for firing the automatic stills and for colliery purposes generally would be led to a different point, perhaps many miles from the pit-head. This offered no difficulty as regards the power required, the great obstacle being the cost of the pipe line, which might to a large extent be reduced by gasholders at the delivery end so as to improve the load factor on the pipe line. The gas would be free from tar, but would contain the sulphur compounds, and would be employed in gas engines for the generation of electricity at high voltages.

No doubt electrical engineers would look askance at gas engines, not only from the many failures that had occurred with some of the large engines, but also at the fact that at present some 2,000 h.p. was about the largest size that could be built, whereas a steam turbine could be constructed to give an output of 20,000 kw. at a low first cost. The gas engine could only compete with the steam turbine when its gas was delivered to it at a price which, when helped by its high thermal efficiency, would enable it to recoup its large capital outlay. But perfect as was the steam turbine as a mechanical machine, its thermal efficiency was half that of its rival, as the cost of the steam delivered to it could not be reduced. There were also no by-products. For these reasons it was quite possible for the gas engine to produce current more cheaply than the turbine, but the price of gas of a calorific value of 500 B.T.U. per cub. ft. would have to be 4d. per thousand cub. ft. if coal be taken at 20s. per ton. This would give for each fuel about 125,000 B.T.U. per penny, and taking the gas engine as 2½ times as efficient as a turbine, this should leave enough margin to compensate for the increased capital outlay. The exhaust gases would be washed so as to extract the sulphuric acid, which would be returned to the pit-head in the manufacture of sulphate and the washing of the tars, so that the only external material to be purchased would be the soda ash used to neutralize the excess acid. In this manner the whole of the products of the coal would be recovered in a form ready for the market, and if the coke were used as a domestic fuel a smoke-laden atmosphere would be impossible.

Producer gas for power and heating purposes had a large field in front of it, particularly when the factory was distant from the coal fields, and also where there was a steady load. In producer gas the whole of the fuel was converted into gas and tar, so that a large quantity of gas—120,000 to 140,000 cub. ft.—could be obtained per ton of coal. The ammonia yield was very high, being 80 to 90 lbs. of sulphate per ton; the calorific value of the gas was low, about 140 B.T.U. per cub. ft., and the tar was small in quantity and poor in quality, as it was nearly all pitch. The low calorific value and the difficulty of cleaning the gas were serious drawbacks to the transmission over long distances. In South Staffordshire, how-

ever, producer gas had been piped over a wide area for several years, and the undertaking now appeared to be on sound financial ground. The suction producer working on coke or anthracite coal had a very definite position for small plants in remote districts, where it formed a cheap and reliable source of power.

Taking the question of producer gas as a whole, it looked as though it would always have a definite use, but only a limited application, more especially in a country like Great Britain, where in time it would be possible in most parts to obtain electricity cheaply in bulk, and when this was the case no other source of power need be considered.

The case of coke ovens readily fell into the same class as the retorted gas, the only difference being that to obtain coke capable of carrying the weight of the iron in the blast furnace, the temperature of carbonization must be high—1,200 deg. C., and the period long—24 to 30 hour; thus the tars were poorer from being more split up, and the cost of repairs to the ovens was considerably higher than on a gasworks retort. As hard coke must be made, the place for it was in conjunction with the ordinary plant, so that the by-products might be readily worked up.

Discussion.—Mr. W. M. Mordey said that Prof. Burstall had held out little hope that the gas turbine would be a practical tool in the near future, but there was one solution which occurred to him, viz., the adaptation of the Humphrey gas pump with a water turbine, allowing the water to drive a dynamo. The overall efficiency of the Humphrey pump in water horse-power was said to be something like 30 per cent., which was very high, and if the pump could be used in conjunction with a water turbine which had an efficiency of about 85 per cent., an overall efficiency of the combined pump and turbine of 25 per cent. would be obtained. Such a solution would very much simplify the problems now presented by the gas turbine and provide at the same time a direct means of driving a dynamo by a simple rotating motor. This method would give an efficiency as high as any large gas engine would give in continuous work in a much more simple manner.

Dr. J. S. Owens, dealing with the suggestion of the carbonization of coal at high temperature in order to get all the possible by-products, said that this produced a coke which was unsuitable for domestic use. Coke would not burn well unless there were a certain amount of volatile matter left in it, and such coke gave a very unpleasant-looking fire. With reference to the loss of nitrates from coal, recent experiments on the deposit in London had shown that the soot and dust falling on a given area measured in three or four places in the city was six times as great as in the suburbs. The total deposit was 500 tons per square mile per annum. On the general question of the utilization of oil, gas or solid fuel, we were apt to forget that very much of the prosperity of England depended upon the utilization of its coal supply, and it seemed to him that we should almost eliminate—except as an academic question—the utilization of oil other than the oil derived from our own coal, because otherwise we would be cutting our own throats.

Prof. Burstall, in winding up the discussion, said he had not said anything about the Humphrey pump, because he did not think it could be made in sufficiently large sizes to warrant any application of the sort suggested. With regard to the coke mentioned by Dr, Owens, he did not wish it to be assumed that the method he had indicated would be the same as was at present employed in gasworks. Gasworks at present were terribly handicapped and did not do what they could if they were free from Acts of Parliament which saddled them with penalties not imposed upon any other industry. If the coal were burned in a retort at a temperature of from 800 to 1,000 deg. C. and means taken by which the gas and tar were at once removed, they got a substance which was quite unlike gas coke, because gas coke was usually quenched in water, which was quite wrong. If the coke were placed in a closed vessel and cooled by conduction alone on the Montreal system, a coke would be obtained which would burn perfectly and which gave a very bright and clear fire. The only difficulty with it was that it burned away more quickly than was desirable. It was possible to regulate the products by altering the pressure and temperature inside the retort more than the majority of people were disposed to think, and it really was a question of what happened to be the most valuable product at a particular time. The best results were 14 gallons of tar, from 2 to 2½ gallons of light spirit suitable for motor-car work, and 3 to 4 gallons of fuel oils suitable for Diesel engines, so that a very large proportion of useful substances could be obtained without sacrificing anything.

PLANT OF CANADIAN-VICKERS, LIMITED, MONTREAL.

Principally through the determination of the people of the Dominion of Canada to ultimately possess a navy under their own control, the opportunity of establishing a shipyard in Canada with brilliant prospects for continuous work has arisen. Quick to seize this opportunity Messrs. Vickers, Limited, of England, under the name of the Canadian-Vickers, Limited, are establishing a complete ship-building and ship-repairing plant in Montreal, capable of constructing and repairing the largest vessels using the port of Montreal.

For repair purposes a floating dock was sent out from England capable of lifting 25,000 tons and repairing a ship 700 feet in length.

For ship construction a slip 600 feet in length, but capable of extension, is being constructed on land reclaimed by the Harbor Commissioners at Maisonneuve.

For the walls of this slip and for adjoining machine shops and factories, approximately two thousand concrete piles are being used.

After exhaustive inquiries into the different types of concrete piles on the market, the owners decided that the most reliable was the Pedestal Pile, which had been used with most gratifying results by the governments of the United States and Canada and by the majority of large corporations in both countries. The pile is driven exclusively by the MacArthur Concrete Pile and Foundation Co., of New York, who possess the patent rights for the United States, Canada and other countries.

The general contract was awarded to Mr. E. G. M. Cape, one of Montreal's leading contractors, while the piling was placed in the hands of the MacArthur Concrete Pile and Foundation Co.

Seven hundred and forty-seven of these piles, averaging about 22 feet in length, have been driven under the ship-building slip. Four tests were made with most gratifying results, a load of 45 tons, 50 per cent. more than the load the piles were to bear, showing no appreciable settlement.

The piling required for the shops, etc., is now being driven.

IMPROVED MANAGEMENT OF WATERWORKS.*

Paul Hansen,
Engineer, Illinois State Water Survey.

THE object of this paper is to advocate the employment, on an annual basis, of consulting experts in connection with the operation of small waterworks installations for the purpose of improving the service, the equipment, and the economy of operation. This is by no means a new practice, but it is exceedingly rare, whereas it should be virtually universal.

The means by which the expert's services may be rendered are by occasional visits, say, monthly or quarterly, by the training of the men locally employed, by the periodic examination of records and accounts maintained in accordance with instructions furnished by the expert and finally, by reports with recommendations, submitted at regular intervals. Not more than a few days per month would be occupied by the work involved, and the service may be rendered at what, comparatively speaking, is a nominal fee. For supervising waterworks in a small community $600 should yield a fair compensation. Perhaps a more satisfactory method would be to base the fee upon the gross receipts, making it a suitable percentage thereof.

Need for Expert Supervision.—It is hardly necessary to point out that there is a real need for improved management of waterworks, for the reason that most engineers who have had anything at all to do with waterworks are aware of the very general slipshod methods employed. During the past eight years the writer has had occasion to visit or receive reports upon about two hundred small waterworks in the States of Ohio, Illinois and Kentucky, and not an instance is recalled of a small waterworks installation (that is to say, for a town having a population of about 25,000 or less), where thoroughly effective methods of management were being employed. This does not infer that all these waterworks installations were not giving good service. As a matter of fact, some were giving good service, but generally at unnecessarily large expense, and without adequate records and accounts to show where economies might be instituted. The great majority, however, were giving very inferior service, and showed every outward evidence of carelessness and neglect in management.

Possible Objections to Expert Supervision.—The method of improving the management herein discussed is not advocated for the purpose of increasing the business of consulting engineers, but because it seems the only practicable method whereby the desired results can at present be accomplished. In large waterworks, of course, it is perfectly feasible to engage the entire time of an expert and designate him as general manager. In small waterworks, however, it is not possible to afford the continuous services of an expert. The men ordinarily employed, while they may be intelligent and conscientious, have not had the opportunities of securing the necessary training and experience to render most effective service. But such men, backed by an expert, are as a rule capable of securing highly efficient results. More generally it is found that the waterworks has become a political football and is relegated to the mercies of very incompetent men. In such cases the consulting expert has a very difficult problem, but by tact and by appealing to the more enlightened sentiment of the community he may accomplish a great deal, and because of the very fact that things are in a run-down condition the results of his efforts will be all the more striking.

There may exist the feeling among some, that the supervision of waterworks should be entrusted to local engineers in general civil engineering practice. This would, as a matter of fact, be an injustice to such engineers for the reason that their numerous other duties and employments rarely permit them to acquire the necessary expertness in the restricted field of waterworks. It would appear, therefore, that no conflict of interest exists between the consulting expert and the local engineer. On the contrary, the local engineer should be the first to recognize the necessity of the services of an expert in waterworks operation.

Some persons lean to the belief that supervision over public waterworks should be maintained by some central State authority, and such supervision is certainly desirable, in so far as the sanitary quality of water supplies is concerned. But to enter into the economic phases of waterworks operation to the extent of giving the close supervision herein contemplated, would be altogether impracticable. It would involve the maintenance of an expensive and cumbersome bureau engaged in performing functions which are primarily of local concern, and, moreover, the mere fact that the services of such a bureau would be foisted on the local community would cause the local authorities to be generally antagonistic toward the bureau's requirements. It is not practicable for any central body to go further in this matter than to do just enough to demonstrate the value of expert services in waterworks operation and leave the rest to municipal and private enterprise.

Results Obtainable through Expert Supervision.—Specifically, the results obtainable through expert supervision of a waterworks are:—

1. Better service.
2. Reduction of cost of operation, which, of course, means increased earnings.
3. Anticipation of future requirements.
4. Improved design.
5. A professional and personal advantage to consulting engineers.

Better service means furnishing, throughout the community, an ample quantity of pure and clear water for domestic and industrial purposes, and providing a liberal safeguard against disastrous fires.

Decreased cost of operation means a supervision of all the details of operation in such manner that effective service will be rendered at minimum expense.

Anticipation of future requirements means that all necessary increases in the supply and equipment will be foreseen, so that they may be provided before the community is reminded of its needs by destructive fires, inadequate equipment, or disastrous epidemics due to the pollution of the water.

Improved design will result from a better knowledge of operating conditions than is ordinarily obtainable under present practice by those entrusted with the preparation of plans and specifications. The structural features can generally be readily taken care of, but a common fault is a failure to provide for contingencies encountered in operation. Under the present regime the consulting engineer's connection ceases at about the time that operation begins, and if he has any curiosity to learn if his designs are working out successfully he must satisfy his curiosity at his own expense.

A personal advantage accrues to the consulting engineer from supervision over the operation by giving him continuous and regular employment, thus enabling

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him to maintain his organization intact. Further, it benefits him professionally by enabling him to concentrate his practice within a limited field, and thus he has the opportunity of increasing his detailed knowledge along his chosen line; in short, he renders himself more expert. There are many men in consulting practice to-day who attempt to cover such a broad field that it may be frankly said they are not thoroughly competent in any one line.

Modus Operandi of Expert Supervision.—For the purpose of illustration and not with any intention of giving a treatise on how to supervise waterworks operations, a brief description will be given of the manner in which expert supervision should work out. Three factors form the basis upon which this work is conducted:—

1. Operation Records, relating to the physical facts connected with waterworks operation.

2. Financial Accounts, relating, of course, to the finances.

3. Technical Skill, which is required in obtaining and interpreting the operation records and financial accounts in such a way that all of the needs of the waterworks plant are fully revealed.

It will be of advantage to inquire a little more fully into these three items and consider them separately.

Operation Records.—Records may be subdivided into several groups as follows: Those relating to source of supply, purification works, pumping station, and line distribution system.

(*a*) *Records Relating to Source of Supply.*—Records relating to the source of supply comprise measurements of the quantity of water available, sources of possible pollution and analyses of the water.

The measurement of the quantity of water available may be made in a variety of ways, some simple, some elaborate, depending upon the character of the source of supply. At any rate, such records are exceedingly valuable in forecasting the adequacy of the source of supply for future requirements. In the southern part of Illinois are two communities, each of which obtain their water supply from an impounding reservoir. During the past summer both of these reservoirs went practically dry, and remained so for some months. In one case no emergency supply could be secured, the community suffered for want of water for ordinary domestic purposes and was left helpless against a conflagration.

In the case of surface-water supplies, the records relating to the condition of the watershed, particularly if the water is used in an unpurified condition, are exceedingly important. Inspections of the watershed, when intelligently made, are much more reliable than analyses in showing dangers to health. It is merely necessary to mention the Plymouth, Pennsylvania, epidemic of typhoid fever in 1885 to demonstrate the futility of analyses in detecting intermittent pollution, such as was responsible for that disastrous outbreak.

Analyses, however, should not be ignored, especially when it is possible to secure a long series of analyses, as they then become a measure of the pollution and give a record of the physical and mineral characteristics of the water. Where purification of the water is employed, such analyses are well-nigh indispensable, as will be discussed later.

It is much easier to give examples of the evil results of failure to maintain proper records regarding the source of supply than to give examples of water famines and other disasters that have been averted by the maintenance of such records. The latter instances are ordinarily not recorded and the danger is never realized by the general public.

(*b*) *Records Relating to Purification Works.*—A volume might be written upon this subject alone. Experiences with small filter plants are most disheartening. Practically all of the small filter plants in Illinois, numbering half a dozen or more, are being ineffectively operated. The same is true in Ohio and Kentucky, and, no doubt, in other States. Some of the difficulty is due to bad design. Very small filter plants are apt to embody bad design, whereas the conditions under which they are operated are such that they should embody the very best design.

Expert supervision over mechanical filter plants (those most generally used in the middle west) does not necessarily result in reduced cost because of the prevalent reprehensible custom of omitting the use of coagulant when the raw water is moderately clear, but within the limits of efficient purification the cost can undoubtedly be reduced. The average small purification works is placed in charge of a pumpman or fireman, having many other duties to attend to, and it is but natural that this, combined with his lack of knowledge of water purification, results in almost total neglect. In many instances such men, through ignorance of the danger of impure water to public health, have no hesitancy in by-passing the raw water into the mains when it becomes convenient to do so.

Records necessary for maintaining proper supervision over mechanical filter plants include analyses of the raw and filtered water, the quantity of water treated, quantity of chemicals used, the frequency of washing the filters, the quantity of wash water used, and numerous other details. For obtaining analytical data there should be established, in connection with every filter plant, however small, a modestly-equipped laboratory. It is an easy matter to train any ordinary waterworks employee of normal intelligence how to make simple analytical determinations which will not only furnish the desired records, but will guide the filter attendant in his daily operation of the plant. If the expert has laboratories at his command, additional analytical control may be maintained on a somewhat more elaborate scale.

(*c*) *Records Relating to Pumping Station.*—A small waterworks pumping station, for which complete records are maintained, is a great rarity. Often it is impossible to get even an approximation of the quantity of water pumped, and generally the only records are from pump revolution counters without any allowance for slippage. It is a comparatively simple matter to weigh the coal and ash, to maintain pumping records both from revolution counters on the pumps and from a meter placed upon the main discharge from the station, and records of the discharge pressure, suction lift, quantity of boiler water used, etc. With such items as these it is possible to always know the condition of the pumps, figure accurately the station duty, and otherwise reveal opportunities for improvement and cutting down the demands on the coal pile. The expert can also arrange, where conditions warrant, for purchasing fuel and possibly other supplies on an analytical basis.

(*d*) *Records Relating to Distribution System.*—Most deplorable of all are the records ordinarily maintained in connection with the distribution system. The location of mains, valves, and service connections is generally stored in the memory of ex-waterworks employees and local plumbers, who regard these facts more or less as stock-in-trade, and would consider it business suicide to record them. In many towns there is no vestige of

a map of the distribution system to be found, and where such maps do exist it is only occasionally that they show mains laid since the original waterworks installation. It is not strange, therefore, that extensions to the distribution system are generally unwisely made, that fire pressure is often lowest where most needed, and that there are many undetected leaks and thefts of water. In the hands of an expert all of these difficulties may be easily overcome simply by the maintenance of complete maps and plans, by periodic inspections, and by occasional tests for pressure, leakage, and waste.

Financial Accounts. — Waterworks accounting, especially in municipally-owned establishments, is usually in a chaotic state. About all that is ordinarily recorded are the gross receipts and gross expenditures, roughly itemized. Capital accounts are almost unheard of, and it is often impossible to get even approximately the cost of the plant. In many municipal plants large donations from public funds are calmly included as earnings. Such items as depreciation, allowances for taxes, interest on investment, sinking fund, rent, etc., are altogether ignored. If the gross receipts, no matter from what source exceed the gross expenditures, no matter for what purpose, a profit is proudly proclaimed. In some instances, on the other hand, large numbers of free service connections make a waterworks appear as a losing proposition, whereas suitable compensation for such services would place the plant upon a sound financial basis.

Correctly-maintained accounts should display fully itemized capital accounts, maintenance accounts, repair accounts, replacement accounts, sinking fund accounts, depreciation accounts, interest accounts, and, in fact, every item that enters into waterworks construction, operation, and maintenance should be carefully recorded in its proper place. In addition, there should be maintained accounts showing unit costs for operation and construction. These latter are very valuable in making comparisons with other plants and with the same plant in other years. Accurately-maintained accounts are particularly serviceable in the adjustment of water rates. The establishment of water rates is, at the present time, on a most unscientific basis, and it is common practice for small communities to adopt, parrot fashion, the rates established in some other community, regardless of the manner in which the water is obtained and the cost of delivering it to consumers.

Technical Skill.—But little can be said with respect to technical skill. It is primarily a matter of natural aptitude and experience, and it is needless to say that no one should presume to enter this field of consulting practice unless his natural aptitude and experience have rendered him fitted therefor. Aside from the maintenance of records and financial accounts it is necessary for the consulting expert to thoroughly instruct the men locally employed in their respective duties, and this necessitates, of course, skill and a thorough knowledge of such duties on the part of the expert. The analytical mind of the expert also enables him to discover opportunities for modifying methods of operation which the more or less untrained man would fail to see.

To summarize: The employment of consulting experts to supervise the operation of public water supplies and other public utilities in the small communities, constitutes a simple and the only practicable method whereby the operation of such utilities may be rendered efficient, whereby the design may be improved, and whereby there will accrue a distinct professional and financial advantage to the experts. Once this system is fairly tried it is hard to believe that it will not gain general favor.

BUCKET ELEVATORS.

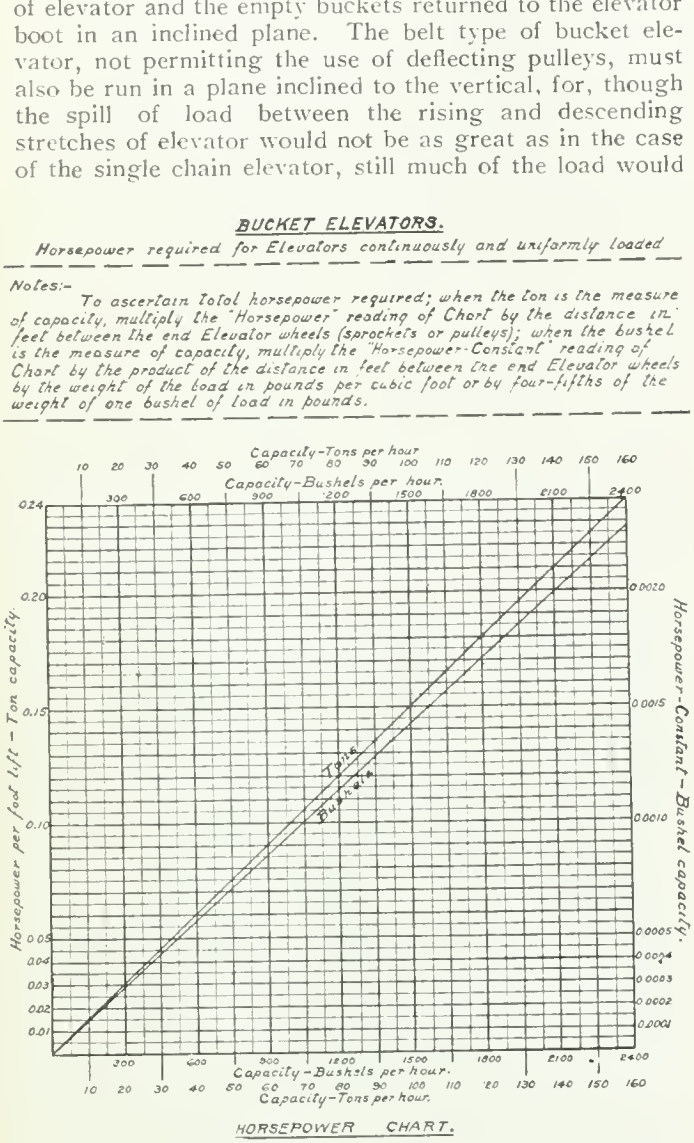
By Reginald Trautschold, M.E.

ALL the material handling equipment so far considered in this series of articles has one and the same drawback—so serious that in some installations use of such apparatus is impossible or inadvisable—and that is its limitations in elevating operations. Flight conveyers, belt conveyers and to some extent even screw conveyers are used to raise material from one elevation to a higher one, but such operation necessitates the load being carried up a comparatively gradual incline so that considerable space for equipment is necessary before any relatively great lift is possible; even when the elevating system consists of a system of several inclined conveyers that deliver their load from one to the other and are arranged as compactly as possible, such as systems of criss-cross conveyers. The logical procedure is to place the load in a bucket and raise it in a vertical or nearly vertical plane—that is, when space is not available for the more cumbersome arrangement of elevating in slightly inclined planes. By substituting a succession of relatively small buckets, attached to an endless chain or belt running over suitable sprockets or pulleys, so that they may be raised continuously, the material may be elevated in small individual loads so that at the higher elevation it is practically delivered in a steady and uniform stream, thus greatly increasing capacity of elevating apparatus and supplying the material in quantities that can be easily and rapidly handled from that point, when further conveyance is necessary, by other conveying machinery, or can be efficiently disposed of by chutes, etc. Such a system for elevating materials comprises what is known as a "bucket elevator."

Two general types of bucket elevators are in common use, those in which the buckets follow one another in close succession (continuous bucket elevators) and those in which the buckets are attached to chains or belts so that there is an appreciable space between succeeding buckets. The continuous type is not now as commonly used as formerly nor as commonly used as the standard type of bucket elevator in which the buckets are spaced further apart and at regular intervals. Continuous bucket elevators, however, possess certain advantages over the more common type of elevator, so cannot be overlooked in a comprehensive discussion. They will be considered then, but after taking up a careful study of the standard bucket elevator.

Bucket elevators in which the buckets do not follow one another in close succession may be of three general classes: 1st, those in which the buckets are attached to a single endless chain; 2nd, those in which the buckets are attached to two matched strands of endless chain; and 3rd, elevators in which the buckets are attached to an endless belt. Bucket elevators in which only a single chain is employed on which to carry the buckets are nearly always installed at an inclination with the vertical in order that the load may be properly discharged from the buckets as they pass around the head elevator sprocket, for a vertical elevator of this kind would spill a large portion of its load between the two runs of buckets, or, if run at such a speed as to assure proper discharge of load as the buckets passed the top of the head elevator sprocket it would be impossible properly to fill the buckets, to say nothing of the difficulty of properly handling the load discharged at the necessarily high speed. Equipment employing two chains for carrying the buckets may be similarly inclined or may be run vertically if choke sprockets are employed to deflect the

return (downward) run of conveyer close to the head elevator sprockets, or if the rising buckets are carried over a short more or less horizontal path before they descend to the elevator boot to be refilled—i.e., causing the path of the buckets to follow the outline of a right-angle triangle, the loaded buckets ascending the vertical stretch, then being carried and unloaded over a horizontal section of elevator and the empty buckets returned to the elevator boot in an inclined plane. The belt type of bucket elevator, not permitting the use of deflecting pulleys, must also be run in a plane inclined to the vertical, for, though the spill of load between the rising and descending stretches of elevator would not be as great as in the case of the single chain elevator, still much of the load would


BUCKET ELEVATORS.
Horsepower required for Elevators continuously and uniformly loaded
Notes:-
To ascertain total horsepower required; when the ton is the measure of capacity, multiply the "Horsepower" reading of Chart by the distance in feet between the end Elevator wheels (sprockets or pulleys); when the bushel is the measure of capacity, multiply the "Horsepower-Constant" reading of Chart by the product of the distance in feet between the end Elevator wheels by the weight of the load in pounds per cubic foot or by four-fifths of the weight of one bushel of load in pounds.
Capacity-Tons per hour
Capacity-Bushels per hour.
Horsepower per foot Lift - Ton capacity.
Horsepower-Constant - Bushel capacity.
Ton line
Bushel line
HORSEPOWER CHART.

fail to reach the discharge chute of the elevator and material would fall against the descending belt and be carried about the boot (lower elevator) pulley, causing disastrous wear to the belt, possible wreckage of elevator, etc.

Standard bucket elevators, of any of the three classes, are nearly invariably similar so far as their drives and loading equipment are concerned. They are driven, through a train of reducing gears ordinarily, by their head sprockets or pulleys and are loaded from an elevator boot which ordinarily contains adjustable take-up bearings for the boot sprocket or pulley by which the tension in the return run of buckets may be regulated—the excess slack taken up. Frequently the elevator is enclosed in a casing, from the elevator boot up, with suitable outlet for the discharge, which serves to protect the equipment from injury and to return any spill of the load to the elevator boot for re-handling. Modifications of these general types of elevators naturally exist, excluding special elevators for handling materials in barrels, boxes, bales, etc., etc., such as elevators in which the lower end consists of a more or less horizontal stretch over which the load is scraped or dragged, as in the case of a flight conveyer, before the buckets start their operation of elevating or where the upper end of the elevator is carried over a similar stretch before entirely discharging its load, but such modifications so closely resemble "bucket carriers" that they will be overlooked at present and referred to again when discussing the more complicated combined bucket elevator and conveyer, the bucket carrier. Limiting this discussion to the ordinary type of standard bucket elevator, therefore, further description is unnecessary owing to the extreme simplicity of the equipment.

Table VIII.—Capacity of Bucket Elevators (Standard Buckets)—Tons Per Hour. Material Weighing 100 Pounds Per Cubic Foot. Elevator Speed, 100 Feet Per Minute.

Size of Buckets	Buckets spaced 12 in.	15 in.	18 in.
5 in. x 4 in.	6.50	5.35	4.25
6 in. x 4 in.	7.75	6.00	5.00
8 in. x 5 in.	19.00	15.00	12.50
9 in. x 5 in.	21.25	17.00	14.00
10 in. x 6 in.	34.50	26.75	23.00
11 in. x 6 in.	37.75	30.00	25.00
12 in. x 6 in.	41.25	33.00	27.25
14 in. x 6 in.	48.00	38.50	32.00
16 in. x 6 in.	55.00	44.00	36.50
18 in. x 6 in.	61.75	49.25	41.00
20 in. x 6 in.	69.00	55.00	46.00
14 in. x 8 in.	78.50	62.75	52.25
16 in. x 8 in.	90.00	72.00	60.00
18 in. x 8 in.	100.00	80.00	66.00
20 in. x 8 in.	112.00	90.00	74.00
24 in. x 8 in.	128.50	104.00	86.00

The capacity of bucket elevators depends, of course, upon the size of the buckets, their number and the speed at which the elevator is run. The size of bucket also depends somewhat on the character of the material to be handled for bulky materials naturally require larger buckets than those which might be entirely suitable for the handling of fine material. However, the average class of materials usually handled in bulk by bucket elevators does not vary so much as to prevent a fair average carrying capacity being fixed for a bucket of specified size. The shape of the bucket also effects the question of its carrying capacity, but here standardization of equipment has devised a shape of bucket that is almost universally employed or when modified for special installations, such as those in which the inclination of the elevator from the vertical is great, has a carrying capacity about the same as the standard bucket, which is fairly constant for any particular size (size expressed as length x width of bucket) so that, for all practical purposes, the length and width of the bucket determines its carrying capacity. The number of buckets, as they are invariably attached to the chain or belt at regular intervals, depends upon the spacing; while the capacity of any elevator buckets and their spacing being the same, depends directly upon the speed at which the elevator is run, i.e., speed of elevator chain or belt. Table VIII. gives the best ordinary capacity, in terms of tons per hour, of standard bucket elevators, equipped with various common sizes of standard elevator buckets at ordinary standard spacings, when the elevator is continuously and uniformly loaded with material weighing 100 pounds per cubic foot and an elevator speed of 100 feet per minute. For elevators handling material of other weight or at other speeds, capacity varies directly with the weight of the material per cubic foot and with the speed at which the buckets are run. Table IX. gives similar data expressed as the number of bushels of material that can be handled by such elevators in an hour. The question of most efficient speed at which

to run a bucket elevator, the condition upon which the capacity of the apparatus directly depends, is one concerning which there is a great diversity of opinion. It is generally admitted, however, that the most efficient speed for a standard bucket elevator is about the same as that for a flight conveyer handling similar material. Such practice is usually pretty correct and Table X., giving the average actual speed at which a number of very successful and efficient bucket elevator installations are run, confirms the rule.

Table IX.—Capacity of Bucket Elevators (Standard Buckets)—Bushels Per Hour. Elevator Speed, 100 Feet Per Minute.

Size of Buckets	Buckets spaced 12 in.	15 in.	18 in.
5 in. x 4 in.	114	91	76
6 in. x 4 in.	137	110	91
8 in. x 5 in.	335	268	223
9 in. x 5 in.	377	301	251
10 in. x 6 in.	610	487	406
11 in. x 6 in.	671	536	448
12 in. x 6 in.	732	586	488
14 in. x 6 in.	854	684	568
16 in x 6 in.	976	781	651
18 in. x 6 in.	1098	879	733
20 in. x 6 in.	1220	976	813
14 in. x 8 in.	1393	1104	929
16 in. x 8 in.	1592	1274	1062
18 in. x 8 in.	1791	1433	1194
20 in. x 8 in.	1990	1592	1327
24 in. x 8 in.	2388	1912	1592

In the consumption of power, bucket elevators are not particularly economical or efficient, for not only does the force of gravity act directly against the lift of the load but several other operations consume considerable power. For instance, there is the loss due to the inefficiency of the driving mechanism, comparatively heavy friction losses considering the fact that the number of bearings is quite small in any elevator, owing, in a chain elevator, to the individual friction in each link joint of chain which resists carrying the chain about the end sprockets, etc., and, in the belt elevator, to the unavoidable slippage between the elevator belt and the elevator pulleys, the resistance of the material in the elevator boot to the passage of the buckets through the boot as they pick up their load, etc., etc. There is also, in an inclined elevator, a certain slight consumption of energy in carrying the load from the vertical loading plane to the vertical discharging plane, but this latter requirement of power is actually so slight, as elevators are ordinarily installed, that it can be disregarded. The exact value of these inefficiencies and operations consuming power that is not instrumental in raising the load is difficult to ascertain, and no fixed law for arriving at the correct proportion to allow for such losses of power can be advanced. Manufacturers of bucket elevator equipment usually allow a margin of 50 per cent. to cover all requirements for power other than the theoretical amount that would be actually required to elevate the given load from the point at which it is received (in the elevator boot) to that at which it is discharged (over the head of the elevator). Numerous tests of various installations in actual operation tend to confirm this practice and though the percentages of power losses in various operations do vary considerably their sum is more constant and does actually amount to close to 50 per cent. In the derivation of Formulæ XVII., XVIII-a and b average losses and inefficiencies have been allowed for and the results obtained from the use of any of these formulæ will be found to agree very closely with the actual requirements of the average well-installed and properly cared for standard bucket elevator. Chart IV. presents the same data as the horsepower formulæ in a

Table X.—Efficient Speeds for Bucket Elevators Handling Various Materials.

Material	Advisable Speed
Coke	100 feet per minute
Broken Stone (coarse); Lump Coal—R/M	125 " "
Ashes, Lime and Cement	150 " "
Ore, Crushed Stone, Sand and Gravel	175 " "
Fine Coal	200 " "

convenient graphical form that enables the ascertaining of the power requirements of any ordinary installation to be made rapidly and with sufficient accuracy for practical purposes.

Horsepower:

H = distance through which load is elevated—height of elevator—in feet.
W = Weight of load elevated in tons per hour (capacity).
B = Bushels of load elevated per hour (capacity).
w′ = Weight of 1 cubic foot of load in pounds.
b′ = Weight of 1 bushel of load in pounds.

$$\frac{W \times 2000 \times H}{60 \times 33000} = \text{horsepower required to elevate load} = \frac{WH}{1000}$$

$$\frac{B \times 1.25\ w' \times H}{60 \times 33000} = \text{" " " " } = \frac{63\ Bw'H}{100{,}000{,}000}$$

$$\frac{B \times b' \times H}{60 \times 33000} = \text{" " " " } = \frac{50\ Bb'H}{100{,}000{,}000}$$

Power loss consumed in running apparatus..... about 17½%
Power loss due to dragging buckets through charged boot 25
Other unavoidable losses 12½

Then,

HORSEPOWER REQUIRED TO OPERATE BUCKET ELEVATOR:—

$$HP = \frac{15\ WH}{10{,}000} \qquad \text{Formula XVII.}$$

$$HP = \frac{95\ Bw'H}{100{,}000{,}000} \qquad \text{Formula XVIII-a.}$$

$$HP = \frac{75\ Bb'H}{100{,}000{,}000} \qquad \text{Formula XVIII b.}$$

Standardization of bucket elevator apparatus facilitates arriving at the cost of the average complete equipment, but the multiplicity of standard types of buckets, chains, etc., varies to a considerable extent the initial cost of even an ordinary installation, necessitating a formula for approximating the cost of equipment a number of constants that differ for the standard component parts of the elevator. However, as this discussion must necessarily be limited to a consideration of general practice and the class of bucket elevator usually found in installations of such character, it is possible to group the apparatus into classes in which exists an approximately constant relationship as to cost. For instance, the chains customarily employed for bucket elevators may be grouped into two classes: one represented by the ordinary detachable link chain, commonly known as the "engineering chain," and the other by the more costly "combination chain," a chain with malleable iron links and steel pins, or by the relatively expensive all-steel link chains, etc. The cost of the chains of both these groups varies closely with their strength or weight, which in turn varies with the load that the elevator is to handle—one group to a greater extent than the other. Practice has also pretty well standardized the spacing of the buckets for any particular size of elevator (size measured by length x width of bucket) so that the load on an elevator can be expressed in terms of size of bucket, height of elevator and weight of the material handled. A similar relationship exists for elevators employing belts instead of chains upon which to carry the buckets. The elevator buckets are usually of steel or of malleable iron, the latter type of bucket being employed when the load to be handled possesses certain chemical properties or is of a temperature that would

be injurious to steel elevator buckets. The weight of the bucket, governed by the thickness of its walls, depends nearly entirely upon the weight of the material to be elevated. These definite relationships, and the fact that the capacity of a standard proportioned elevator varies with the size of the buckets employed, permit the expression of the cost of the necessary elevator buckets at so much per foot of elevator, depending upon their size, the weight of material handled and whether of steel or malleable iron construction. The balance of the necessary equipment, consisting of elevator boot, drive, sprockets or pulleys, shafting, bearings, etc., does not vary so much in cost with the load carried as with the size of the buckets—at least, in the ordinary installation. In fact, grouping must again be resorted to, for the cost of these parts does not vary to any great extent for elevators of about the same size—that is, the cost of these parts for 8″ x 5″ elevator would not differ much from the cost of similar parts for a 10″ x 6″ elevator. The average carrying capacity of these two sizes of elevators, however, would vary by nearly 100 per cent. All these relationships and conditions are taken into consideration in the derivation of Formula XIX. and a certain allowance is also made for the cost of the elevator discharge chute, so that the costs obtained through the use of this equation will be found to be approximately accurate in the majority of simple bucket elevator installations. It must be remembered, however, that no allowance is made for an elevator casing and, if such is required, it should be figured upon as an extra item—an item of convenience or safety that does not necessarily affect the economic value of the installation.

Initial Cost:

C = Cost of complete bucket elevator equipment in dollars
H = Height of elevator in feet—distance load is raised.
wl = Size of elevator (buckets) = width x length in inches.
S = Spacing of buckets in inches.
w′ = Weight of material elevated (load) in pounds per cu. ft.

$$\text{Cost of elevator chains (engineering chain)} = \frac{0.00656\ wlH}{S} \times w'$$

$$\text{(combination chain)} = \frac{0.01312\ wlH}{S} \times w'$$

$$\text{Cost of elevator belts (high grade rubber)} = \frac{0.00437\ wlH}{S} \times w'$$

$$\text{Cost of standard steel elevator buckets} = \frac{0.02592\ wlH}{S} \times w'$$

$$\text{Cost of malleable iron elevator buckets} = \frac{0.04493\ wlH}{S} \times w'$$

Cost of boot, drive, pulleys, etc. (D = constant) = Dwl.

Then :—

$$C = \frac{(A + B)wl \times H \times w'}{S} + Dwl \qquad \text{Formula XIX.}$$

Where :—

A = Constant = 0.00656—standard detachable chain.
= 0.01312—combination chain.
= 0.00437—high grade rubber belt.

B = Constant = 0.02592—standard steel elevator buckets.
= 0.04493—malleable iron elevator buckets.

SINGLE CHAIN ELEVATORS.

D = Constant = 1.56 when wl does not exceed 24 square inches
= 1.09 when wl exceeds 24 square inches

DOUBLE CHAIN AND BELT ELEVATORS.

D = Constant = 2.01 when wl does not exceed 24 square inches
= 1.40 when wl equals from 30 to 66 square inches
= 1.18 when wl equals from 72 to 96 square inches
= 1.11 when wl exceeds 100 square inches

Assuming that an ordinary installation of bucket is properly cared for and that it is subjected only to the service for which it was designed, Formula XIX. may be greatly simplified and a close approximation of the initial cost of equipment expressed in terms of average tonnage capacity and height of elevator. Such a general equation would not be as accurate for purposes of forming an estimate of the cost of an installation, but is quite accurate enough for purposes of arriving at the probable net operating cost, where the fixed burden of interest on investment, taxes and insurance represents but a comparatively small percentage of the initial cost of equipment. Calculations of depreciation, etc., may be made on such a general equation, for, though depreciation is not constant for elevators subject to all kinds of service or even to average service, the error or increase in depreciation for an elevator handling heavy material would be in large part compensated for by the excess fixed burden charge that would arise from the error in the initial cost, as obtained from the use of such general formula, such initial cost being in excess of the real cost. The expense for power, supplies, etc., being nearly directly proportional to the load handled and height of the elevator and, being a considerable expense in "net operating cost," can be pretty accurately figured and has a marked effect upon the accuracy of Formula XX., by the use of which a conservative and fairly reliable opinion can be formed of the probable net operating cost of any ordinary installation of bucket elevator, knowing the actual cost of power.

Net operating cost (N.O.C.):—
H = Height (distance) through which load is elevated in feet.
= Height of elevator.
W = Weight of load elevated in tons per hour (capacity).
Average cost of equipment :—
= 0.000328 WH + 0.003484 W.
Fixed charges :—
Interest - 6% total cost)
Insurance - 1% = 0.000027 WH + 0.000296 W
Taxes - 2%—¾ cost)
Depreciation, renewals, etc. :—
On elevator buckets .... = 0.000090 WH
elevator chain or belt = 0.000012 WH
balance of equipment = 0.000523 W
Depreciation account = 0.000010 WH + 0.000052 W
Total depreciation, etc. = 0.000112 WH + 0.000575 W
Yearly burden :—
= 0.00014 WH + 0.00087 W
Horsepower, attendance, supplies, etc.:—
P_c = Price (cost) of a horsepower per hour.
N = Number of hours (total) elevator is in use per year.
Cost of power = 0.0015 WHNP_c
attendance, etc. = 0.000075 WHN
supplies, etc. = 0.000055 WHN
Burden depending on use of elevator = 0.0015 WHNP_c + 0.00013 WHN
Then :—
Net operating cost (N.O.C.) per ton :—

$$\text{N.O.C.} = \frac{112\ H + 575 + (130\ H + 1500\ HP_c)\ N}{1{,}000{,}000\ N} \qquad \text{Formula XX.}$$

Examples:

1. Conditions :—
Material elevated 50′ 0″ = H
Service ... . 2400 hours per year = N
Cost of power .. $0.02 per horsepower per hour = P_c

$$\text{N.O.C.} = \frac{5600 + 575 + 19200000}{2{,}400{,}000{,}000} = \$0.0080025 \text{ per ton elevated.}$$

2. Conditions :—
The same as in the preceding example except that service is but 1200 hours per year.

$$\text{N.O.C.} = \frac{5600 + 575 + 9600000}{1{,}200{,}000{,}000} = \$0.0080051 \text{ per ton elevated.}$$

Assuming conditions that are common in practice and which may therefore be taken as representative, it will be noted that there is really very little difference in the average net cost of handling material by a bucket elevator whether the installation is in operation a good share of the year or only made use of for half that time. This is due, of course, to the fact that the item of power, etc.,

which is dependent upon the actual hours of service, plays an important part in the question of cost of operation. This is a decided advantage in dredging and excavating operations, etc., in which modifications of the standard type of bucket elevators are very frequently and extensively employed, as such operations are of necessity intermittent and, though not as conducive to economy as if the apparatus was more mechanically efficient, does enable accurate preliminary estimates of cost to be arrived at, etc., etc.

The continuous bucket type of elevator differs from the standard bucket elevator principally in design, consisting of a close succession of V-shaped buckets, having their sides projecting past the back of the bucket so as to form a kind of chute over which—on commencement of the downward travel of the buckets—the succeeding buckets discharge their load as they pass over the head elevator wheel or sprocket, and in the common omission of loading elevator boot. The elevator may be vertical or lie in a plane somewhat inclined to the vertical. In the former arrangement, take-up bearings must be provided for the tail elevator wheel to permit the maintaining of the proper tension in the elevator chain in order that the return (downward) run of buckets may not oscillate and interfere with the rising and loaded buckets. Inclined continuous bucket elevators, on the other hand, are seldom provided with take-up bearings, the tension in the chain of the rising run of buckets provided by the elevator drive, which for all types of bucket elevators is invariably located at the head of the elevator, keeping the loaded side of the elevator taut while the return run of empty buckets is allowed to descend in the path of a parabola—the exact curvature depending upon the slack in the chain. As appreciable time is required to fill each succeeding bucket of a continuous bucket elevator, and thus realize the full capacity of the apparatus, it must necessarily be run at a comparatively slow speed. It is in this exaction for efficiency that the main advantage of this type of elevator construction lies, and for this reason the continuous bucket elevator is not entirely replaced by the higher speed and cheaper elevator of standard bucket elevator construction. The slow speed of the buckets enables them to be filled directly—that is, the elevator load is usually delivered directly to the buckets, not to an intermediate receptacle from which the load is picked up by the moving buckets, as is the practice for the standard bucket elevator. The slow movement also permits the discharge of load in a comparatively slow-moving stream. Thus, breakage of material by the moving buckets at moment of loading the elevator is minimized, as is also the breakage on discharge.

The carrying capacity of each individual V-shaped bucket of the continuous elevator does not vary greatly from that of the individual bucket of the standard type of bucket elevator, so that the table of capacity of standard bucket elevators can be made applicable to the continuous bucket type of elevator by correcting for the speed of the elevator and the spacing of the buckets; which, in the case of the continuous bucket elevator, is approximately equal to the depth of the V-shaped buckets. The power required to operate a bucket elevator of either the standard or continuous bucket type is the same—elevators of the same carrying capacity—as the descending empty buckets compensate for the power required to raise the buckets themselves on the carrying stretch, so that the formula for horsepower required is the same for either type of bucket elevator. The formula for ascertaining the net operating cost of a standard bucket elevator (the measure of true economic value of the system) is also approximately correct for a continuous bucket elevator, for though the latter type is more expensive in first cost, its depreciation charge, etc., is not apt to be as high. The two inaccuracies tend to counteract each other, besides which any error is discounted by the fact that the major expenses, those for power, attendance, supplies, etc., are about the same under similar conditions of service.

Other modifications of bucket elevators are in common use for handling barrels, boxes, heavy bales of goods and for many other special purposes, but a detailed consideration of such is quite impossible in a limited discussion of this nature. However, the horsepower formulæ will be found to be of considerable value in considering the economic advantages of even such special types of apparatus, as but minor alterations in such formulæ need be made to suit any conceivable system. Net operating costs will vary in each special installation, however, and cannot readily be arrived at without careful consideration of all the particular conditions and requirements. Without such data, an opinion of the economic value of any such apparatus must be based largely upon the convenience that such an installation would promise, but it is usually safe to assume that in addition to convenience a considerable monetary saving would ensue from the installation of almost any kind of apparatus for mechanically elevating materials confined in boxes, barrels, or in other ways—a saving usually approaching that which is possible in the handling of materials in bulk.

DESTRUCTION OF GARBAGE BY INCINERATION.

By H. C. Andrews.

ACCORDINGLY as the population of this country increases so must the representatives of communities and officials in charge of public works give this important matter their more careful consideration, more especially in the large cities and thickly populated areas.

The health of the community is reflected in its commercial prosperity; and, unquestionably the sanitary arrangements of a town go very far towards promoting and maintaining the health and energy of its inhabitants. In this age of the application of science to all questions of sanitation, it is universally recognized that cleanliness (by which is meant the entire absence of filth) is not only "next to Godliness," but is absolutely essential for the prevention of such diseases as smallpox, typhoid fever, and consumption. Students of public health are agreed that such diseases have, in the past, been very largely caused by deposits of refuse providing the breeding ground for the multiplication of the most deadly of the known bacilli; and, as a consequence, the method of dealing with the refuse accumulating daily in a town of any size becomes a vital question.

In Canada, with its hot summer, collections of dumped garbage should be an unknown quantity, and it is surprising that the Department of Public Health should have allowed to exist so long as it has the large and offensive garbage tips one frequently sees, and upon which dwellings are subsequently erected, the occupants of which are likely to suffer from the exhalations that must necessarily arise in such cases.

It has been for some years past an acknowledged fact that the worst of our summer pests, commonly called the house fly, and the blue bottle, thrive and multiply in millions on these heaps, which are in various stages of putrefaction and decomposition; also that these flies are responsible for a large proportion of infantile mortality and other sickness during the summer months.

City authorities preach to the householder to "swat the fly," but if they themselves collected the garbage more frequently and totally destroyed it when collected, they would strike right at the root of the evil, do more to abate the fly nuisance, and incidentally improve the health statistics.

The above is a résumé of what has been preached by the medical health officers in Great Britain, Germany and France for some years past, with the result that the authorities of nearly every densely populated area have at the present time an efficient, and what is really more important, an hygienic method of dealing with the garbage.

Incineration has been nearly universally adopted for this purpose, although in a few cases reducing plants have been utilized. The practice of incineration, the first to be used, is gaining in favor, because it fulfils more closely the combined necessities, efficiency and hygiene, than does disintegration.

The latter may or may not be a paying proposition, as is claimed for it, but the fact remains that the public and expert opinion in the older countries are almost unanimous in deciding in favor of destruction by fire, and obtain thereby a clean innocuous clinker residue, rather than risk the adoption of a plant which in abating one nuisance is likely to create another; and this is the case with any scheme which does not destroy immediately and totally all garbage deposited.

Having thus far proved that incineration is at least the most hygienic method of dealing with garbage, the process of incineration can next be examined.

In the early days of incinerators, many difficulties were encountered which earned for them a none too savory reputation, partly because the plants were too small for dealing with the quantity of material to be consumed.

The heat obtained in the furnaces was not sufficient to destroy everything, and at times the fires were nearly put out, this resulted in ashes rather than clinker being raked out when the fires were cleaned, causing quantities of dust to be always flying about. Unconsumed gases escaped up the chimney causing smoke and evil odors.

All these difficulties have now been overcome and the modern incinerator, as a natural consequence of years of experience and use, is positively without nuisance, and can be worked in close proximity to a residential district, without causing offence.

The work of the employee is not unpleasant, and there should be no dust or overpowering odors within the building itself.

Design of Incinerator Plants.—In designing a modern plant it is the universal practice of engineers to consider the following details:—

1. The furnaces should be able to deal efficiently and easily with the maximum supply of garbage; no storage should be allowed for longer than a few hours.

2. There should be stand-by furnaces or cells so that in case of repairs the capacity of the plant is not impaired.

3. The arrangements for feeding the cells should be such that the garbage may be dumped from the carts, and these released at once with as little delay as possible. On this detail will weigh to a great extent running expenses, but a mechanical feeding device may be adopted to overcome this vital point.

4. The construction of the furnaces must be of suitable design, strong and well reinforced to prevent bulging or collapsing of the arches. The heat of the fires must be intense. The continuous grate is now the only accepted form of fire grate; the cells may be arranged in units, with a combustion or carcase chamber and boiler.

5. There are various types of doors for clinkering the fires and also various methods of clinkering, but a truck running on tracks in front of the furnaces, into which the clinker is raked direct from the fires, is used in most cases, as the truck, when full, can be pushed outside and dumped at any convenient spot outside the building.

6. Forced draft can be obtained by electric or steam-driven fans, the air being drawn by pipes from any desired part of the building. By this means no foul air or dust has a chance to collect within the building itself.

7. If power is required boilers can be introduced and the steam generated entirely by the heat obtained from the incinerator furnaces.

8. The flues should be arranged so as to make it absolutely impossible for unconsumed paper and dust to escape up the chimney.

9. The chimney should be of strong construction and lined, and of ample area to allow for possible additions of extra furnaces.

10. The buildings should be built so as not to be an eyesore to the neighborhood, and provision be made for the attendants' wants, i.e., proper washing accommodation, etc.

Generally speaking, there is always a good outlet for the clinker obtained and it is often turned into a revenue-earning item.

From high-temperature furnaces the clinker obtained is hard and perfectly innocuous and may be used for a variety of purposes. For road beds, for concrete, ground for mortar, for concrete paving blocks, for ordinary filling purposes and several other every-day requirements.

The choosing of a site for an incinerator is often the stumbling block over which all sorts of trouble is encountered, but this should not be the case, as providing the contractor for the plant will guarantee no nuisance, and there are several well-known contractors who would take the onus of such guarantee, the modern incinerator should be no more offensive and certainly less unsightly than many factories.

There are cases known of city councils having been compelled by public sentiment to go to the expense of building far away from habitation and in a few years finding their incinerators completely built around by a very fair class of property-holders.

TRUCKS AND ECONOMY.

A Montreal contracting firm recently undertook to test the practical possibilities of trucks with trailers in work in that city, using one or two trailers, these being animal wagons that had been adapted for the service and which were constructed to be discharged quickly. The trains are made up with two trailers, carrying nine tons, 2.5 tons on the truck and 3.25 tons on each wagon, and it was found that the truck could haul the trailers over comparatively rough ground and in soft roads at a satisfactory speed—at least, fast enough to be very economical. The cost of moving excavated material was, with the loads described, reduced from $1.50 to 95 cents, the comparison, of course, being made with horse haulage. So satisfactory was the trial that the company bought seven four and five-ton trucks and will use them with trailers in excavation work whenever possible, and in other haulage wherever practical.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Chemistry in Engineering 591
Ontario's Ten-Million-Dollar Roads 591

Leading Articles:

An Example of Difficult Tunneling 575
Traffic Census in Massachusetts 578
Liquid, Solid and Gaseous Fuels for Power Production 580
Improved Management of Waterworks 583
Bucket Elevators 585
Destruction of Garbage by Incineration 589
Canadian Public Health Association Convention at Regina 592
Ottawa Water Supply Project 595
Over Fifteen Hundred at Road Congress 599
Essential Features in Good Brick Construction 600

Coast to Coast 602
Personals 604
Coming Meetings 604
Railway Orders 73
Construction News 76
Technical and Municipal Societies 94

CHEMISTRY IN ENGINEERING.

The field of the chemist is many times the magnitude it possessed a few years ago, and it is rapidly co-mingling with many of the branches of the engineering profession. With the exception of mathematics, and perhaps of physics, the science of chemistry stands closest, and as the manufacture of the materials used in engineering approaches perfection, the more pronounced is the handiwork of the chemist.

The production of iron, steel, and the alloys, for varied and special purposes, are examples. The constituents of each are selected in proper percentage by the chemist, and the rules-of-thumb are no more. The chemist furnishes the data whereby the engineer varies the chemical content of his materials to obtain the particular physical characteristics desired. The manufacture of cement is another striking example.

Equally important are the relations of the chemist and the engineer in the matter of water supply and the treatment of sewage. It is what the former finds in the nature and extent of impurities that determines the policy of the engineer in the treatment of the water supply. The utilization of nitrogen, of ozone, or of the much-indulged-in hypochlorite of lime or soda, to destroy bacteria; the introduction of copper sulphate (1 part to one million parts of water) to dispose of algae; the use of alum to precipitate suspended organic matter, without appreciable trace in any instance of the remedial substance in the clarified water—these are notable instances of the work of the engineer wherein he is dependent upon the chemist.

In the growing science of road engineering, with its many complexities; the selection and composition of the materials of construction; problems of water purification, and of the disposal of waste—a knowledge of chemistry is essential to the engineer in many phases of his work, and his engineering skill, supplemented by the expert assistance of the professional chemist, leads one to believe that the advancement of industry would be relieved of a considerable amount of its hazard if there was more of an outward acknowledgment of the interdependence of these two applications of science.

ONTARIO'S TEN-MILLION-DOLLAR ROADS.

Ontario is willing to spend ten million dollars during the next few years on road construction. But it wants one hundred cents' value for every dollar expended. The Commission which was appointed by the Government—Messrs. Magrath, Rankin and MacLean—are therefore going to more trouble in gathering information on roads than did any similar commission ever appointed. They are expected to devise a model system for Ontario—avoiding all the errors made by the State Highway Commissioners in the United States, dodging political "pull," keeping the lid tight on the "pork-barrel," and reducing maintenance costs to the lowest limit consistent with reasonable first cost.

The problems that are being considered by the Commission are included in three general classes—men, methods and materials. More specifically, they come under the headings of legislation, administration, finance, expenditure, construction and maintenance.

The most important part of the legislation is to keep the roads out of politics. To this end the Ontario Com-

mission is studying the Highway Acts of twenty-seven States, noting their weak points and their good points. The Highway Commissioner of each of these States is being consulted as to the success or failure attending the road laws enacted by his State, the changes that have been recommended in the laws and the reasons therefor, and above all, the changes that each Commissioner would like to see made to obtain his ideal, but which he perhaps dares not make on account of politics, public sentiment, poverty of the State coffers, or other reasons. The amount of money placed by the Provincial Parliament at the disposal of its road-building organization must also be carefully considered. Were too much money voted at one time, it is feared that it would tax the contracting capacity of the Province too greatly. It is thought desirable to have only thoroughly reliable contractors build the roads, and to let to each contractor only enough work to ensure his being able to handle it with the most careful attention. The letting of too much work in any one season might result in higher prices and inferior work, it is said.

The selection of the administrative and constructive staffs is most important. Mr. Campbell, the Deputy Minister of Railways and Canals (and why not of Highways also?) said at the banquet of the American Road Congress at Detroit, that proper drainage was the most essential item in road building. The Mayor of Detroit replied that "drainage" is not so important as "foundation"—the foundation of good men to administer the enterprise. It is recognized by the Ontario Commission that it will take some time to build up the personnel of the various highway departments. Men with the proper qualifications must be picked or trained. The administrative policy must be carefully decided; whether it would be better to have division engineers each in charge of certain limited territory, or to have strongly centralized control. Under the heading of administration come also the problems of cost-keeping, purchasing departments, etc.

The financing of good roads may prove troublesome in Ontario. The large mileage compared to population makes financing more difficult than in densely populated States. Various methods of raising revenue are being considered—bond issues, automobile fees, corporation taxes, assessments on railways that would benefit by better roads, etc. The substitution of a money tax instead of the work done on the roads by the farmers is being considered. The wisdom of using convict labor will also be decided.

Provision will be made for the systematic inspection of the expenditure of moneys. Uniform accounting systems must be provided and such statistics kept of all payments that accurate data can be placed before Parliament at all times.

The actual construction and maintenance of the roads causes, perhaps, the most travel by the Commissioners. They will visit ten or eleven States and obtain accurate data regarding costs, lifetime, popularity, etc., of the various types of roads. Hundreds of miles of roads will be inspected.

In order to meet and obtain the good-will of the numerous State Highway Commissioners to whom they will later apply for information and assistance, the Ontario Commissioners gave a luncheon at the American Road Congress and invited all of the State Commissioners. The ice was thus broken, and the interest of each commissioner awakened in Ontario's problems. These State Commissioners are now furnishing the Ontario officials with data concerning dimensions, first cost, wear, maintenance charges, what types are being abolished as unsatisfactory, what types are being substituted as more satisfactory, etc. The relative merits of concrete, brick, bituminous macadam, asphalt block and chemically bound macadams are being investigated; the methods of construction and suitability of gravel, sand-clay and earth roads are being studied.

The Commission is being aided in this work by J. E. Pennybacker, whom they have appointed as a consulting expert, as previously mentioned in these columns.

CANADIAN PUBLIC HEALTH ASSOCIATION. CONVENTION AT REGINA, SEPTEMBER 18, 19 AND 20.

[This article, dealing with that part of the proceedings of the Canadian Public Health Congress at Regina that is of interest to *The Canadian Engineer* readers, was unavoidably precluded from our issue of October 9th; hence its appearance at this late date.—Ed.]

THE Third Annual Congress of the Canadian Public Health Association was held in Regina, Sask., Sept. 18th, 19th and 20th. Upwards of two hundred delegates registered. As indicated in the programme appearing in a previous issue, the work of the convention was divided into eight sections, additional to the general sessions. To each of them the papers presented were of such a nature as to open up a volume of keen and vivid discussion upon all phases of the work which the association has set itself about to do.

The congress had its various sessions well interspersed with social functions of one kind and another, and the city of Regina displayed such an excellent type of hospitality to the visitors as earned for it a highly commendable resolution on the minutes of the association.

There were several papers read at the general session that would have interested a large number of the engineers of Canada, apart from Section VI., which was devoted entirely to engineering subjects, and Section V., which was closely related covering the various phases of sanitary inspection and promotion.

Of the ten papers presented at the Engineers' Section, two, viz., "Mechanical Gravity Filtration at Saskatoon," by George T. Clark, city engineer, Saskatoon; and "The Chemical and Biological Effects of Water Filtration," by H. W. Cowan, chief engineer, Bell Filtration Company, Toronto, appeared in October 2nd issue, and other important papers will be published in due course in these columns.

Among the papers read at the general sessions the presidential address by Dr. J. W. S. McCullough, Provincial Health Officer for Ontario, related a few of the experiences of the speaker in his recent visit to Europe. His address was, in part, as follows:—

"In the province of Ontario, from the fact that the rivers and lakes must become the great sources of water supply, it has become apparent that to preserve these supplies in a pure state, it is necessary to take prompt action to prevent their pollution with sewage. With this end in view the legislature of last year and this year gave very extensive powers to the Provincial Board of Health in this regard, requiring that all plants for waterworks and sewage disposal must have the approval of the Board before any money can be raised for these purposes. In

addition, a further enactment gives the Board power to compel the construction of such works, when, in the Board's opinion, they are required by an urban municipality; and such approval being made, no vote for the electors is required to raise money on debentures for this purpose."

During the present season the Board has been engaged in making a careful examination of the rivers and lakes separating Ontario from the United States, beginning at Fort Francis and ending at the eastern boundary of the province, with a view of discovering the causes and extent of what sewage pollution may exist. Following this, the speaker was instructed by the Government of the province to take up the study of sewage questions in Great Britain and other parts of Europe.

"Of the many extensive works for the disposal of sewage in Great Britain, perhaps the most important are those of Birmingham, Manchester and Glasgow. Many large cities such as Liverpool and Edinburgh have an easy problem—that of letting the sewage go out to sea with a rapid ocean tide. Others, like London, Belfast and Glasgow, send the sludge or solids out to deep sea by vessels, but the hundreds of inland towns and cities must otherwise dispose of it. Since the great water supplies of Great Britain are taken from upland watersheds, it is not, generally speaking, so necessary to have as good an effluent as conditions in most of Canada require.

"The problem of dealing with sewage embraces the disposal of sludge or solids, of the liquid portion of the sewage, and of storm water. Each of these is a problem of importance and difficulty. It is apparent that the sludge problem is the most difficult one, while that of the liquid portion from a sanitary point of view is perhaps the most important."

The major portion of Dr. McCullough's address comprised a description in detail of typical British and German disposal plants with an outline of the methods employed.

Dr. M. M. Seymour, Commissioner of Public Health for Saskatchewan, in his paper dealing with the work which was being done in that province, detailed the methods employed by the Government toward the prevention of disease and the prevention of the pollution of rivers and streams.

Dr. R. E. Wodehouse, a district Health Officer in Ontario, in his paper concerning the field work of an officer in his position, referred to Dr. McCullough's division of the province into seven districts, eventually to be increased to ten, for the administration of public health work.

The first duties of the office pertained to making a careful sanitary survey of each organized municipality in the several districts. These surveys called for a report of the activity of the Board of Health and its officers, the keeping of the vital statistics, the condition of public buildings, the source, nature and management of water supplies, private and public; the sewerage undertakings, both to have maps in detail, in duplicate, one to be retained by the district office and the other to be sent with the report to Toronto office. The schools, ice supply, garbage collection and treatment, hotels, restaurants, railway stations, lanes, nuisance grounds, stagnant water and all things pertaining to public health to be investigated. The epidemiological history of the community, both as to man and animal, were to be reported upon.

The results of the work have been fairly satisfactory. Actual improvements in the state of the provinces' status of health will probably be more grossly evident at the end of three years. Speaking of District No. 7, the one to which the writer is attached, during the past six months five municipal water chlorination plants have been installed upon order, three municipalities have regulated, changed location of or abandoned nuisance grounds. Railways have cleansed the lights of boarding camps and cars, have established sewage treatment plants at their terminal or divisional points, and are reporting surveys of the water supplies used for their dining cars, day coaches and the engines, as this is used by the rolling stock men.

"Standards With Reference to Sewage Treatment" was the subject taken by Mr. T. Aird Murray, consulting engineer, Toronto. The paper dealt exhaustively with the different systems of the treatment of sewage before allowing it to flow into the streams and lakes from which the water supply of towns and cities is taken.

Mr. Murray summarized his paper by stating that in his opinion, based on much observation, there was no standard of treatment which could be generally applied to sewage, but that some system which would do away with internal germs in the sewage should be generally adopted. Such care to some extent must be treated separately according to the local requirements.

The dilution method of treatment as advocated by many engineers because it is the most economical method from a financial point of view was pointed out as a makeshift, which did not protect future water supplies. The different systms of dilution and purification by chlorinization were fully discussed.

With the sewage treatment subject, one of the most important points touched upon by the author was that of the pollution of water supplied. Water supplies, he stated, should be doubly protected by the disinfection of sewage flowing into them and the filtration and disinfection of the water drawn from them which is about to be used. He called attention to the fact that there are many uncontrollable sources of pollution with which it is hard to deal, but ventured the opinion that legislation would be able to control much of the apparently uncontrollable sources of pollution. He pleaded for legislation in Canada before the waterways become hopelessly polluted as they are in the United States and in England.

Section V. brought out several papers of particular value to those who have to do largely with the maintenance of proper sanitary conditions in congested or outlying sections of cities. Mr. E. W. J. Hague, Assistant Chief Sanitary Inspector, Winnipeg, furnished a lengthy paper on the housing problem, recommending a number of remedies to counteract over-crowding, inadequate building laws, etc. Mr. F. Cartlidge presented a paper entitled "City Waste Disposal by Incineration. He briefly reviewed the history of city waste disposal, from the old method of the nuisance grounds, with its unsightliness and the comparatively large area of land laid waste for this purpose, through the different stages in the development of a satisfactory incineration plant down to the present, where it was possible by incineration, to convert the putrescent matter in city refuse into harmless products, by means of combustion.

"The process of incineration," he said, "has made much headway with the introduction of high temperature furnaces of 2,000 Fahr. and upwards by means of forced draught, induced either by powerful fans or steam blast. The heat obtained in these furnaces is sufficient to consume anything put into them.

"In the older types of independent cells the introduction of a fresh charge of refuse resulted in the lowering of the temperature with imperfect combustion of the gases, a condition which is obviated by increasing the number of cells, and by charging them in turn so that some are at their greatest heat while others are being charged.

"With present improved methods of construction such high temperatures are often obtained that no inconsiderate amount of waste heat is available, and steam boilers are generally made a part of the equipment. This will provide steam for the blast or to drive the fan, and by absorbing heat from the waste gases will reduce the cost of repairs to flues and a less expensive and lighter firebrick in the chimney will suffice.

"Naturally, in these notes a description of the incinerator at Moose Jaw, and the methods for operating same may be much in evidence, as it is operated under similar conditions and with the same class of refuse that will be met with elsewhere throughout Western Canada.

"In the collection of our refuse all house and trade refuse are collected and dumped together at the incinerator, where it becomes automatically mixed with a larger quantity of stable manure, as both are being delivered in the course of the day.

"To obtain the best results and complete combustion, the conditions necessary are:—

"A sufficient air supply brought into intimate contact with all parts of the fuel and the maintenance of the temperature up to ignition point until the whole is consumed.

"All modern high temperature incinerators will have the following features: Forced draught, either steam blast or air; a drying hearth above the grate; a combustion chamber where the gases are mixed and raised to incandescence; a steam boiler for utilization of waste heat; an economizer to heat the feed water, and a regenerator for the air blast. Other things of equal importance are some arrangement to discharge direct into the combustion chamber from above, carcases of horses, mattresses, wet damaged fruit and certain other things that cannot be consumed during the burning of a single fire on the grates, and which would come out with the ashes only partly burned and require to be thrown in again. A storage floor to hold 24 hours' accumulation of refuse, and tipping platform of such size and arrangement that the ordinary box wagon can safely be brought to the tipping sill.

"The incinerator at Moose Jaw is a Heenan and Froude high temperature, with three cells in one continuous chamber. Fires are fed from the top, where the refuse is shovelled into hoppers, the top of which are with the floors of the tipping and storage platform. The blast is air, supplied by fan and drawn from above storage floor. A pressure of from 3 to 4 inches is given, with temperature around 2,000 Fahr. The fan for the blast is driven by an enclosed steam engine which, with the feed pump, absorbs approximately 15 per cent. of the power generated by the waste heat.

"Under ordinary working conditions an average of two tons of refuse per hour is consumed, and the fires are cleaned about every two hours. The operating costs average a little over $1.00 per ton.

"Until quite recently no serious effort was made to utilize the power in the steam generated by waste heat. Observations have been made several times under ordinary working conditions which indicated that after allowing for use on the plant itself there was at least 100 h.p. available for other purposes. This is now to be used for the purpose of pumping sewage at the disposal works, which are situated conveniently near, the steam being piped across the short distance in 4-inch insulated pipes.

"Without going outside the scope of the Health Department there are many uses to which this waste steam might be put and so reduce the cost of disposal of refuse, for instance: The establishment of baths and washrooms; steam disinfecting station; electric lighting of depot and works; or even to generate current for ordinary purposes.

"Of other residuals very little has been made so far. The clinker is made small in size, and when free from dust is a suitable material for bacteria beds, some having already been used for that purpose. The dust from the combustion chamber can be used as a body for disinfecting powder and in a small way this has been experimented with."

Business Session.—The Association elected the following members to form the executive committee for the ensuing year: President, Dr. M. M. Seymour; general secretary, Major Lorne Drum; treasurer, Dr. George D. Porter, and Dr. C. J. Hastings, M.H.O., of Toronto, Dr. C. A. Hodgetts, of Ottawa, and Dr. Duncan Anderson, of Toronto. Dr. Adam H. Wright, chairman of the Provincial Board of Health of Ontario, was elected honorary president of the association for the ensuing year.

The next annual congress will be held at Fort William and Dr. Woodhouse, the district sanitary officer of that city, has been appointed the convener of the local arrangements committee.

Among the resolutions adopted was one authorizing the appointment of a committee to assist in the formation and operation of a proposed Federal Health Department. Another read: "That in the opinion of this association it is a matter of great importance that the Dominion Government do take steps to create a Department of Public Health in order that all federal branches dealing with health work may be co-ordinated under one administration."

Another fixed the membership fee of the association at $3.00 per annum.

Mr. J. T. Vallance, of Lethbridge, Alberta, read a very interesting paper on "Public Abattoirs," going fully into the questions of cost, methods of operation, sanitation and other details, expressing himself of the firm belief that civic abattoirs will prove themselves not only self-supporting, but profitable. He spoke of the manner in which the institution of civic abattoirs in England and Germany had reduced materially the cost of living.

"Leaves From An Inspector's Note Book" was the subject of a paper by Mr. H. D. Mathias, of the Health Department of Regina. The paper dealt largely with the training of a man for sanitary inspection, and with the essential recognition of the provision of a pure and ample supply of air and water as an assurance of safety and health.

Mr. Thomas Watson, of Regina, dwelt upon the legal aspect of the sanitary inspectors' work. In the course of his discourse, Mr. Watson mentioned the unanimity of the various health acts of the Dominion in placing under the control and jurisdiction of the Boards of Health all that properly belongs to sanitary and health matters; but added that in spite of this there is a tendency among municipal authorities to deprive sanitary inspectors of a good deal of authority they should possess with respect to certain elementary fundamentals under their supervision.

OTTAWA WATER SUPPLY PROJECT.

FOR years the supply of water for domestic use in Ottawa has been unsuitable. The summer of 1912 was marked by the visitation of a serious outbreak of typhoid, which brought the problem into prominence, and called for a rapid and permanent solution. The result has been that in the past year the civic authorities have kept the matter constantly under probe, until the present time finds them furnished with numerous reports covering all feasible sources of supply.

There are five possible sources, viz., Ottawa River, Madawaska River, Lake Deschenes, McGregor Lake, and Pemichangaw Lake.

The Ottawa River, the present source, has been reported upon as being unfit for use without mechanical filtration and chemical treatment. In February, 1913, Sir Alex. Binnie and Dr. A. C. Houston advised the city to abandon the Ottawa River as a source of supply. Then, in April the Ontario Provincial Board of Health advised the city that the use of the Ottawa River without mechanical filtration would not be permitted. The decision was backed by the fact that Ottawa had had 3,000 cases of typhoid within 18 months from using this water. The filtration scheme has not met with favor at the hands of the ratepayers, generally, when advanced for their consideration. The proposal submitted last year did not provide for future growth, sentiment was against chemical treatment, and the risk of contamination from the unsanitary waters of Nepean Bay, under which the supply had to be conveyed, was important and against the adoption of the scheme.

Lake Deschenes.—On October 3rd, 1913, City Engineer Currie submitted a report in answer to the following Council inquiry:—

"If the city of Ottawa continues to use the Ottawa River water in its natural condition as a permanent source of supply, what would be the best point from which the water should be taken, and what works would be required to be constructed, with an estimate of the expense of such works?"

His report stated that in his opinion the most suitable point from which to take the water was a little west of Ennis Point, in Lake Deschenes, and opposite Aylmer Island. This is over 14 miles from the pumping station. Mr. Currie found that the gradients were such that the water could not be carried by gravity to the pumping plant, and that, therefore, another pumping plant would need to be installed and operated at Lake Deschenes. As no hydraulic power could be secured there, this plant would require to be operated by electric power.

The city engineer proposed that a small low-level service reservoir to hold ten million gallons be constructed just inside the city limits to provide a reservoir of water in case of fire, and to enable the water to flow by gravity from the reservoir to the present pumping station. He also proposed to have two 48-inch pipes from the intake at Lake Deschenes to the service reservoir, and two 42-inch pipes from the reservoir to the pumping station. The estimated cost of this project was estimated at $2,900,000.

A later issue will contain a more detailed report of Mr. Currie's investigation.

McGregor Lake Supply.—This includes a large number of lakes at distances varying from 15 to 30 miles to the north of Ottawa. The engineering features connected with this source of supply for the city will appear in a later issue. It is generally conceded that filtration would be necesary. An estimate of the cost of the necessary works is placed at $7,054,000.

Madawaska River.—Owing to the necessary length of pipe-line from this source to the city, the variations of level along it, and the low total elevation above Ottawa, this project has not met with favor. It is also objected to because of its questionable quality, and the uncertainty of continued safety of river water generally, which feature applies forcibly to the proposition.

With this brief summary of the situation, attention is directed to a report, submitted last week. It has already been mentioned that in February Sir Alex. Binnie and Dr. A. C. Houston visited Ottawa, studied its water supply, advised the abandonment of the Ottawa River as the source, and recommended an uncontaminated source, such as is afforded by the lakes lying between the Gatineau and Lievre Rivers. The city was also advised to undertake a careful survey of the district. Consequently, arrangements were made with the Dominion Government, whereby contour maps and other necessary information have been obtained.

On May 5th, the City Council requested Sir Alex. Binnie to make a detailed report, and the result has been a thorough investigation by his staff of all the sources of water supply, including a detailed examination of the proposed routes for the aqueducts, service reservoir, etc.

In the report the city is recommended to use every effort to bring down the rate of water consumption, which at the present time averages 170 gallons per capita per day. Contrasting this consumption with that of other Canadian cities, according to the report of the Commission of Conservation, 1912, the report deems it feasible to reduce the water supply per capita to 100 gallons per day. It is on this assumption that the capability of the various sources of supply to provide for 250,000 persons with a possible future population of 750,000, has been considered.

The report divides itself into a consideration of two schemes: (1) Supply from Thirty-One Mile and Pemichangaw Lakes. (2) Supply from McGregor series of lakes. These sources are shown in Fig. 1. The following is extracted from the portion of the report dealing with the former:—

Thirty-One Mile and Pemichangaw Lake Scheme.—These two lakes are situated on the east bank of the Gatineau River at a distance of about 40 miles to the northward, measured in a straight line from Parliament Hill to the south end of Pemichangaw. The surrounding area of land which drains to these lakes is dotted with numerous other smaller lakes, but the above are the only lakes of any importance and extent.

As to the quantity of water that may be obtained from this source, the three important factors upon which the service from any drainage area depends, respond to investigation in the following way:—

(1) The extent of the drainage area is approximately 150 sq. miles.

(2) The quantity of rain or snow annually precipitated on this area averages 37 inches.

(3) The run-off is conservatively placed at 13.6 inches.

Taking 13.6 inches of run-off from a catchment area of 150 sq. miles, the average yield approximates 81,000,000 gallons per day, ample to meet the requirements of a population of 750,000.

The drainage area has been found free from peat or other surface deposits liable to discolor the supply. The water is bright and clear and of exceptionable purity, and if steps are taken by the city to prevent future contamination, the report forecasts not the slightest neces-

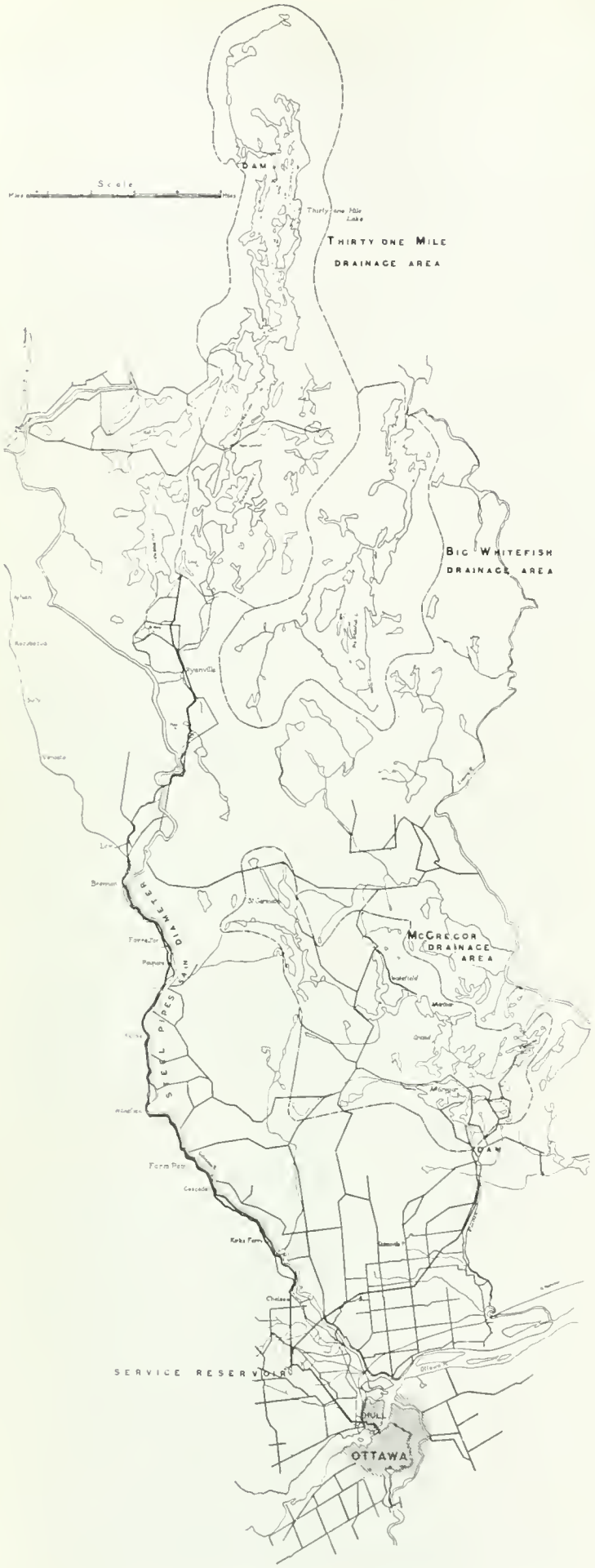

Fig. 1.—General Plan of Storage Area.

sity for filtering this water at any time. It pronounces this source as one of the finest supplies in the world.

The method of collecting and storing the water is as follows, according to the report Fig. 2 illustrates the plan herewith described:—

There are four lakes which form a chain stretching approximately north and south. Commencing at the north is Mitchell Lake, a small lake which discharges through a narrow gorge at its outlet into a channel which finds its way into the Gatineau. This lake has a surface area of 0.7 square miles, and the water level in Sept. was 523 feet above datum. It receives the entire discharge of Thirty-One Mile and Pemichangaw, and a narrow rocky gorge, already referred to, forms an admirable site for a dam.

The next in the chain towards Ottawa is Thirty-One Mile Lake, which is about 18 miles in length, with a water area of 18 square miles, the water level this summer being about 530 feet above datum. Immediately to the south, and separated by a narrow neck of land, lies Pemichangaw, with a water area of 6 square miles and a length of about 5 miles, the water level this summer being about 552 feet above datum. Crossing the height of land to the south-west of Pemichangaw we come to Long Lake, having a length of about 1¼ miles, and a water area of about one-quarter of a square mile. The distance between Pemichangaw and Long Lake is about 3,000 feet, and the water surface of Long Lake is 561 feet above datum.

It is proposed to tunnel through the ridge between Pemichangaw and Long Lake, and by means of the dam at the outlet of Mitchell Lake to bring all the lakes to one level, namely, 570 feet above datum, and to start the aqueduct to Ottawa from the south end of Long Lake. This would mean raising Mitchell Lake 47 feet, Thirty-One Mile Lake 40 feet, and Pemichangaw Lake 18 feet.

The contour surveys to determine the top water area at this level are not yet completed, but the total when brought to this uniform level of 570 feet above datum will increase to about 35 square miles in area. One foot difference in level of a water surface having an area of 35 square miles represents about six thousand one hundred million gallons, and 18 inches would give a year's storage of a daily flow of 25,000,000 gallon, 3 feet would give sufficient storage for 50,000,000 gallons per diem, and 4 feet 6 inches sufficient for 75,000,000 gallons per diem. The maximum variation in water level would, therefore, be small.

The dam at Mitchell's Lake would be designed so as to overflow at a height of 570 feet, the total content of masonry to this level being estimated at about 9,100 cubic yards.

It has already been stated that the dam would be constructed so as to raise the level of the lake to 570 feet above datum, which means that Thirty-One Mile Lake would have to rise 40 feet, and Pemichangaw 18 feet. Owing to the enormous area of Thirty-One Mile Lake it would take five or six years before this lake would rise even to the level of Pemichangaw, that is 22 feet, and ten or twelve years before it reached the final level of 570 above datum. It is obvious that the scheme should be so laid out as to enable water to be brought forward to Ottawa as soon as the aqueduct and service reservoir can be completed, which can be effected in the following manner:—

Pemichangaw and Long Lake have a total drainage area of about 41½ square miles, and would yield on the basis of a runoff of 13.6 inches about 22½ million

gallons per diem, or sufficient for the needs of the city for many years. The level of Pemichangaw Lake varies between about 554 and 552 feet above datum, and the lake is separated by a narrow neck of land known as Point Comfort from Thirty-One Mile Lake, which is about 30 feet lower in level. This neck of land acts as a natural barrier, which retains water at the higher level in Pemichangaw, and is traversed by a narrow gorge, through which the water is discharged into Thirty-One Mile Lake. This gorge is blocked by a wooden dam provided with sluices, and the fall of water from one lake to the other is utilized for a saw-mill. Water also finds its way into Thirty-One Mile Lake from Pemichangaw through debris overlying the rock, filling the bottom of what no doubt was at one time a valley of discharge from one lake to the other. There are underground fissures connecting the two lakes, and the measurements which have been taken this summer show that when the water level in Pemichangaw stood at 554 feet above datum the amount of water which got through this debris or surface fissures in the rock amounted to approximately 8,000,000 gallons per diem; but when the water level in the lake had fallen to 552 feet above datum the discharge was very small, indeed, showing that the water was really finding its way from one lake to the other namely, 81,000,000 gallons per diem, being passed through into Long Lake without appreciable loss of head.

The best location for the invert of the tunnel would be about 6 feet below the present level of Pemichangaw, or at about 540 feet above datum, 24 feet below top water level when brought up to 570 feet above datum.

This tunnel would terminate at each end in covered shafts, the water entering and leaving the shaft well below the water level of the respective lakes, to remove all danger of freezing.

Works at Long Lake.—Long Lake varies in depth from about 20 feet to 50 feet, being shallow towards the north end and deep towards the south. This lake, like Pemichangaw, is formed by a natural barrier, and the water issuing from it passes over this barrier by means of a series of small falls and cascades to the valley below, dropping 50 or 60 feet in a short distance. A short cutting through this barrier will, therefore, enable the water to be drawn down 20 or 30 feet without any difficulty.

The shores of the lake are steep and rocky, but at times during and after windy weather the sediment in the bottom is stirred up by wave action. This action does not extend to any great depth, probably not much

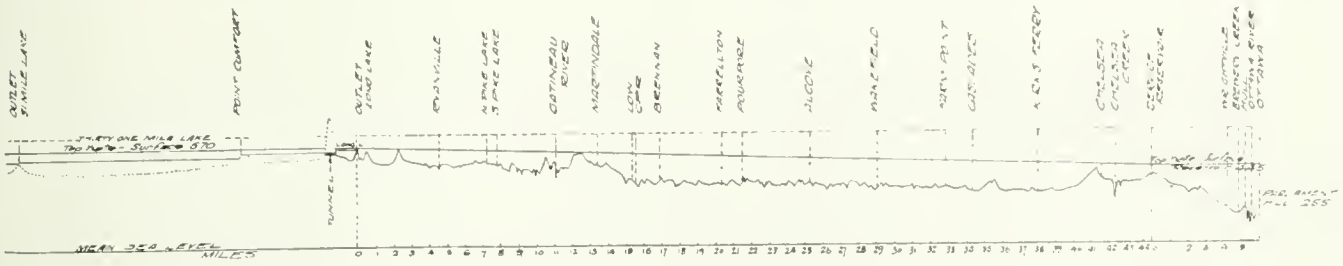

Fig. 2.—Profile of Lakes and Pipe Line.

through a comparatively shallow channel. It is proposed to open a trench first of all across the old channel, and fill with concrete so as to cut off the supply that would leak away when the water level is raised to 554. This would enable the water to be retained in Pemichangaw Lake, upon which the city could draw as soon as the aqueduct is completed. The present water area of Pemichangaw is about 6 square miles, and 5 feet in depth on that area would represent the total storage required for the first instalment of 25,000,000 gallons per diem. Assuming that the minimum draw-off level was to be 549 feet above datum, or 3 feet below the present level, the maximum level at which the water would overflow would be 554 feet above datum.

The dam at the outlet of Mitchell's Lake should be proceeded with as soon as the necessary arrangements could be made, so that Thirty-One Mile Lake can be gradually raised to such a level as to flow towards Ottawa by means of the aqueduct. The report includes in the estimate for the supply of 25,000,000 gallons the cost of the dam at Mitchell's Lake, and also the necessary clearing to bring Thirty-One Mile Lake and Pemichangaw Lake to the level of 570 feet above datum, when storage will be provided for the full yield of the drainage area, or 81,000,000 gallons a day.

Tunnel between Pemichangaw and Long Lakes.—To bring the water of Pemichangaw into Long Lake, from which lake the aqueduct would start, will necessitate constructing a tunnel through the height of land between the two lakes, a distance of about 3,000 feet. This tunnel should be made about 7 feet internal diameter so as to permit of the whole available yield, below 10 feet. It is, therefore, proposed to remove the sediment, logs, etc., when the lake is drawn down so as to prevent similar action taking place in the future.

The outlet works would consist of a straining tower about 50 feet high, covered at the top, and provided with copper gauze screens; the water entering the tower at a depth of 7 or 8 feet below the minimum water level of the lake and after passing through the screens leaving by means of a culvert through the natural barrier already referred to, to the commencement of the pipe. It is proposed to install a small water-driven turbine so as to work a pump for supplying high-pressure water for washing the screens. The power for this turbine would be supplied by allowing water to pass from the lake to the valley below, the turbine being situated at the foot of the fall, which has already been referred to. The screens would be made so that they can be lifted in rotation for cleaning purposes without interfering with the flow of water, and the dirty water, after cleaning, would be discharged into the valley below the straining tower.

Description of Pipe Line.—The top water level of the service reservoir would be 445 feet above datum. The distance between the outlet and the service reservoir is about 235,000 feet, and allowing for losses of head at the reservoir, the hydraulic gradient would be approximately 1 in 1960, and with this gradient a welded or lock-bar steel pipe, 54 inches in diameter, would deliver 25,000,000 gallons a day, allowing for future encrustation. If rivetted steel pipes were used the internal friction is slightly greater on account of the rivet heads and the diameter of the pipe would be slightly larger to discharge the same quantity of water. The

estimate has been based on approximate quotations received for 54-inch welded steel pipe, 7-16ths of an inch in thickness. With soft water considerable encrustation may be anticipated, but seeing that the Thirty-One Mile Lake water contains about four and a half grains of lime per gallon it is probable that this may not take place to any appreciable extent. The Ottawa River water contains about two and a half grains per gallon, and appears to have had very little effect on steel pipes which were laid many years ago without any protection by means of coating. It has been found that steel pipes are also liable to corrode from the outside if laid in saline or marshy ground unless special precautions are taken. The best protection in such cases is to surround the pipe with tarried hessian or jute, and provision has been made in the estimate for this precaution where the pipes would be located in swampy ground. To prevent freezing in winter the pipes should be laid so that the bottom would come a minimum of 8 or 9 feet below the surface of the ground, and the estimate has been got out on this assumption.

After leaving Long Lake the pipe would pass southward gently undulating cultivated land for a distance of about one mile until a cedar swamp is reached, which would have to be traversed for a distance of another mile, when open, cultivated land is again reached about two miles north of Ryanville. The ground is of much the same character between Ryanville and the Gatineau, which would be crossed at a point about 11 miles south of Long Lake by means of a bridge having a span of 150 feet. The estimate has been got out on the assumption that provision is made for two pipes across the bridge, each to be able to carry 25,000,000 gallons per diem, and the pipes would be housed in and surrounded with sawdust or some other suitable insulating material to prevent freezing in winter where they are brought over the bridge. After crossing the Gatineau the pipe would proceed in a south-westerly direction, joining the C.P.R. about half a mile south of Low Station, passing through cultivated land and another cedar swamp between the river and this point, the total length of the pipe from Long Lake to the C.P.R. being about 16 miles. From Low as far as Chelsea, a distance of about 24 miles, the pipe track would be in close proximity to the C.P.R., and this portion of the route would not be so easy from the point of view of pipe-laying, a good number of minor work, such as bridges, stream crossing and culverts being required. At Chelsea the pipe would leave the C.P.R. and proceed nearly due south, passing close to Old Chelsea to the service reservoir, a distance of about four and a half miles. The service reservoir is located in the hills, about two and a half miles south of Old Chelsea and four miles north-west of Hull. The portion of the track between the C.P.R. and the service reservoir would be through cultivated land.

Service Reservoir.—The function of this reservoir is two-fold:—

1. To provide against a water famine in the town should the water have to be cut off in the aqueduct to allow of repairs being executed.

2. To meet the daily fluctuations in demand, as the water supplied to a town varies throughout the day, the maximum draught or peak load being nearly twice the average. A reserve must also be available in case of fire.

It is far more economical to lay out a gravity scheme of this nature so as to include a service reservoir of ample size than to lay a duplicate main when the aqueduct is long and a good site can be found for the reservoir at a suitable level. Fortunately, a good site at a suitable level has been found where the water would be stored in a basin having a flat bottom and surrounded by hills. The bottom of the reservoir varies from about 410 to 416 feet above datum, and by means of three small dams the water would be held up to a level of 545 feet above datum. The water area would be about 54 acres, and one foot in depth would represent approximately 15,000,000 gallons. The probable variation in water level to meet the daily fluctuation in demand would, therefore, be less than one foot. The contents of the reservoir between the level of 420 and 445 feet above datum would amount to about 295,000,000 gallons, and represents a reserve of about 12 days' supply, which is very ample when compared with what is allowed by other cities. The static pressure given by this reservoir would represent 118 pounds at the pumping station, or 81 pounds at Parliament Hill, and is about the maximum pressure that the house fittings would stand in the lower parts of the city.

Pipes from the Service Reservoir to the City.—These pipes should be designed so as to be able to discharge for short periods during the day a much larger quantity than the pipes from the source to the service reservoir. The maximum rate of consumption is taken at 110 gallons per head per diem, and, if unavoidable waste is added to this, say, 40 gallons, the total maximum rate of consumption would amount to 150 gallons per capita per diem. To this should be added the amount required for, say, 25 fire streams, which would be equivalent to a rate of discharge of another 36 gallons per head per diem; so that the pipes should be designed to be capable of discharging 186 gallons per capita per diem as a peak load. On the basis of a population of 250,000 persons the above rate would represent a discharge of 46½ million gallons per diem. Two 51-inch pipes would deal with this peak load, so that when the population increased to 250,000 persons the pressure would not fall below 110 pounds at the existing pumping station, even should a serious fire occur during the period when the maximum demand was being made for water for domestic purposes.

After leaving the service reservoir the pipes would be laid through cultivated land to the west side of Hull Station so as to cross under the proposed Georgian Bay Canal below the level of the bottom of that channel. If the canal is constructed culverts should be provided by the Canal Company at some future date to surround the pipe under the bed of the canal and allow them to be always visible for inspection. The pipes would then cross Brewery Creek about the site of the existing bridge at the end of Wright Street, and would pass through Hull till the bank of the Ottawa River is reached at a point about 1,400 feet east of the Union Bridge.

It is emphatically recommended in the report that the pipes should be carried over the Ottawa River rather than under it, so as to facilitate easy inspection and maintenance in good condition at all times. A tunnel is not recommended, owing to the peculiar rock formation, which, being full of joints and crevices, would have occasioned considerable difficulty in driving.

There are four channels which would necessitate: a bridge about 300 feet long on the Hull side of the river, a bridge 500 feet long over the main channel of the river, two short spans, one of 80 and one of 120 feet, the latter crossing the tail-race canal from the present pumping station. For the longest spans 500 feet and 300 feet in length, it is proposed to carry the pipes on suspension bridges, which can be made light and elegant

in design at a smaller cost than any other form of bridge for these spans. Changes of temperature cause the decking of such bridges to rise and fall considerably at the centre of the span, and allowance for this will, of course, have to be made by the employment of a special form of joint to prevent racking of the pipes. In order to prevent the freezing of the water in the pipes where they would be exposed to the air, there is the alternative of insulating them with a sufficient thickness of material and of carrying them within a light timber structure or shed, special provision being made to warm the air inside the shed in winter. The latter alternative permits of a lighter and cheaper bridge for the long spans, and the estimate is based on this assumption. Where the pipes cross the two narrow channels the box girder form of bridge would be suitable, the pipes being laid in the interior of the box girder, the bridges being designed so as to interfere as little as possible with the existing surface of the ground and of sufficient strength to carry four 51-inch diameter pipes, which would give a maximum discharge at the rate of 93,000,000 gallons per diem without material loss of head between the service reservoir and the city.

The following estimate is based upon the proposals mentioned in the report:—

Head Works.	
Dam at outlet of Mitchell's Lake to raise water surface to 570 feet	$ 130,180
Clearing and burning area to be submerged	128,000
Tunnel between Pemichangaw and Long Lake, including shafts, etc.—3,000 lin. ft.	119,630
Outlet works at Long Lake—straining tower, etc.	43,660
Smaller works about lakes, including subsidiary dams at depressions in height of land, temporary works at Pemichangaw, dowering and clearing Long Lake, etc.	72,000
Aqueduct to Service Reservoir.	
54-in. steel main, 7-16-in. thick, between outlet tower and service reservoir—235,000 lin. ft.	4,314,080
Bridge on Gatineau River	30,000
Various smaller stream crossings and culverts	110,000
Service Reservoir.	
Dams	212,150
Clearing and stripping site	21,460
Inlet and outlet works	26,600
Aqueduct Service Reservoir to City.	
51-in. steel main, 7-16-in. thick between service reservoir and city—two lines of pipe, each 32,000 lin. ft.	1,101,120
Various smaller stream crossings, culverts, etc.	20,000
Bridge across the Ottawa River	180,000
Total for works	$6,508,880
Add 10 p.c. for engineering and contingencies	976,320
	$7,485,200
Land, lakes, compensation, etc.	500,000
Total	$7,985,200

If the scheme is proceeded with immediately, the system may be in use in 1917.

The City Council will have the proposal under consideration at its meeting to-morrow (October 17th, 1913).

OVER FIFTEEN HUNDRED AT ROAD CONGRESS

OVER fifteen hundred delegates attended the American Road Congress held at Detroit the first week of this month. About sixty Canadians attended the meetings, including A. W. Campbell, Deputy Minister of Railways and Canals; Honorable Dr. Reaume, Minister of Public Works of Ontario; Honorable J. E. Carron, Minister of Agriculture and Roads of Quebec Province; the members of the Ontario Highway Commission; the city engineers and some of the assistant city engineers of London, Hamilton, Toronto, Ottawa, Oshawa, Port Arthur, Orillia, St. Catharines, Windsor and Walkerville; M. D. Hallman, County Roads Superintendent, Berlin; E. A. James, engineer of the York County Highway Commission, Toronto; C. H. Keefer, C.E., Ottawa; A. T. Laing, Department of Highway Engineering, University of Toronto; A. J. MacPherson, Chairman of the Provincial Highway Commission, Regina; W. G. MacKendrick, of the Warren Bituminous Paving Co., Toronto; Controller J. W. Nelson, Ottawa; the Mayors of Port Arthur and Hamilton; Victor Pigeon, Chairman of the Road Commission of Longueuil, Que.; J. O. Sharkey, President of the Central Steel and Wire Co., Toronto; B. E. Smith, of the Barrett Manufacturing Co., Toronto; Gordon Smith, of the Barber Asphalt Paving Co., Toronto; F. M. Williamson, Engineer of Dominion Parks, Ottawa; D. P. Wagner, secretary of the Ontario Highway Commission, etc.

The attendance was better than at the Second American Road Congress, which was held in 1912 at Atlantic City, and far better than the First American Road Congress, held in 1911 at Richmond, Va. The exhibits occupied twice as much floor space as they did at Atlantic City, and were most interesting and instructive.

The asphalt interests were represented by the exhibits of the Barber Asphalt Paving Co., A. B. Chamberlain, Standard Oil Co., The Texas Co., U.S. Asphalt Refining Co., and the Warner-Quinlan Co.

The brick interests were represented by the National Paving Brick Manufacturers' Association and its constituent companies.

A number of cement companies exhibited, including the Canada Cement Co., which was the only Canadian firm having a booth, with the exception of *The Canadian Engineer.*

Several firms exhibited expansion joints or reinforcements for concrete pavements, including the American Steel and Wire Co., R. D. Baker & Co., Thomas Steel Reinforcement Co., and the Trussed Concrete Steel Co. A felt expansion joint filler was exhibited by Philip Carey Co.

Among the companies exhibiting other types of pavements or paving materials were the Asphalt Block Pavement Co., Barrett Manufacturing Co., Rudolf S. Blome Co., Dolarway Paving Co., Jennison-Wright Co. (wood block), Robeson Process Co. (Glutrin), and Warren Brothers Co.

Rock crushers, graders, rollers and other road machinery were shown by the Acme Road Machinery Co., J. D. Adams & Co., American Road Machinery Co., Austin Western Co., Climax Road Machine Co., Galion Iron Works Co., Good Roads Machinery Co., Charles Hvass & Co., Port Huron Engine and Thresher Co., Rumely Products Co., Wheeling Mold and Foundry Co., etc.

Buffalo Pitts, Holt and Wallis traction engines were at the show. Buffalo Pitts and Troy dump wagons were exhibited, a Packard motor dump wagon also being shown.

The increasing use of concrete for road construction, whether for foundations or surfaces, was indicated by the number of different makes of concrete mixers exhibited, which included the Austin, Big-an-Little, Coltrin, Eureka, Hartwick, Kent, Koehring, Lansing, Milwaukee, Rapid-Heated, VanDuzen and other makes.

Various methods of building culverts were exhibited, the cast iron pipe interests being represented by the American Car and Foundry Co. and the United States Cast Iron Pipe and Foundry Co., while corrugated metal culverts were shown by the Shannon Self-Locking Metal Culvert Co., the Portsmouth Culvert Co., the American Rolling Mills and the Galion Iron Works. Collapsible forms for concrete culverts were shown by the Concrete Form and Engine Co.

Engineering instruments were shown by the Bausch and Lomb Optical Co., and Keuffel and Esser.

Laboratories were represented by Robert W. Hunt & Co.

Gasoline engines and pumping outfits were exhibited by the New Way Motor Co., Novo Engine Co., Original Gas Engine Co., and the Whitman Agricultural Co.

Orenstein-Arthur-Koppel Co. showed models of dump cars. Steam shovels were represented by the Marion Steam Shovel Co.

The Steel Protected Concrete Co. showed the Wainwright Corner Bar, and distributed literature of the new Guelich asphalt plant. The Tarrant Manufacturing Co. exhibited various tools and other appliances for paving work, as did the Iroquois Iron Works and the Anderson Tool and Supply Co.

The exhibit of miniature models by the Office of Public Roads of the United States deserves special mention. Models of roads from the early Roman roads to the present modern types were shown. There were also models of bridges, culverts and drainage structures, rollers, crushers, etc. The New York State Highway Commission chemists were present with considerable laboratory equipment, and gave out much useful information. The United States technical papers were well represented, eleven of them having booths.

The exhibition of machinery and materials formed only one part of the work of the Congress of course, great interest being shown in the large number of valuable papers read at the meetings. Some of these papers appeared in full in last week's issue and in this issue of *The Canadian Engineer*, and others may be printed during the next few weeks; but it is understood that a complete report of the proceedings of the Congress, together with all speeches in full, will be procurable within a few weeks, for a small fee, from the secretary of the American Highway Association, J. E. Pennybacker, Colorado Bldg., Washington, D.C.

The Fourth American Road Congress will likely be held at Atlanta, Ga. The executive committee are considering the advisability of holding the Congress about January, 1915, instead of late in the fall of 1914. Many road contractors and engineers are too busy in the fall to attend the Congress, and it is also thought that possibly the lessons learned would be better remembered if the Congress were held nearer the opening of the following construction season.

ESSENTIAL FEATURES IN GOOD BRICK ROAD CONSTRUCTION.

IN the course of the paper which he read before the American Highway Association at Detroit (American Road Congress), Mr. Jas. M. McCleary, road engineer of Cuyahoga County, Ohio, refers in an interesting manner to the various events in the process of evolution which road engineering has gone through in that county from the initial stages of highway improvement to the conditions which at present mark its roads as being worthy of praise. The paper deals largely with mistakes of early brick construction, and the methods whereby they were, and may be elsewhere, overcome. Cuyahoga County possesses no peculiarities of topography or soil that are not ordinarily found in other districts and countries, and for this reason the following points as disclosed by Mr. McCleary's paper are applicable, with almost equal weight, in Canada:

In the western part of Cuyahoga County the land is so level that drainage is a difficult problem and must be given much consideration. In the southern and eastern parts, the land is so broken that to secure a feasible grade without undue expense for excavation becomes the chief difficulty. The soil varies from a sticky yellow clay in the southern and eastern sections to a sandy loam at the west. The development of the brick road, therefore, was obstructed by all the probable problems to be found elsewhere: natural and artificial soil, grades, climatic influences and the opinion of the abutting property owner.

The first brick road in the county was started in 1893 and completed in 1895. It was located on what is known as the Wooster Pike, in the southwest portion of the county. The wearing surface was of standard size brick, eight feet in width, tar filled, placed between stone curbs, $3'' \times 15''$, and resting upon a six-inch broken stone base. The pavement was placed upon one side of the roadway with a graded earth drive occupying the balance of the width. No drainage was provided and really nothing of detail was taken into consideration. No requirement in the specifications dealt with the quality of the stone, and the result was that field stone was used for base, and of such consistency that, when the roller had done its work, one might think that sand ballast had been used. Upon this the cushion was placed without compression and then the brick. As to the filler, no one could have told its composition at the end of six years, so little of it could be found.

The pavement being but eight feet in width, all the traffic came in one place. Lack of bond and absence of uniform support caused a depression to appear. In the wet season this rut or groove filled with water which soaked through the base, creating a worse condition from day to day during the damp seasons. The colder weather brought upheavals and such havoc that many sections of the so-called improvement were a hindrance rather than an aid to the traffic.

These defects were not repaired, owing to the fact that the law under which these improvements were made permitted no expenditure for maintenance. In 1898 this legislative flaw was remedied, but for five years there was no chance to palliate the badness of our methods nor to interfere with the increasing delapidation which constituted the chief value of this road—the value of a horrible example.

The next road laid was South Woodland. This is in the eastern section of the country. Again the wearing surface was eight feet in width, tar filled, and placed be-

tween flush stone curbs on a six-inch broken stone base. We had learned, in a small way, from our first mistakes and placed a six-inch drainage tile beneath the centre of the roadway. But on account of the soft filler and imperfect preparation for carrying off the water, but little improvement in the result was realized. An uneven settlement of the base soon resulted in roughness.

Lorain Road, our next installation, was built sixteen feet wide, tar filled, and resting upon a crushed stone and slag base between flush curbs, with drain tile beneath each curb. Subjected to an unusually heavy traffic, the almost inevitable result of such construction must be extensive repairs, amounting almost to reconstruction.

Our next great forward step occurred when the tar filler gave way to a grout filler composed of one part sand and one part cement. This plan was followed until 1905 with success, at least in comparison with previous experiences. The cement filler alone could not cure all of the defects due to inferior drainage and frost action. Another step was therefore decided upon—the inclusion in the specifications of a requirement for a 4-inch concrete foundation which, of course, increased the price. The increased cost brought immediate opposition, resulting in a temporary return to broken stone or slag base until 1908, when concrete was again adopted as a foundation and continued up to the present time.

Since 1908 it has been the policy not merely to conform to the chief essentials of brick paving, which are: (1) properly prepared subfoundation, (2) smoothly finished concrete base, (3) compressed sand cushion, (4) laying of good brick, (5) application of the cement filler to the joints; but to attach importance to minor details of approved manner and method of construction. Doubtless we have not even yet given weight to certain details advocated by some of the more painstaking students of brick road construction in the country.

A satisfactory plan for an average rural pavement may include a paved portion anywhere from 9 to 16 feet in width, the width being controlled by the amount of traffic to which the road is subjected. A dirt or gravel macadam should occupy the balance or unpaved portion of width. Whatever dimensions are adopted, the surface drainage should be over the pavement toward a ditch on the side of the road closest to the pavement, eliminating a crown from the paved portion. The unpaved portion should be drained in the opposite direction.

Immediately you ask: "Why a dirt road?" The best answer is, "Ask the farmer," and he will tell you to ask the horse.

The engineer will save himself much trouble if he holds to such a grade line as will entail minimum depths of fill. This is not always possible and it is the larger fills that call for the most extreme care. It behooves the engineer to see that his specifications contain a clause calling for the fill to be put in layers of not more than 6-inch thickness and each layer compacted with a roller not exceeding 10 tons in weight. This clause must be enforced with rigidity.

Puddling is the one method that can be followed successfully in the treatment of old fills. The surface of the road should be broken and dirt removed from the centre to the sides. At right angles to this trench, shorter trenches should be dug at intervals of 25 feet, forming a rectangular vat. Pump water into these compartments and allow it to stand until it has leaked its way into the fill. This will disclose the weak spots and the engineer can take care of them as he thinks best.

The drainage of the graded portion of the road is of first necessity. Whatever plan is adopted, the one that will most nearly maintain the sub-structure free from moisture below the frost line is the ideal condition to be sought. This means that you must not merely drain the road bed, but adequate side ditches must be provided to carry off promptly the accumulated water. In the preparation of a sub-base the only debatable proposition is the purpose of rolling. Common practice, including the use of a very heavy roller, has been founded upon the theory of compacting the soil to as great a depth as possible. This can do no harm, but the writer believes that the chief purpose of rolling is accomplished when the weak or spouty places in the soil are revealed so that the engineer can treat them as he sees fit. For this purpose, a roller weighing from 8 to 10 tons answers every requirement.

Preceding the final preparation of the sub-base the curbs must be placed. In case of most of our rural work, curbs are placed flush with the surface of the completed pavement.

With curb set and base prepared, the next step is the placement of the concrete base, which with our roads has been 4 inches in depth. In specifying the proportions, a mixture of 1:3:5 with a permissible variation according to the size of the aggregates which will most nearly fill the voids, meets every necessity. To meet this variableness, which obtains with almost every job, it is necessary to specify the size of the coarse aggregate, but not the amount, requiring only so much of the coarse aggregate to be used as shall leave the concrete most nearly free from voids. This, instead of an inflexible rule of proportions, will assure a condition of concrete whereby a smooth surface is easily attained. A smooth surface must be had, for upon that much of efficiency and durableness of the wearing surface depends. It assures in the next step a requirement of equal importance, that of placing the sand cushion of uniform fill and of uniform density.

While it is possible that often too much importance is placed upon the ability of the sand cushion to afford a resiliency or absorb shock, it is unquestionably a necessity for the purpose of bringing the wearing surface of the brick to a perfect plane, by neutralizing the unevenness and lack of uniformity of the brick. No one will question but that the support of the wearing surface provided for by this sand cushion must be uniform. It is therefore necessary to compress and bring to a like density every part of this cushion. Dropping the sand cushion on to the base from dump wagons and leaving the bottom portion of the load untouched before striking off with a template is objectionable, as it renders the hand rolling difficult by having a dense pile and a loose pile to contend with, the roller spanning the looser portion. It is better to spread the sand entirely by shovels, then by rolling and striking off and re-rolling, even a third time. This brings the cushion to a condition of compactness and even density that will not only furnish an even support to the entire pavement, but will prevent the sand from flowing up into the joints of the brick when the brick surface is rolled. While it is not necessary for this cushion sand to be entirely free from soil and vegetable matter, it should be nearly so, otherwise its density cannot be maintained.

Respecting the laying of the brick, the following points are noted by Mr. McCleary as important:—

(1) See that the lugs are turned one way.

(2) Make certain that the joints are broken so that one-third or more of the brick of one course overlaps the brick of the next course.

(3) Be sure that every fourth course is driven up to a straight line.

(4) For the sake of appearance, keep the line of the brick at right angles with the curb.

Next in order is culling. Care should be taken to see that all soft brick or brick that are burned too hard are removed. Those so heavily kiln-marked that they will cause unevenness in the pavement should be turned. Caution should be exercised in this, for many a kiln-marked brick is thrown out which, if allowed to remain would have been of more value to the pavement than others that are retained.

After the brick are thus placed in the street, their slight unevenness should be ironed out by the use of a roller not exceeding 5 tons in weight. If a horse roller is used at all, it should have a diameter of at least 5 feet. Rolling should begin on one side and pursue a course parallel to the curb. The roller should return over the same course. The next trip should lap the first, the roller again returning over the same course. This should continue until the centre of the pavement has been reached when the roller should be moved to the opposite curb and continue as before until the centre is reached from the other side.

The roller should then start at one side and work diagonally across the pavement. This diagonal rolling will have a tendency to bed the brick in such a manner as to avoid "rocker." The pavement should then be culled again for broken brick, after which it should be hand-rammed with a paver rammer weighing not less than 50 pounds. Interpose a plank not less than 6 feet long, 10 inches wide and 2 inches thick, between the surface of the pavement and the rammer. The plank should be laid parallel to the curb.

For filling joints, the next process in order, use a grout filler composed of equal parts of sand and cement. It seems hardly necessary to state that the cement should meet the standard specifications for Portland cement as adopted by the American Society for Testing Materials. The sand with which we have had much success has been taken from the lake and, although not very sharp, is nevertheless fine and clean and has given good results. In any event the sand to be used should be free from sewage, acid or soil, and should be sharp and fine.

A watertight box, standing on uneven legs so as to afford a "lower corner," should be used as a receptacle for the grout. In it place one cubic foot of sand and one bag of cement, mixing the mass until it assumes a uniform color. Add water and stir the mixture until it assumes the consistency of thin cream. The mixture should then be applied to the pavement by means of scoop shovels and thoroughly swept into the joints. After this has had sufficient time for setting a second coat, slightly thicker, should be applied and later a third coat, which will assure filled joints. This last coat should be worked either with a specially prepared broom or a rubber squeegee, and swept across the joints at an angle of 45 degrees.

After the initial set has taken place, the pavement should be covered with a half inch or more of sand and this kept saturated with water for at least 5 days. The pavement should not be opened to traffic for at least 10 days.

We have not undertaken any special provision against possible thermal effect, such as contraction and expansion due to low and high temperatures, but have relied mainly upon the condition of our structure by avoiding moisture underneath the roadway and by an endeavor to have our cement-filler of the greatest possible strength. These provisions, together with a rigid curb, enables us to hold in compression, the expansion occurring in our narrow roadways. In this respect, we have not been entirely successful. A few cracks in the pavement have appeared, but so far, they have not ravelled out so as to injure the traffic worth of the road, and have not been thought of sufficient importance to require repairs.

COAST TO COAST.

Montreal, Que.—The fourth and last 270-foot span of the C.P.R. Lachine bridge has been placed in position.

Toronto, Ont.—The Hon. Robert Rogers, when inspecting the city harbor, made the statement that it is planned to have the Great Lakes watercourse for ocean freighters completed in 1918.

Regina, Sask.—The sewer work contracted for by the Regina City Council early in the year is nearly all completed, and already the city engineer and his staff are busily engaged on planning the extensions for next year.

Vancouver, B.C.—The contractors have announced that within 30 days, work will commence on the erection of the Dominion Government dock in East Vancouver, which has let at an estimate of three-quarters of a million dollars.

Edmonton, Alta.—The city council has instructed the city commissioners to apply to the Dominion Government to have lands reserved for the source of the city's gas supply in the gas district at Vegreville. A pipe line of 90 miles, the cost of which would be $946,500, would be necessary to carry the supply to Edmonton.

Saskatoon, Sask.—At the recent convention of Canadian municipalities held at Saskatoon, a movement was set on foot to urge the establishment of a local government board, whose particular function will be to keep in constant touch with the finances of each city and municipality within its jurisdiction on lines similar to the system in vogue in England.

Montreal, Que.—The first C.N.R. train to make the through trip from Toronto to Quebec, covered the road early in October, bearing the president and Lady Mackenzie to the "Royal Edward" steamship. The track is pronounced in first-class condition, though regular passenger service will not commence until the ballasting is fully completed.

Ottawa, Ont.—The Conservation Commission will support the recommendation of the Ontario Municipal Electric Association that the water powers along the rivers and canals of Ontario be handed over to the Ontario Hydro-Electric Commission. It has been urging this policy for some time, though it is not particular whether the development is carried out by the federal or by the provincial government.

Edmonton, Alta.—A deputation of 70 farmers called upon Premier Sifton to ask that he urge upon the government the necessity of considering the question of assisting in the building of light railways to connect with settled districts removed from main lines of railway. The deputation was particularly concerned with the construction of a railway in Blindman Valley in the Lacombe and Ponoka districts.

Montreal, Que.—Mr. T. S. Darling has stated that between the 20th and 30th of December, the completion of the tunnel through the mountain will be announced. Two thousand feet of distance remain to be cut, but there has been little trouble so far and none anticipated until the work is

finished. No difficulty with respect to air pressure has been experienced, since the tunnel does not lie under a river.

Victoria, B.C.—An important operation was achieved in connection with the improvement work in the Inner Harbor, when 700 tons of rock were displaced at a single charge. This was accomplished at the Soughees rock where drilling and blasting operations are being carried on at present. The elimination of several of the dangerous rocks has removed the menace to shipping, which has prevented large vessels from entering the Inner Harbor.

Montreal, Que.—At the annual meeting of the Grand Trunk Pacific Railway Company, report on the construction of the main line to the Pacific coast showed that the work has reached mile 1,204 west of Winnipeg, and mile 305 east from Prince Rupert. This leaves a section of only 236 miles in British Columbia on which the grade is to be completed and the track laid. It is hoped to complete the connection of steel to the Pacific Ocean within the next nine months.

Coquitlam, B.C.—After four years of labor, the great dam at Coquitlam has reached completion. Its construction necessitated the tearing down of hills and the displacement of vast quantities of earth, the boring of two tunnels through solid granite and the erection of two towers. Work has ceased on all portions of the construction, the final piece of labor being the spillway, a trench 250 feet in width and 15 feet in depth, which was driven through solid rock.

Victoria, B,C,—The announcement has been made that the middle of next summer will see a new channel for the use of steamers entering and leaving Victoria's inner harbor. This channel will be one quarter of a mile wide and 20 feet deep at low water. Several patches of mud must still be cleared away, and a couple of pinnacles of rocks broken up and removed. A shorter run into the harbor will be gained by the new channel, eliminating the turns which cause considerable trouble to certain boats.

Toronto, Ont.—The acceptance of the 86-foot road standard by the Ontario Railway Board assures for Greater Toronto one of the finest road systems on the Continent. St. Clair Avenue has a width of 100 feet, and will serve as a plan for future boulevard constructions. Only at street intersections can vehicles cross from one side of the street to the other, thus obviating the difficulties to street car traffic caused by vehicular traffic in older sections of the city. Here, also, the track area has been covered by broken granite for the purpose of deadening sound.

Vancouver, B.C.—Another bridge, the largest of its type on the mountain section of the C.N.R., has been completed. It stretches for 760 feet over Stoyama Creek, and consists of seven steel spans resting on six concrete pedestals. Surmounting the pedestals are six towers, each 40 feet in width. Track is now being laid over the bridge and beyond it westwards until Nine Mile Creek is reached, where another steel viaduct, 300 feet long, having three towers and two spans, will be constructed. Still further west, between Nine Mile Creek and Cisco, smaller steel bridges will be erected over obstructing creeks and gullies.

Regina, Sask.—City Engineer McArthur has decided on a novel plan to keep the roadways of Regina in proper condi tion. The assistance of the boy scouts has been enrolled Boy scouts patrol different sections of the city at stated times and report where improvement is needed in the roads. These reports are handed over to what is now called the "road repair gang." This gang of men is employed for the specific purposes of making repairs, and is kept busily engaged fixing up the bad spots reported by the boy scouts. It is expected that by this system the roads throughout the entire city will be in good repair by freeze-up.

Vancouver, B.C.—The opening of Kingsway, the newly-paved 12-mile highway connecting Vancouver with New Westminster and the municipalities of South Vancouver and Burnaby, was celebrated recently by a program of ceremonies comprising an imposing procession of city and municipal officials carried by 563 automobiles bountifully decorated with flags as far as the corner of Kingsway and Boundary Road, where speeches were given by the Mayor, Reeves and the Hon. Thos. Taylor. He formally declared the highway open to traffic, congratulated the cities and municipalities upon the highway construction, and outlined the possibility of a circular road paved from Vancouver to New Westminster, via Kingsway, returning by the river road. Amidst the enthusiastic cheering of the great crowd assembled, the procession re-formed and continued along the highway to the Royal city.

Medicine Hat, Alta.—The Southern Alberta Land Company has been carrying out an irrigation project that will water the greater part of 400,000 acres of excellent land in Southern Alberta. They have engaged in the work Mr. David W. Hays as chief engineer with a force of about 500 men. One of the greatest feats in connection with the scheme will be the construction of one of the longest tunnels for carrying water in Western Canada, as well as one of the largest in diameter, its cross-section being 100 feet. The tunnel will commence at a point three miles south of Lake McGregor, and extend about two miles along the lower end of the Snake Valley. It will cut off five miles along the main ditch from the lake, which is the main source of supply. When completed it is estimated that it will carry 1,300 second feet, or 1,300 cubic feet will pass a given point every second.

Edmonton, Alta.—Much discussion is being given to the deficits which appear every month in the earnings of the city's street railway department. Among other recommendations, Cost Engineer Bowness has suggested that an immediate investigation of power rates be made to settle the basis of rate and the method of measuring power delivered, which is now indefinite and unsatisfactory. The rates charged by the power department are admitted to be excessive. To reduce the power charges so as to supply direct current to the street railway company at the exact cost of production would alter the monthly report of Mr. Woodroofe, superintendent of the street railway department, and deficits would be eliminated. The power department would show a smaller surplus with the carrying out of the recommendation, but a report showing a balance on the right side in both departments would make more pleasant reading for the citizens, the owners of these concerns.

PERSONAL.

W. G. CHACE, B.A.Sc., of the firm of Kerry and Chace, Limited (until recently, Smith, Kerry and Chace), has been appointed chief engineer of the entire construction of the Greater Winnipeg water system.

W. S. HARVEY, mentioned in our personal column on August 21st, as acting city engineer of Lethbridge, Alta., succeeding A. C. D. Blanchard, resigned, has just been appointed to the position of city engineer.

ERNST POENSGEN, manager of the Tube Department of the Phœnix Steel Works of Dusseldorf, Germany, returned home last week. He spent some time at Montreal with his firm's Canadian agents, Gerald Lomer, Limited.

DR. CARL IMHOFF, eminent in the design of system and apparatus for scientific sewage disposal was a visitor in Toronto last week, and made a careful tour of inspection over the sewage disposal plant at Morley Avenue.

J. H. FUERTES, civil and sanitary engineer of New York, and a member of the board of experts, who reported recently on the Shoal Lake Water Supply scheme for Winnipeg (See *The Canadian Engineer*, September 11th, 1913), has been appointed consulting engineer for the work.

C. R. KRUMBIEGEL has been appointed Chief Engineer for Canada for Deutsche Maschinenfabrik, A.G., Duisburg, Germany. Mr. Krumbiegel has been on the engineering staff of this firm for a number of years and has had experience, not only in Germany, but in the United States as well. He will be permanently located in the office of the firm's Canadian agents, Gerald Lomer, Limited, Fraser Building, Montreal.

R. H. REYNOLDS, was last week appointed a commissioner to act in connection with the Shoal Lake water supply system for Winnipeg, upon which construction work will begin immediately. It is stated that the other commissioners will not be appointed for some little time. Mr. Reynolds was for some years assistant city engineer under City Engineer Ruttan, and when he left in 1907 was succeeded by R. D. Wilson, who still holds that position. For a number of years he was engaged in mining pursuits, and is at present a resident of Victoria, B.C.

J. E. PENNYBACKER, secretary of the American Highway Association, was in Toronto this week making preparations for his new work as consulting expert to the Ontario Highway Commission. Mr. Pennybacker was educated at West Virginia University and the University of Georgetown, graduating in law in 1900. After four years' practice with a railroad corporation, he was appointed chief clerk of the United States Office of Public Roads. Some particularly able work that he did in gathering economic data regarding roads, attracted the attention of the Cabinet, and he was appointed Chief of Road Management. When the American Highway Association was formed about two years ago, Mr. Pennybacker resigned his government position to become its permanent secretary. On the recommendation of Director Page of the United States Office of Public Roads, Mr. Pennybacker was also appointed as consulting expert to the Joint Congressional Committee on Road Legislation. Mr. Pennybacker gave valuable assistance to the Committee which reached the notice of the chairman of the Ontario Highway Commission. At the request of the Ontario Government, the American Highway Association permitted Mr. Pennybacker to act as consultant to Ontario Highway Commission. The vast amount of data that he has gathered during the past ten years on every phase of road legislation and road construction, will undoubtedly help the Ontario Commissioners in framing a model Highway Bill and in organizing an ideal Highway Department.

OBITUARY.

GEO. G. ROSE, C.E., a member of the engineering staff of the Cornwall Canal, and a native of Morrisburg, Ont., died last week at Cornwall. Mr. Rose was a graduate of the Royal Military College, Kingston, and was connected with the Marine Department, Ottawa. Fifteen years ago he was in charge of the construction of a part of the Rapide du Plat Canal. He was 63 years of age.

JAMES HARRISON, a member of the engineering staff of the York County Road Commission, died suddenly in Woodbridge, Ont., last week. Deceased was overcome by a paralytic stroke, and a record run to a city hospital proved in vain. Although not a graduate, Mr. Harrison was a member of the 1887 class in Civil Engineering at the School of Practical Science, Toronto

EXTENSIONS TO ELECTRICAL FIRM.

Contracts have just been placed by the Eugene Phillips Electrical Works of Montreal for a large amount of new machinery with which to equip the new quarter of a million dollar extension to their Montreal plant. There has already been installed in this extension all of the machinery that had been previously used by the Stromberg-Carlson Telephone Manufacturing Company of Rochester, New York, in their telephone-cable making branch. This branch of the Stromberg-Carlson business was purchased outright by the Montreal firm, which is now in a position to bid on very large contracts for telephone cable. The capacity for making other cable will also be greatly increased, and the contracts recently let for machinery will widen the field of the company's activities.

COAL TESTING.

At the October meeting of the Cleveland Engineering Society, held on 14th inst., Dr. W. G. Wilcox, of the Cleveland Research and Testing Laboratories, presented an illustrated paper on "Coal Testing." Another meeting is being held on October 21st, when Mr. Jos. R. Poe, Structural Engineer, the Wellman, Seaver, Morgan Company, will give a paper on "The Practical Side of Steel Structures."

OTTAWA BRANCH—CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the annual meeting on October 2nd, of the Ottawa Branch of the Canadian Society of Civil Engineers, Mr. Geo. A. Mountain was appointed chairman of the branch. Meetings for the presentation and discussion of papers will be held on the first and third Thursdays of the fall and winter months, the other Thursday evenings to be devoted to informal or business meetings. Mr. R. F. Uniacke is the retiring chairman.

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—The first monthly meeting of the Society for the winter session will be held on Thursday, the 16th inst., at 8.15 p.m. An illustrated address on Elevator Construction will be delivered by Mr. Jas Spelman, M.Can.Soc. C.E.

NATIONAL SOCIETY FOR PROMOTION OF INDUSTRIAL EDUCATION.—Annual convention to be held at Grand Rapids, Mich., October 19th to 25th. Secretary, C. A. Prosser, 105 E. 22nd Street, New York City.

AMERICAN MINING CONGRESS.—Annual convention will be held at Philadelphia, Pa., October 20th to 25th. Secretary, J. Callbreath, Majestic Building, Denver, Colo.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—Annual convention will be held at Montreal, Que., October 21st to 23rd. Secretary, C. A. Lichty, 319 N. Waller Avenue, Chicago, Ill.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

NATIONAL MUNICIPAL LEAGUE.—Annual meeting will be held in Toronto, November 12-15. Secretary, C. R. Woodruff, 705 North American Building, Philadelphia, Pa.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20447—September 30—Authorizing C.P.R. to open for traffic that portion of its Swift Current North-West Branch from Cabri, mileage 34.8, to Westerham, near mileage 94.0, a distance of 59.2 miles. And relieving company of speed limitation of fifteen miles an hour between mileages 34.8 and 33.0, imposed under Order No. 16869, dated June 25th, 1912.

20448—September 29—Authorizing Lachine, Jacques Cartier, and Maisonneuve Ry. Co., to take certain lands in city of Montreal, P.Q., required for diversion of Harbor Street; said lands being required to give effect to Order No. 16181, dated March 28, 1912, authorizing the crossing of certain streets in Montreal, including diversion of Harbor Street.

20449—September 29—Directing that crossing of Wallace Ave., Toronto, by G.T.R., be protected by gates operated by day and night watchmen appointed by Ry. Co.; cost of installing and maintaining gates and wages of watchmen be borne and paid by city of Toronto; work to be completed within 60 days from date of this Order, and rescinding Order No. 9247, dated January 12th, 1910; such revision to take effect upon installation of gates herein required to be provided.

20450—September 26—Authorizing G.T.R. to construct siding, and spur therefrom, into premises of Ogilvie Flour Mills Co., Limited, west of Mill Street, Montreal, Que., subject to and upon certain conditions.

20451—September 27—Authorizing G.T.R. to construct additional track, or siding, commencing at a point on its railway west of Gore Street, Stratford, Ont., thence extending easterly across Gore Street. Siding to be completed within three months from date of this Order.

20452—September 29—Extending, for a period of three months from date of this Order, time within which G.T.R. construct branch lines of railway and additional tracks in the village of Port Colborne, Ont., authorized under Order No. 19535, dated June 4th, 1913.

20453—September 29—Authorizing C.N.O.R. to construct, subject to conditions contained in consent of Montreal Tramways Company, dated August 26th, 1913, proposed temporary grade on its Montreal-Hawkesbury Line from mileage 46.69 to 48.62, to be used for construction purposes only for a period of one year; and to cross on said temporary grade for said period, the Monkland Boulevard, Bois Franc Road, Montreal Park and Island Ry., and St. Laurent Road.

20454—September 30—Authorizing C.N.R. to construct across twenty-two (22) highways on its Goose Isle Branch, Manitoba.

20455—September 30—Authorizing C.L.O. & W. Ry. (C.P.R.) to construct, at grade, across side road in Lot 14, Con. 3, Tp. of Bathurst, Ont.; and to construct temporary diversion of said railway at mileage 2.1.

20456—September 30—Authorizing C.L.O. & W. Ry. to construct ballast pit spur line, by means of grade crossing, across road allowance between Lots 10 and 11, Con. 1, Tp. Murray, Co. Northumberland, Ont., at mileage 0.09 on ballast pit spur.

20457—September 30—Approving, subject to provisions of sub-section 2 of Sec. 327, and sub-section 1 of Sec. 331, of Ry. Act, maximum tolls to be charged for passengers for all distances on C.P.R. lines in Canada now in operation or under construction, as specified in Co.'s Standard Passenger Tariff, C.R.C. No. 2279, dated at Montreal, Aug. 12th, 1913, to become effective Sept. 1st, 1913, namely: three cents (3c.) per mile east of and including company's railway between Macleod, Calgary, and Edmonton, Alta., and four cents (4c.) per mile west of and including Macleod and Calgary, said tariff being a consolidation of company's approved Standard Passenger Tariffs, C.R.C. Nos. W. 38, and E. 664.

20458—September 30—Directing C.N.O.R. to provide and construct suitable farm-crossing and cattle-pass where it crosses lands of William and Robert Wilson, in Lot 26, Con. B, Tp. Westmeath, Co. Renfrew, Ont., subject to and upon certain conditions.

20459—September 11—Authorizing C.P.R. to construct spur for Northern Elevator Co., Limited, Winnipeg, Man., from a point on existing spur on Sutherland Ave., subject to and upon certain conditions.

20460—September 30—Authorizing G.T.P. Ry. to construct wye track at mileage 29 west of Yellowhead Pass, Cariboo District, B.C.; and rescinding Order No. 17618, dated September 25th, 1912, made herein.

20461—September 30—Extending, for a period of thirty days from date of this Order, time within which G.T.R. complete culvert under its tracks, Tp. Tecumseh, Ont., authorized by Order No. 19988, dated Aug. 5th, 1913.

20462—October 2—Declaring that joint tariff of Alta. Ry. and Irrigation Co., C.R.C. No. 165 is lawfully in effect; and that Supplement No. 16 thereto, published and filed by C.P.R. to take effect August 18th, 1913, is disallowed. Board will be prepared to consider an application for annulment of said C.R.C., No. 165 on publication and filing by C.P.R. of local and joint tariffs of rates from Lethbridge, and from points on line of Alta. Ry. and Irrigation Co., via Lethbridge, which shall not be greater than those shown in said C.R.C., No. 165, via Coutts, to points in B.C., on G.N.R. and C.P.R., to which the rates of said C.R.C., No. 165 are now lower than via C.P.R. from Lethbridge, having regard to provisions of Ry. Act.

20463—September 30—Establishing collection and delivery limits of the Dominion Express Co., in town of Swift Current, Sask.

20464—October 1—Authorizing Edmonton, Dunvegan and B.C. Ry., to construct across two highways—namely, 1. between N.E. ¼ Sec. 13-74-16, W. 5 M., and N.W. ¼ 18-74-15, W. 5 M.; 2. N.E. ¼ Sec. 13-74-16, W. 5 M., Province of Alberta.

20465—October 1—Extending, for a period of 60 days from date of this order, time within which G.T.R. install electric bell at crossing of Mill Street, Milverton, Ont., required under Order No. 19893, dated July 24th, 1913.

20466—October 1—Authorizing G.T.R. to construct siding into premises of the Ham and Nott Co., Limited, on Block "C." north of Bruce Street, city of Brantford, Ontario.

20467—September 30—Authorizing G.T.P. Ry. to construct spur for the Park Lumber and Planing Mills, Limited, in Block 10, Cromdale Subdivision of River Lot 24, Edmonton, Alta.

20468—October 2—Approving location C.P.R. stations on Port McNicoll Subdivision, Ont. Div.—namely, 1, Lot 28, Con. 3, Tp. Ops, Co. Victoria, Ont., at Cambray, mileage 22.78, and 2, at Franklin, mileage 6.3, Lot 22, Con. 12, Tp. Manvers, Co. Durham, Ontario.

20469—October 1—Authorizing C.P.R. to construct spur into premises of G. F. Stephens and Co., Limited, on Lot 64, parish of St. Boniface, Winnipeg, Man., subject to and upon certain conditions.

20470—October 1—Authorizing C.P.R. to construct, subject to terms of consents of town of Swift Current, dated May 23rd and September 9th, 1913, spur for Swift Current Grocery Co., Limited, and Winnipeg Paint and Glass Co., Limited, Swift Current, Saskatchewan.

20471—October 1—Approving location C.P.R. station at Musquash, parish of Musquash, Co. St. John, N.B., at mileage 66.41 on Co.'s Shore Line Subdivision, Atlantic Div. Dist. No. 1.

20472—September 30—Authorizing C.P.R. to construct Weyburn-Stirling Branch Line across twenty-nine (29) high-

ways between mileage 37.94 and 65.20 (zero of said mileage being at Stirling).

20473—October 1—Authorizing C.P.R. to construct sidings for Messrs. McGregor and McIntyre, Toronto, Ont.

20474—October 2—Authorizing Commissioners of Transcontinental Ry., to make, subject to terms of consent of C.P.R., siding connection with C.P.R. tracks to shop site of applicants, in Lot Cadastral, No. 2345, parish of St. Sauveur, Co. Quebec, Que.

20475—October 2—Authorizing G.T.R. to use and operate Bridge over Richelieu River, at Mile Post 8.73 on Thirtieth Dist., near Lacolle Junction, authorized to be reconstructed under Order No. 15863, dated February 2nd, 1912.

20476—October 2—Authorizing C.N.O.R. to construct spur from its Rly. at Richmond Hill to property of J. H. Dunlop, Lot 24, Con. 1, Tp. Markham, Ontario.

20477—October 2—Authorizing C.P.R. to construct tracks of extension to town siding, at grade, across public road between Lots 12 and 13, Con. 3, Tp. Hagar, Dist. Sudbury, Ont.

20478—October 3—Amending Order No. 20226, by striking out figure "2" after word "Lot," wherever same appears in said Order, and inserting in its place figure "4," so as to make the Order read, "situated in Subdivision, Lot 27, Lot 4, Con. 11, Tp. Tillsonburg.

20479—October 2—Authorizing C.P.R. to change present grade crossing, necessitated by additional track (double track); and to construct, by means of grade crossing, said additional track across road allowance between Cons. 2 and 3, Tp. Toronto, at mileage 18.61 on Co.'s main line, London Subdivision.

20480—October 3—Amending Order No. 16874, dated June 26th, 1913, by striking out figures "35.5" in first line under heading Mountain Subdivision, and substituting figures "35."

20481—October 2—Directing that C.N.R. install caretaker at Sandy Lake, Man., who shall, amongst other things, keep waiting room clean and heated for arrival of passenger trains; meet passenger trains on their arrival and assist in putting on or taking off any baggage; meet local freight trains and see that package freight is properly housed; keep freight shed locked, with key at a convenient point; and deliver freight to consignees between hours of 8 a.m. and 6 p.m. Caretaker be installed not later than October 5th, 1913.

20482—October 3—Authorizing C.N.O.R. to construct bridge to carry its railway across Kiosh-Koqui Lake, Tp. Pentland, Dist. Nipissing, Ont., at mileage 186.6 from Ottawa.

20483—October 3—Directing that the sum of $4,700, deposited in a chartered bank in City of Fort William, Ont., under Order No. 18908, dated March 20th, 1913, be paid upon request of C.P.R.; and that production of a certified copy of this Order be authority to bank for such payment.

20484—October 3—Approving C.P.R. plans dated Winnipeg, May 30th, 1912, and September 10th, 1913, showing proposed location of stairway from Arlington Street Bridge to engine house at Winnipeg, Man.; and rescinding Order No. 16860, dated June 22nd, 1912.

20485—October 3—Authorizing C.P.R. to construct additional track (second track or siding) across road allowance on East Boundary of Sec. 5-9-21, W. 4 M., Alberta.

20486—October 3—Relieving G.T.R. from providing further protection at second highway crossing north of Corbeyville, Belleville and Peterboro Division, Ontario.

20487—October 4—Authorizing C.P.R. to construct, by means of a bridge, additional track of its main line, Sask. Div., Moose Jaw Subdivision, over and across road allowance between Secs. 21 and 22, Tp. 18, R. 13, W. 2 M., at mileage 52.65 on said main line. Province of Saskatchewan.

20488—October 3—Requiring C.N.R. to erect a third-class station building at St. Gregor, Sask.; work to be completed with not later than July 31st, 1914.

20489—October 2—Amending Order No. 20009, dated August 11th, 1913, by adding following clauses:—"3. That Government road allowance over C.P.R. between Sec. 1-17-27, and Sec. 6-17-26, W. 2 M., be closed subject to and upon condition that C.P.R. (Applicant Co.), provide and construct subway 40 feet wide, in the clear, just south of and adjoining its right of way, in accordance with plans submitted by Applicant Co., and approved by the city of Moose Jaw. 4. That contribution of $2,000 herein required to be paid by C.P.R. shall not become due or payable until on or after completion of subway authorized and required to be constructed under this Order."

20490—October 4—Authorizing C.P.R. to construct spur for Manitoba Cold Storage Co., Limited, city of Winnipeg, Man., subject to and upon certain conditions.

20491—October 4—Authorizing C.P.R. to use and operate, subject to condition that men be kept off sides and tops of cars when using the crossing, undercrossing shown in red on plan, during construction of Heffernan Street Bridge, Guelph, Ont. And approving and authorizing clearances as shown on plan of false work to be used at Heffernan Street Viaduct, Guelph, Ont.

20492—October 4—Authorizing city of Edmonton, Alta., to open up Spadina Avenue, across C.N.R. at rail level, within limits of city; expense of constructing and maintaining crossing to be borne and paid by applicant.

20493—October 3—Granting leave to B.C. Telephone Co., Limited, to erect its lines across G.N. Ry., on Oscar Street Abbotsford, B.C.

20494—October 1—Authorizing C.N.O.R. to construct spur to mills of Laberge and Sons, in town of Sudbury, from station 41.58.7 on connecting track between its line and Algoma Eastern Ry., and across Wilma Street.

20495—October 4—Authorizing C.P.R. to construct, at grade, spur for Tillsonburg Electric Car Co., Limited, Tillsonburg, Ont., across King Street and Sixth Street, at mileage 15.4, Port Burwell Subdivision.

20496—October 4—Approving Michigan Central R.R. plan showing bridge to be constructed under M.C.R tracks at mileage 32.98, Little Creek Drain, Tp. Tilbury West.

20497—October 4—Authorizing G.T.P. Ry. to construct spur and sidings, for Pembina Coal Co., Limited, in Secs. 19 and 30-53-7. W. 5 M., Alta.

20498—October 6—Extending collection and delivery area, in the city of Ottawa, Ont., prescribed by Order No. 16147, dated March 18th, 1913, by inserting words "including the Isolation Hospital" after words "Somerset Street," in said Order.

20499—October 6—Authorizing C.N.O.R. to construct bridge to carry its railway across Ottawa River at Fitzroy Harbor, Tp. Fitzroy and Onslow, Cos. Carleton and Pontiac, Provinces of Ontario and Quebec, at mileage 37.32 west of Ottawa, subject to terms and conditions contained in Order in Council.

20500—October 1—Authorizing C.N.O.R. to cross, at grade, Metcalfe, John, Harvey, Bourke, Jane, Durrill, Copeland, Bell, William, McIntyre, Timmons, and Nipissing streets, town of North Bay; and certain streets and avenues by means of subways. 2. construct across and divert Marion Street. 3. Closing of Cedar Street be conditional upon Co.'s extending McLaren Street, from Klock Avenue, to Home Avenue. 4. Closing of Fraser Street, be conditional upon Co.'s constructing subway 10 feet in clear width and 8 feet in height through station and under its tracks; station to be located in centre of Fraser Street to be as good, if not better, and of similar design, as Co.'s station at Belleville, Ont. 5. Co. be responsible for any damages property owners affected may be legally entitled to recover. And 6. All subways be satisfactorily drained by Applicant Co.

20501—October 6—Extending, until December 31st, 1913, time within which C.P.R. was required to construct and complete subway at Dundas Street, Woodstock, Ontario.

20502—October 6—Approving revised location C.P.R. main line, double trackage, Moose Jaw Subdivision, Sask., from a point in Sec. 27, in S.W. direction to a point in Sec. 21-18-14, W. 2 M., being from mileage 59.6 to 60.45. 2. Authorizing C.P.R. to construct road diversion across Blocks 147, 148, 149 and 150, Sec. 21, Blocks 143 and 144, Sec. 28, and across Sec. 27-18-15, W. 2 M., and to construct, by means of grade crossings main line across said diversion and across town crossing.

20503—October 6—Authorizing Government of Saskatchewan, at its own expense, to construct highway north of Sec. 28-16-15, W. 3 M., Sask., across C.P.R. Swift Current Northwesterly Branch.

20504—October 7—Amending Order No. 20190, dated August 26th, 1913, by striking out words "Suffield to Blackie" where same occur in said Order, and substituting therefor words "Weyburn-Stirling."

Barrett Specification Roofs

Last Longest—Cost Least

THE proper unit in comparing the values of roofings is the cost-per-foot-per-year-of-service.

To have a low unit cost a roofing must be—

1st. Inexpensive to build,
2d. Inexpensive to maintain, and
3d. Of great durability.

Barrett Specification Roofs are—

1st. The ***least*** expensive of all permanent roofs to build,
2d. They cost ***nothing*** to maintain, and
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Accordingly, Barrett Specification Roofs are in almost universal use on buildings such as illustrated herewith, where unit costs are intelligently studied.

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Copy of the Barrett Specification with tracing ready for incorporation in your building plans sent free on request. Address nearest office.

Special Note

We advise incorporating in plans the full wording of the Barrett Specification, in order to avoid any misunderstanding.

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ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified and subject to the inspection requirement.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

Δ—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Cap Chat, Que., training pier	Oct. 22.	Oct. 2.	80
Chocolate Cove, N.B., extension to wharf and dredging	Oct. 29.	Oct. 9.	80
Fraser River, B.C., wing dam	Oct. 21.	Oct. 2.	80
Halifax, N.S., railway terminals	Oct. 22.	Sept. 18.	88
Halifax, N.S., quay wall, &c.	Oct. 15.	Oct. 2.	80
Kincardine, Ont., breakwater	Oct. 29.	Oct. 9.	86
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Poupore, Que., training pier, &c.	Oct. 27.	Oct. 2.	80
Regina, Sask., power house equipment	Oct. 25.	Sept. 11.	86
St. Jean Port Joli, L'Isle Co., Que., wharf improvements	Oct. 28.	Oct. 9.	80
Ste. Anne de Monts, Que., wharf.	Oct. 22.	Oct. 2.	80
Summerland, B.C., wharf	Oct. 31.	Oct. 2.	82
Thornbury, Grey Co., Ont., harbor improvements	Oct. 29.	Oct. 9.	80
Wellington, Ont., harbor improvements	Oct. 29.	Oct. 2.	88

RAILWAYS—STEAM AND ELECTRIC.

Cardston, Alta.—Mr. Louis Hill, head of the Great Northern Railway, who surveyed in the first week of October, the extension made by the G.N.R. in southern Alberta, announced that the company were preparing to start work at once on a branch feeder line that would open up the country in the Cardston district.

Hamilton, Ont.—Mayor Allan has announced his determination to proceed with the construction of a new incline railway if the scheme of Geo. F. Webb means that the present one must remain closed for any length of time. In the meantime a motor truck service is to be operated to convey residents to the mountain top.

Ottawa, Ont.—At the next session of Parliament an application is to be made through the Vancouver firm of solicitors, Taylor, Harvey, Grant, Stockton and Smith, for an act to incorporate a railway company to be known as the Canadian Alberta Railway Company. The line the company proposes to build will run for about 14 miles in a north-westerly direction from a point on the C.P.R., a mile west of Blairmore, Alta.

Port Arthur, Ont.—It is reported, supposedly from the Winnipeg offices, that the C.N.R. will build next year a modern car-repairing plant in connection with its local terminals at Port Arthur. This will be constructed at a cost of at least $30,000.

Quebec, Que.—Vice-president McNicoll of the C.P.R., has announced that the C.P.R. has added its signature to that of the Trans-Continental Railway and the Government to the contracts for the new Union station and railway workshops.

St. Thomas, Ont.—The city council have adopted a resolution endorsing the action of the Safety First Committee of the Michigan Central in recommending that a subway or tube be constructed under the company's local yards for the convenience and safety of the employees.

Toronto, Ont.—The promoters of the proposed Hydro-Electric railway to Whitby and Port Perry have unanimously adopted the plans and estimates submitted by the Hydro-Electric Commission at a capital cost of $2,470,776, and are considering ways and means of getting those affected by the line to approve the project and the apportionment of cost. Hon. Adam Beck pointed out to those assembled to hear the report of the commission that the construction of the line was only practicable by combining railroad operation with the distribution of electric power and light, but that the Provincial Hydro Commission would be able to supply this in towns and villages at from $5 to $17 per horsepower.

Toronto, Ont.—The Ontario Municipal and Railway Board has concluded the argument over the Annette Street line, and has ordered the completion of the line before December 1st. The city is to proceed at once with the street widening at the intersection of Law Street, plans for which must be filed at once with the board.

Vancouver, B.C.—Mr. C. L. Dickeson, manager of the White Pass and Yukon Railway route, has stated that tentative arrangements have been made between his company and the Chicago, Milwaukee and St. Paul line, for the building of that railway into Vancouver from Seattle and for the putting on of a big fleet of steamers between Vancouver and Skagway. The steamers are to handle the railway business and freight until the Pacific Great Eastern Railway is completed to Fort George, and that line has been continued to link with the White Pass Railway. This latter railway has been reported to have sent an offer to the United States Government to extend its lines into Alaska.

GARBAGE, SEWAGE AND WATER.

Edmonton, Alta.—Wholesale merchants of this city are agitating the need of a bridge or subway to be constructed across the C.N.R. tracks in the vicinity of Fourth and Fifth streets.

Edmonton, Alta.—City employees are to commence work on a 10-inch main pipe line to connect with the city's main, and to extend from 122nd Avenue to 127th Street, thence north to 129th Avenue, from which point a 6-inch pipe is to carry the city's water to the yards and shops of the E.D. and B.C. Railway. By the agreement with the city, Mr. J. D. McArthur will bear the whole cost of the work.

Fredericton, N.B.—The city Gaslight Company have asked the city for permission to lay a sewer of 12-inch terra cotta pipe from their plant along Shore Street to the river.

Hamilton, Ont.—The works committee has approved the plans designed for a system of overflow sewers to relieve the flooding which occurs during times of heavy rainfall, at an estimated cost of $650,000.

+—Montreal, Que.—The Board of Control has awarded contracts calling for an expenditure of about $60,000 in sewers. RICE AND COMPANY will lay sewers in Lacordiere Street at $13,917, in Monsabre Street at $18,968.50; PALERMO, GENTIL AND COMPANY will construct sewers in Macgregor Street at $5,560, in Edward VII. Avenue at $5,000.50, in Turenne Street at $3,442; MR. HENRI BERTRAND was given the contract for Adair Street, Ontario Street, Lafontaine Street and St. Catherine Street east of Maissoneuve for $1,691.90 each, and for George V. Avenue at $7,414.90.

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BOOKLETS ON REQUEST **51 Victoria Square, MONTREAL**

Ottawa, Ont.—The Bryson Realty Company has written the city Board of Control asking that it be provided with sewer accommodation for its new building, the present system on Queen Street being inadequate. An extension of 120 feet from the Kent Street sewer is asked to accommodate as well other large buildings, which will be erected in this section.

Regina, Sask.—Tenders will be received up till October 20th, 1913, for the following works:—(1) Construction of a filter bed; (2) supply of a steel roof for filter bed; (3) supply of 9,025 concrete flooring blocks. Plans and specifications may be obtained on application to the City Engineer. R. Martin, Mayor.

Saskatoon, Sask.—Tenders will be received for the construction of sewer and water mains on Avenue O, from 17th Street to the Separate School. Plans and specifications may be obtained from the City Engineer, Geo. T. Clarke, Esq., Saskatoon, Sask.

▲—**Toronto, Ont.**—Tenders will be received up till October 21st, 1913, for the construction of a number of sewers. Specifications may be seen, and forms of tender obtained at the office of the Commissioner of Works, City Hall, Toronto. H. C. Hocken, Mayor.

+—**Toronto, Ont.**—The city will undertake the construction of the Esplanade sewer at an estimate of $11,000.

+—**Toronto, Ont.**—The GODSON CONTRACTING COMPANY have been awarded the contracts of constructing Danforth Avenue sewers at a cost of $68,800, and Morrison Avenue sewer at a cost of $17,487.

+—**Toronto, Ont.**—The contract for the construction of sewer system in Earlscourt was awarded JOHN MAGUIRE of Toronto, at a cost of $47,800.

Toronto, Ont.—Directions have been given for laying new gas mains on Geneva, Spruce and Sumach streets, these mains being inadequate for the present supply in this section of the city.

Toronto, Ont.—Commissioner Harris has notified the Board of Control that the present pumps and mains of the high level pumping station on Poplar Plains Road must be entirely rearranged. Two 20-million gallon pumps and two 7½ million gallon pumps, the steam engines and boilers necessary for operating these, and a coal and ash handling plant, are considered necessary to make provision for the water supply of the central district of the city. The steam equipment is to have a capacity of 55 million gallons, and the new steam plant will be built as an additional wing north of the electrical wing recently completed.

Vancouver, B.C.—The Burrard Peninsula Joint Sewerage Board have accepted the offer of Messrs. Brown, Shipley and Company to advance approximately $500,000 to commence the work on the sewerage system of Greater Vancouver.

Winnipeg, Man.—Tenders will be called early in 1914 for the construction of works necessary for the delivery of water from Shoal Lake to the Greater Winnipeg District. A description of the proposed works can be obtained from M. Peterson, Acting Secretary of the Administration Board, Greater Winnipeg Water District, City Hall, Winnipeg, Man.

Winnipeg, Man.—Tenders will be received up till October 17th, 1913, for the supply of a quantity of sewer pipe. Plans and specifications may be obtained from the City Engineer, 223 James Avenue, Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control.

LIGHT, HEAT AND POWER.

Edmonton, Alta.—To meet the increasing demands of the street railway department for power, it has been recommended that a new 400 k.w. street railway engine be installed to take the place of the 400 k.w. Robb engine which is said to be of no practical value. The new engine would be required to duplicate exactly the Belliss engine of 400 k.w. being used now, and should be provided with a surface condensing plant capable of dealing with the steam from both engines. The present condensing plant is of the jet type, and is extremely unsatisfactory and is costly to maintain. Plans have been prepared and a tender obtained for a duplicate engine and a suitable condensing plant at an estimate of $11,460 f.o.b., Edmonton. Mr Parsons, superintendent of the power plant, recommends its acceptance. The Board of Commissioners have not yet acted in the matter, but will consider the proposal at a future meeting.

Fredericton, N.B.—A complete modern electrical system is to be installed in the city opera house, and tenders will soon be called for the work.

Hamilton, Ont.—The ratepayers have carried with a very large majority the by-law granting the National Natural Gas Company a franchise to supply the city of Hamilton with gas.

Hamilton, Ont.—The National Natural Gas Company have made arrangements for the letting of contracts for pipe that will be used to carry gas 20 miles to this city. An engineer is to be engaged at once and everything prepared for a start on the work this year.

Maisonneuve, Que.—Tenders will be received up till October 15th, 1913, for the complete electrical installation for the erection of the public market. Plans and specifications may be obtained from Marius Dufresne, City Engineer, Maisonneuve, Que.

Medicine Hat, Alta.—Engineers and engineering contractors are interested in the survey of plans for the tunnel projected by the Southern Alberta Land Company in connection with its irrigation scheme in Southern Alberta. Tenders have been called for this work, and owing to its magnitude, numerous tenders are anticipated.

Montreal, Que.—Tenders will be received up till October 23rd, 1913, for the supply and erection at the Low Level Pumping Station, Point St. Charles, of one direct current electric generator of 35 K.W. capacity, direct, coupled to steam engine for electric lighting. Plans and specifications may be obtained from L. N. Senecal, Secretary, Board of Commissioners, Montreal, Que.

+—**Ottawa, Ont.**—The contract has been awarded the CANADIAN GENERAL ELECTRIC CO., LIMITED, by the Ottawa and Hull Power and Manufacturing Company, for the addition to their power plant of two water wheel type alternators each 6,750 K.V.A., 120 R.P.M., 2,300 volts and also of two transformers each 6,750 K.V.A., 2,300/12,000 volts.

Regina, Sask.—The citizens have shown their approval of the street lighting program as scheduled, and the Light and Power Department are free to proceed with the work as soon as can be arranged. The system requires the furnishing of standard light throughout the city, save in the business sections where double the standard will be used without extra cost to the ratepayers except for the installation of the extra lighting.

Regina, Sask.—Mr. M. L. Hovis, of Gibsonburg, Ohio, driller for the Calgary Petroleum Products Company, at Black Diamond, Alta., and Mr. W. R. Martin of Medicine Hat, will place before the Regina city council proposals for the drilling of a municipal well within the limits or close to the city's boundaries. They will also place the matter before the Moose Jaw civic authorities. In the event of failure to make an agreement with these bodies, they will organize doubtless a company for undertaking operations in this part of the province.

South Vancouver, B.C.—The members of the Greater Vancouver Sewerage Commission are making an inspection of those districts of South Vancouver mostly in need of sewerage. A motion has been passed in council for the preparation of plans and profiles for lateral sewers, and the council has announced that it will co-operate with the commissioners in working out a scheme for sewers in the municipality.

Toronto, Ont.—The program for the electrical show to be held in the Arena from November 10 to 15 is being arranged. All efforts are being put forth to make this exhibition a complete demonstration of the progress and uses of electricity in transportation, communication, surgery, mechanics, as protection against fire, as an aid to industry, and as a vital promoter in various other fields.

Westmount, Que.—Tenders will be received up till October 15th, 1913, for the supply of carbon and Tungsten incandescent lamps required by the Light and Power department. Westmount, Que. Plans and specifications may be obtained from A. F. Bell, Secretary-Treasurer, 4188 St. Catherine Street, Westmount, Que.

+—**Winnipeg, Man.**—The contract has been awarded C. H. SIMPSON AND COMPANY for the power house and heating plant of the new parliament buildings. The build-

Engineering Works of Canada,

LIMITED

Head Office: NEW Birks Building, MONTREAL, QUE.

Builders under the patents of the

Societe Alsacienne

Belfort (France)

Mulhouse, Grafenstaden (Germany)

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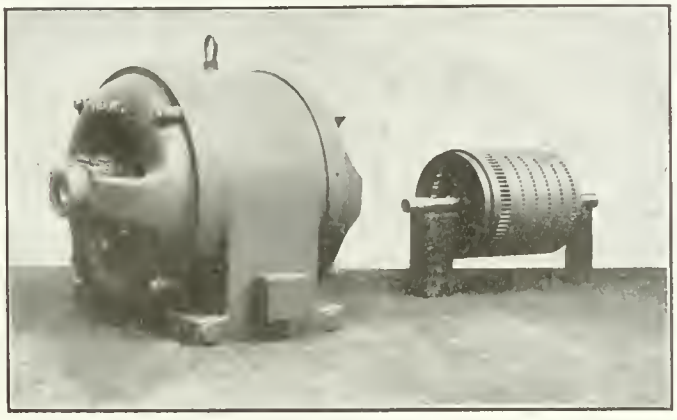

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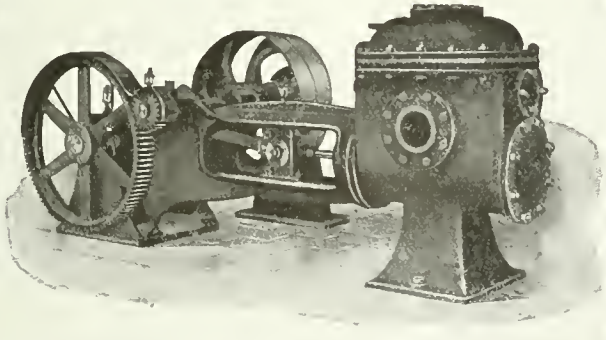
We manufacture all kinds of Steam and Power Pumps for all kinds of service, using only the best material and workmanship. They will not short stroke or stop.



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REAVELL AIR COMPRESSORS

ing of the plant will be situated on Kennedy Street, and the plant will heat the government buildings, both of the court houses, the land titles office and the provincial jail. It is to be built of stone, brick and steel and to employ the "forced hot water heating system."

Winnipeg, Man.—Controller Cockburn and Power Manager Glassco are investigating the merits of flexible and brace towers in connection with the construction of the second transmission line to be commenced this fall from Winnipeg to Point du Bois. When they have reported to the Board of Control, the tenders which have been received will be opened and the contract awarded.

BRIDGES, ROADS AND PAVEMENTS.

Moose Jaw, Sask.—The C.N.R. bridge-builders are progressing rapidly with the work upon the bridge that is to carry C.N.R. steel from South Hill to Fairford Street. The first deck is nearing completion, but until the second deck, which will permit of crossing the C.P.R. tracks without interference with traffic beneath, is built, the company cannot carry their tracks forward from South Hill, a point which it will reach shortly.

Ottawa, Ont.—The city Board of Control are considering the report of Controller Nelson and Engineer Currie on the new method of block pavement with a view to its use in paving the city's streets.

St. Thomas, Ont.—The city council have decided to construct 6-foot boulevards on Alma Street from Talbot to Redan, leaving a concrete roadway 17 feet wide on each side of the street railway tracks. From Redan Street to the city limits, the roadway will be 26 feet wide. The city will doubtless undertake the work, to be constructed next spring.

▲—**Toronto, Ont.**—Tenders will be received up till October 21st, 1913, for the complete construction of a reinforced concrete bridge between Centre and Olympic Islands. Plans and specifications may be obtained from the Office of Railways and Bridges Section, Department of Works, City Hall, Toronto. H. C. Hocken (Mayor), Chairman, Board of Control.

▲ **Toronto, Ont.**—Tenders will be received up till November 25, 1913, for the supply and erection of structural steelwork for the Gerrard Street bridge over the Don River. Plans and specifications may be obtained from the office of the Railways and Bridges Section, Department of Works, City Hall, Toronto. H. C. Hocken, Mayor.

Toronto, Ont.—Tenders will be received up till November 25th, 1913, for the supply and erection of the steel work for the Gerrard Street bridge. Plans and specifications may be obtained from the Board of Control, City Hall. H. C. Hocken (Mayor), Chairman.

Victoria, B.C.—Mr. H. E. Beasley, General Superintendent of the E. and N. Railway, stated that the steel bridge across French Creek has been completed, and that work on the erection of a steel bridge across the stream is now being undertaken. It is the intention to carry on the track—laying and ballasting as quickly as the material is available from the manufacturers, and weather permitting, to Big Qualicum. From Big Qualicum to Courtenay, being the terminus of the line so far as the present plans are concerned, it will be necessary to span two fairly large waterways—namely, Tsable and Trent rivers. Outside of these, the works consists of track-laying and ballasting, which, with the facilities on the site, should be handled expeditiously. This line will be ready for operation some time in either May or June of next year.

INDUSTRIAL WORKS.

Galt, Ont.—The town council has decided to proceed with the construction of a retaining wall on the west side of the river, to extend back 10 feet, so as to admit of a wider channel and to minimize flood danger.

Hamilton, Ont.—The Hydro Commission have approved the contract made by the city with Mr. Gest for conduit work. Mr. Gest will re-lay the base concrete work of all streets torn up, and the city will replace the 3-inch top dressing.

Ottawa, Ont.—Tenders will be received up till October 23rd, 1913, for dredging required at Glace Bay, N.S. Plans and specifications may be obtained from R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—The preliminary hearing of the application of the Michigan and Lake Superior Power Company, for permission to build a dam at the Soo, and the granting of a preliminary hearing of a similar request to build a dam on the Canadian side by the Algoma Steel Corporation, was the business accomplished by the International Joint Commission at Ottawa, on October 7th. These companies propose to build a dam from each side of the international boundary, which will unit in forming one entire project. Further hearing must be given the scheme in Sault Ste. Marie, where any local objections may be considered.

+—**Saskatoon, Sask.**—The contract for concrete tunnel, to contain the intake pipes at the pumping station, has been awarded to JAMES PRIEL, at a cost of $4,153.

+—**Toronto, Ont.**—Contracts have been awarded by the John Inglis Co., Limited, for the concrete work on their new boiler shop to JOHN E. WEBB AND COMPANY of Toronto, and for the steel work to the PHŒNIX BRIDGE COMPANY of Montreal.

Toronto, Ont.—Tenders will be received up till November 25th, 1913, for the installation of one or more 7½ and 20-million Imperial gallon pumping engines, three water-tube boilers with piping, and coal handling apparatus at the High Level Pumping Station. Plans and specifications may be obtained from Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto. Signed, H. C. Hocken (Mayor), Chairman, Board of Control.

Vancouver, B.C.—The notification that the C.P.R. is prepared to withdraw its opposition to the application of property owners for crown grants for foreshore rights, providing that the owners will undertake not to ask for a level crossing over the company's tracks for each lot, means that extensive developments may now be carried out on the east end waterfront, which will doubtless include the construction of a dock at the end of Renfrew Street.

Victoria, B.C.—Four noted ironfounders—Messrs. H. F. Bullen, Andrew Gray, F. P. Harrison for Evans, Coleman and Evans, and Mr. F. Muirhead, for Jones and Rant, Limited, will offer to construct the rivetted steel pipe in connection with the waterworks project at a lower figure than any yet bid, their purpose being to employ home labor. They offer to purchase the Thetis cove plant from the receiver for the Westholme Lumber Company, to put it into good operating condition, and to retain it on another site when the lease of the land at the cove shall have expired.

Victoria, B.C.—The government has been asked to provide better landing piers at ports on the west coast of Vancouver, touched at by the Canadian Pacific Company's steamer "Princess Maquinna."

Victoria, B.C.—Tenders will be received up till October 20th, 1913, for the delivery of about 555 gross tons of 20 lbs. to-the-yard rails in 20-foot lengths. Plans and specifications may be obtained from W. Galt, Esq., City Purchasing Agent, Victoria, B.C.

Victoria, B.C.—Tenders will be received up till October 20th, 1913, for one hundred 45-foot poles, to be delivered within forty days from date of order. Plans and specifications may be obtained from W. Galt, Esq., City Purchasing Agent. Victoria, B.C.

Winnipeg, Man.—The harbor commissioners of Winnipeg and St. Boniface will ask the Dominion Government for $100,000 to build docks along the Red River. Mr. L. R. Voligny, government engineer, is to make a report on the cost of the work.

Winnipeg, Man.—Tenders will be received up till October 24th, 1913, for the supply and delivery f.o.b., City Yards, of 50 four-inch gate-valves. Plans and specifications may be obtained from the City Engineer, 223 James Avenue, Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control.

AS FIXED AT

Aberford
Marlow
Dublin
Frome
Goudhurst
Aldenham
Newbury
Hunstanton
Blackpool
Enfield
Gayle
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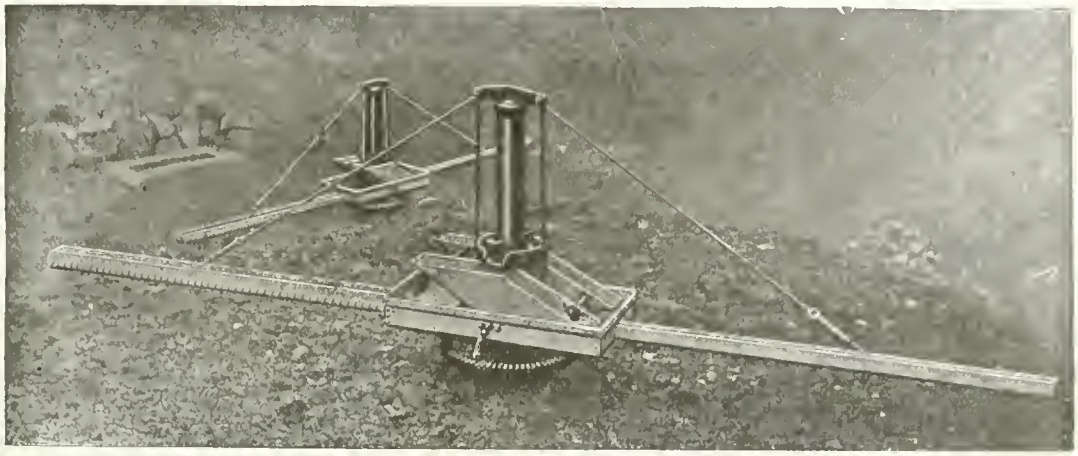
Edenbridge
Etc.

THE "IDEAL" DISTRIBUTOR
FOR BACTERIAL SEWAGE FILTERS



AS A DISTRIBUTOR, gives an even and gentle distribution from the serrated edges of the arms.
AS A MOTOR, obtains greater power from the liquid head for propulsion than any other type of machine, and will revolve in any wind.
AS AN AUTOMATIC MACHINE, having no orifices to choke, does work for weeks without attention.

SEWAGE LIFTS & EJECTORS

PATENTEES & MANUFACTURERS TUKE & BELL LTD., 69 LEADENHALL ST. LONDON, ENGLAND.

AGENTS FOR CANADA LAURIE & LAMB, ENGINEERS, MONTREAL

SIMPLEX VALVE & METER CO.

Manufacturers of

Water Meters
for large pipes.

Controlling Valves
for reservoirs, stand-pipes and railroad water tubs

Loss-of-head Gauges
and rate-of-flow gauges and controllers for filters

Automatic Air Valves
and combined air and vacuum valves for water mains.

MANOMETERS VENTURI TUBES
CHEMICAL FEED DEVICES
OPERATING TABLES FILTER STRAINERS
"HEAD AND FALL" Recording Gauges for Water Wheel Plants

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Simplex Valve & Meter Co.
112 North Broad St. - PHILADELPHIA, Pa.

Hampton
(or Travis)
Hydrolytic Tank

for the rapid sedimentation of sewage. Used in connection with an electrolytic hypochlorite treatment, the process is

Absolutely Odorless

Effluent free from disease germs. This tank is not an experiment. Proved efficient and economical by

NINE YEARS' USE

Efficient Economical Practical

Leaflet on request.

Sterilization Co.
Union Building, Clinton Street
NEWARK, N. J.

Also engineers for the electrolytic treatment of water.

MISCELLANEOUS.

Calgary, Alta.—Mr. J. H. Brown of the Oil Well Supply Company, Pittsburg, visited the city recently for the purpose of investigating the advisability of establishing in Calgary warehouses from which to supply the local companies now drilling or about to drill in southern Alberta's oilfields.

Chatham, Ont.—An agreement has been officially signed whereby the National Forging Company will take over the plant known as the Defiance Iron Works, and more recently as the Swift Motor Car Company. It will manufacture auto and carriage forgings, and sockets of different kinds, becoming to Canadian trade what the Detroit Socket Company is to American trade.

Edmonton, Alta.—It is announced that Mr. J. D. McArthur will move at once his shops from Transcona to Edmonton, together with all machinery and equipment. His intention is to carry on all work in connection with the Edmonton, Dunvegan and British Columbia Railway at Edmonton.

Fort William, Ont.—The construction of the new building of the Fife Hardware Company, for which the A. C. Stewart Company are the contractors, is being delayed through the exhaustion of the supply of reinforcing steel.

Lachine, P.Q.—Tenders will be received up till October 20th, 1913, for the preparation of a plan of the territory of the said city showing the existing and proposed streets. Plans and specifications may be obtained from Hector Charette, City Clerk.

Medicine Hat, Alta.—Premier Sifton has announced the intention of the government to erect a telephone exchange at Medicine Hat next spring, and that it was expected to complete the building in about three months.

+—Ottawa, Ont.—A contract for the purpose of erecting a station on Main Duck Island has been awarded ALEX. McMASTER of Toronto, at a cost of $17,000.

Sault Ste. Marie, Ont.—The new Drydock and Shipbuilding Company has agreed with the city to place in the city's branch of the Bank of Montreal $25,000 as a guarantee that the construction of its plant will be started not later than next April 1st, and will be ready for operation two years from that date, the sum named not to be released to the company until it has expended $100,000 in constructive work. The contractors for the company's plant are Sir Douglas Fox and Company, a well-known British firm.

St. Catharines, Ont.—The city council has approved of a by-law relating to the establishment in this city of a branch of the firm, Lord and Burnham, which operates factories in Irrington-on-Hudson, N.Y., and in Desplaines, Ill. The firm are manufacturers, designers and erectors of entire complete greenhouses of steel, including boilers and all necessary apparatus in modern greenhouses.

St. Telesphore, Soulanges Co., Que.—Tenders will be received up till October 30th, 1913, for the construction of a steel bridge with concrete pillars across the Beaudette River, in the parish of St. Telesphore, Soulanges Co., Que. Plans and specifications may be obtained from Jos. Ed. Charlebois, Secretary-Treasurer of the municipality.

Toronto, Ont.—The engineers employed upon the work of making tests to determine the character of the different strata at Scarboro', the proposed location for the duplicate waterworks system to be constructed by the city, have completed the work and appear satisfied with the result of their efforts. They will doubtless recommend the construction of a tunnel under the lake off the Scarboro' shore.

Toronto, Ont.—Tenders will be received for sub-contracts on the Methodist Book and Publishing building, cor. John and Queen streets. Plans and specifications may be obtained from John H. Parker and Co., 8 Colborne Street, Toronto.

▲—Toronto, Ont.—Tenders will be received up till November 25th, 1913, for the installation of one or more 7½ and 20 million Imperial gallon pumping engines, three water-tube boilers with piping and coal handling apparatus at the High Level Pumping Station. Plans and specifications may be obtained from the office of Mr. James Milne Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto. H. C. Hocken, Mayor.

Vancouver, B.C.—A statement has been made authoritatively that a new syndicate including Saskatchewan capitalists will be formed for the purpose of developing the coal mines of the northern portion of Graham Island.

Welland, Ont.—It has been stated that steel and other material necessary for the construction of the new high-voltage electric transmission plant being erected by the Hydro-Electric Commission between Welland and Niagara Falls, is arriving on the site. A new transformer house, which will distribute 60,000 h.p., is to be built at a cost of $12,000, with electric equipment at an estimate of $40,000.

CURRENT NEWS.

Calgary, Alta.—The public works department adopted some time ago the policy of reducing all the hills of the city to the lowest possible grade, and in consequence thereof all the streets of the Park Hill district have been graded, and the machines are working now upon the grade in Fourteenth Street West.

Calgary, Alta.—The first of the C.N.R. bridges, that over the C.P.R. tracks near Ogden is practically completed, and work is being started on the other bridges to be erected between it and Calgary. It is expected that all will be finished within 50 days, and with that end in view, contracts are being considered for the temporary depot and buildings to be placed at the east side of the Elbow River. Yards are also to be constructed on that site.

Calgary, Alta.—According to the statement of Mr. R. J. C. Stead, of the publicity branch of the department of natural resources, the C.P.R. are aiming to have a completely double-tracked main line four years from now when the Rogers Pass tunnel will be finished.

Cornwall, Ont.—The Stormont Electric Light and Power Company have completed to all practical purposes the installation of a new lighting system in Cornwall. A distribution of 350 60-candle-power lights has been made in Cornwall, Beaconsfield, Lorneville and Gladstone.

Edmonton, Alta.—At the meeting held between the executive council of the Alberta Government and the board of directors of the Alberta Co-Operative Farmers' Elevator Company, Limited, a statement was presented by the company giving in detail the cost of directing, purchasing and equipping elevators. A total of about $300,000 will be required for the establishment of the 42 elevators which are to be in operation this fall, and 85 per cent. of this will be advanced by the government to be repaid by 20-year annual instalments. With the completion of this year's program of buildings, the company will have in operation in Alberta, during the grain season, 51 elevators.

Lethbridge, Alta.—Two large steel bridges on the G.N.R. between Collins, near Shelby Junction and Great Falls, have been completed. One of these, which span the Teton River is 3,300 feet long and 125 feet high.

London, Ont.—Engineer W. W. Wilson, of the Canadian Stewarts Company, has completed a survey of the proposed line to Port Burwell, which the G.T.R. will use to handle its coal business in the event of the railway electrification by-law being carried.

Montreal, Que.—The raising of the sluice dam of the Western Canada Power Company at Stave River by an additional 10 feet in order to increase the capacity of the plant is practically completed, and the intake dam has also been raised. The company expects to receive the first additional penstock in January, and the second in April of next year, and that by this time also the power house extension will be well under way.

Montreal, Que.—The new drag line scraper, being used by the Cook Construction Company on the aqueduct enlargement contract has proven itself very successful. A number of Montreal contractors have inspected it, and it will be used for excavation at the Welland Canal and other large contracts.

Moose Jaw, Sask.—The city council has succeeded in moving to action the Railway Commission relating to the question of a train service and station facilities from the Grand Trunk Pacific Railway. The Mayor has been notified that the Commission will send an engineer to investigate the city's claims.

St. Catharines, Ont.—On the 30th instant, the ratepayers of St. Catharines will vote upon four by-laws, three of which relate to electric lighting and one to industrial development, at an aggregate expenditure of $116,000.

A Combination in the Interest of Trade

Combinations in business are all right when they make for greater efficiency and better service to the public.

Our business is a combination of many businesses, or special lines, into a great "Departmental House for Mechanical Goods." We find by organizing our business along departmental lines that we can serve industrial Canada more efficiently, more economically and in a way that makes for the best interests of our customers.

You will find it a great convenience to deal with a House that can supply you practically anything you require in the mechanical line all "under one roof" One of the two items mentioned below may interest you

Elwell-Parker Electric Trucks

Wherever used have shown an actual saving of from 25 to 65 per cent., both for railroads and industrial concerns. One large Canadian plant trying electric trucks for the first time claims that each truck, operated by one man, has replaced eight men with eight wheelbarrows.

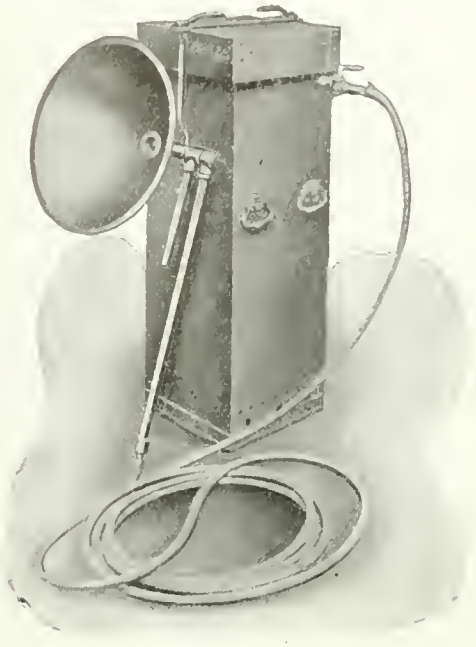
The truck shown above is one of the many types of Elwell-Parker Electric Storage Battery Trucks used by the American Express Co. The Canadian Pacific also use these trucks.

Elwell-Parker Electric Trucks are equipped with Edison Storage Batteries which are now recognized to be about the best on the market. Edison Batteries increase greatly the efficiency of the electric truck. We think so much of them that we would not advise you to purchase any electric truck that was not equipped with Edison Batteries.

Ellwell-Parker Trucks are extremely easy of operation, in no way requiring skilled labor, and by having a spare battery set can be worked continuously without injury.

If you are extending or rebuilding your plant it will pay you to investigate this well known truck.

Ask for Bulletin 107.



The Milburn Light

The No. 3-W Milburn Acetylene Light shown here gives from 5,000 to 12,000 candle power and lights 1,500 feet. The light follows the crane or shovel and throws its rays directly on the work. It lights instantly, requires no attention, and positively defies wind and weather. Has water tight cover and is made to withstand hard usage, the vibration and movement of cranes, steam shovels and dredges. Supplied with 15 inch aluminum reflector and 25 feet of armoured hose with connections. Cost 4 to 6 cents per hour to operate. Over 70,000 Milburn lights have been sold.

Ask for catalogue of Milburn Lights.

The Canadian Fairbanks-Morse Co., Limited

"The Departmental House for Mechanical Goods"

ST. JOHN QUEBEC OTTAWA MONTREAL TORONTO
WINNIPEG SASKATOON CALGARY VANCOUVER

TENDERS CALLED FOR

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on **Tuesday, October 21st, 1913,** for the construction of the following sewers:—

Danforth Avenue Storm Overflow Sewer, Section No. 2.

Eastern Avenue, from Leslie Street to Knox Street.

Lane 1st E., Spadina Avenue, from Morris Avenue to Sussex Street.

Lane 1st N., Davenport Road, from Elmwood Avenue to McFarland Avenue.

Victor Avenue, from Carlaw Avenue to 464 feet west.

Lane 1st S., College Street, from Crawford Street to Shaw Street.

Jersey Avenue, from 84 feet 3 ins. S. of Clinton Avenue to 47 feet further south.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen, and forms of tender obtained at the office of the Commissioner of Works, Toronto.

Tenderers shall submit, with their tender, the names of two sureties (approved of by the City Treasurer, not members of the City Council, or officers of the Corporation of the City of Toronto), or in lieu of said sureties, the bond of a guarantee company approved of as aforesaid.

The usual conditions relating to tendering as prescribed by the City By-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, October 8th, 1913.

TENDERS FOR STEELWORK.

GERRARD STREET BRIDGE.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on **Tuesday, November 25th, 1913,** for the supply and erection of structural steelwork for the Gerrard Street Bridge over the Don River.

Specifications and tender forms may be obtained upon application at the office of the Railways and Bridges Section, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City By-law must be strictly complied with or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties, approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, September 22nd, 1913.

TENDERS FOR PUMPING ENGINES, BOILERS AND COAL HANDLING APPARATUS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on

Tuesday, November 25th, 1913,

for the installation of one or more 7½ and 20 million Imperial gallon Pumping Engines, three Water Tube Boilers, with Piping, and Coal Handling Apparatus at the High Level Pumping Station.

Specifications and tender forms may be obtained upon application at the office of Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City By-law, must be strictly complied with or the tenders may be declared informal.

Tenderers shall submit, with their tenders, the names of two personal sureties approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, 9th October, 1913.

TENDERS FOR CONSTRUCTION IN REINFORCED CONCRETE OF OLYMPIA BRIDGE.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, October 21st, 1913, for the complete construction of a reinforced concrete bridge between Centre and Olympic Islands.

Specifications and tender form may be obtained upon application at the office of the Railways and Bridges Section, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City by-law must be strictly complied with or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, October 8th, 1913.

(For further Tenders see page 86.)

When designing structures do you pay sufficient attention to the various matters that govern insurance rating? Why not use—without charge—the services of a well-known firm of

Insurance Engineers

Specializing in fireproof construction and protective devices

Not only can you add greatly to the fireproofness of buildings by adopting our suggestions, but it is very likely that you can do so without the improvements costing anything ultimately. They will practically be paid for by the lower insurance rates.

Correspondence solicited.

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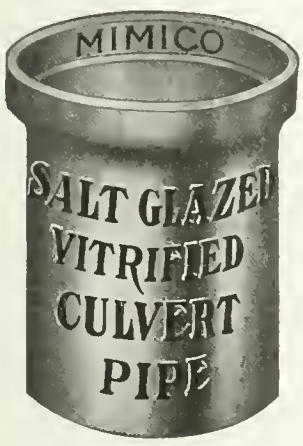
136 St. James Street - Montreal

Sewers last indefinitely—or rather they should do so. They will last indefinitely if laid with MIMICO PIPE.



To be permanent a sewer should be built of a good material that can be handled and inspected simply and surely. MIMICO PIPE is finished completely and perfectly at the factory and when delivered can be easily tested. It is far preferable to any material made of several ingredients any one of which may cause failure by being defective, and the mixing of which requires most careful, skilled attention.

Round Pipe and Square Dealings *Write for 1913 catalogue*

The Ontario Sewer Pipe Co.
LIMITED
MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

Renouf Publishing Co.

25 McGill College Ave.
MONTREAL

Underground Waters for Commercial Purposes.

By Frank L. Rector, B.S., M.D., Bacteriologist, Great Bear Spring Company, New York; Member American Public Health Association, American Microscopical Society, American Chemical Society, American Association for the Advancement of Science, New England Water-works Association. 12mo, vi+97 pages, 8 figures. Cloth $1.00 net.

The subject of underground waters for commercial purposes has received meagre attention at the hands of various authors, and this book is intended to discuss in more or less detail this phase of the question.

Domestic Water-Supplies for the Farm.

By Myron L. Fuller, S.B., Specialist on Underground Water-Supplies. 8vo, x+180 pages, 65 figures. Cloth $1.50 net.

Explains both the advantages and dangers of the common sources of domestic water-supplies, and points out the danger signals and indicates the steps to be taken in order to safeguard the supplies.

SECOND EDITION, Re-written and Enlarged
Engineering for Land Drainage.

A Manual for the Reclamation of Lands Injured by Water.

By Charles Gleason Elliott, Member American Society of Civil Engineers. 12mo, xvi+339 pages, 60 figures. Cloth, $2.00.

Embodies the essential features of drainage engineering in this country at the present time, with the latest developments along each line, and is adapted to the use of the professional engineer and the student.

Farm Gas Engines.

By C. F. Hirshfeld, M.M.E., Professor of Power Engineering, Sibley College, Cornell University, and T. C. Ulbricht, M.M.E., Instructor, Department of Power Engineering, Sibley College, Cornell University. Small 8vo, vii+239 pages, 188 figures. Cloth, $1.50 net.

The greater part of this book has been devoted to a discussion of the weak and strong points in the various designs, to the features which give long and useful life, and those which tend to cause early failures and to the characteristics which best adapt different types to different uses.

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned, and endorsed "Tender for Breakwater at Kincardine, Ont.," will be received at this office until 4 p.m. on Wednesday, October 29, 1913, for the construction of a Breakwater at Kincardine, Bruce County, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of H. J. Lamb, Esq., District Engineer, Windsor, Ont.; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Kincardine, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 %) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, September 30, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—46683.

SPECIAL NOTICE TO CONTRACTORS.

RE GREATER WINNIPEG WATER SUPPLY.

(Estimated Cost $13,500,000.)

Notice is hereby given to Contractors that tenders will be invited early in the year 1914 for the construction of works necessary for the delivery of water from Shoal Lake to the Greater Winnipeg Water District. The following is a brief description of the proposed works:—

1. A dyke and channel for the diversion of the Falcon River into Snowshoe Bay.
2. 85 miles concrete aqueduct.
3. 10 miles pipe line (probably 1916 work).
4. 900 lineal feet tunnel under Red River.
5. 85 miles of construction railway.
6. Telephone line.
7. Clearing and ditching.

The fall season of the year affords the best opportunity for inspection of proposed route of the aqueduct, and it is recommended that contractors having a view to tendering on the work should send their inspectors over the line at as early a date as possible.

Particulars as to estimated cost of the work and map of approximate location and profile of aqueduct may be obtained from the undersigned.

M. PETERSON,
Acting Secretary of the
Administration Board,
Greater Winnipeg Water
District.

City Hall,
Winnipeg, Canada,
October 6th, 1913.

Note.—Copy of report of the Consulting Engineers, plan and profile of work and typical details of design may be seen at the office of *The Canadian Engineer*, 62 Church Street, Toronto.

MAIL CONTRACT.

Sealed tenders addressed to the Postmaster-General, will be received at Ottawa until noon on Friday, the 14th November, 1913, for the conveyance of his Majesty's mails, on a proposed contract for four years, six times per week each way, over Mono Road and Rural Mail Route, from the Postmaster-General's pleasure.

Printed notices containing further information as to conditions of proposed contract may be seen and blank forms of tender may be obtained at the Post Office of Mono Road, and at the office of the Post Office Inspector, Toronto.

A. SUTHERLAND,
Post Office Inspector.

Post Office Inspector's Office, Toronto, October 7th, 1913.

52 A.—2,500-26 9-12.

(For further Tenders see page 84.)

CURRENT NEWS.

Moose Jaw, Alta.—For some time there has been a delay on the construction of the C.N.R. bridges crossing the Moose Jaw River. Work has recommenced, and it is expected that the bridge at the second crossing will be completed within a month. Steel can then be laid into South Hill and the temporary station erected. Work on the bridge at the third crossing is to be carried on throughout the winter on the ice so that the erecting of the station in Block 48, Old City, may be begun in the spring.

Ottawa, Ont.—It is planned that the Government system of wireless telegraphy between Le Pas and Port Nelson will be in operation before Christmas. The apparatus, which will have two of the longest ranges in Canada, is designed to enable the department to keep in touch with the Hudson Bay Railway work.

Ottawa, Ont.—A new line of street railway has been finished and officially opened in the city running over Bank Street Bridge to Ottawa South.

Regina, Sask.—The street railway running through Broad Street subway has been completed, and an initial trip over the line has been made by representative citizens.

Sarnia, Ont.—Work has been commenced on what will be in Sarnia the industry second only in importance to the Imperial Oil Company. The new industry is the Perfection Stove Company, which is an adjunct to the Standard Oil Company, manufactures oil stoves and all kinds of oil-burning appliances.

Saskatoon, Sask.—The work upon the new Dominion Government Interior Elevator at Saskatoon has been set in operation. The contract which was awarded recently to John Davies, Esq., a local contractor, calls for the removal of 60,000 yards of material, a much larger contract than anything similar undertaken previously in the city.

Saskatoon, Sask.—The C.N.R. has commenced construction of a spur line into Factoria, a sub-division about three miles north of the city.

St. John, N.B.—Two-thirds of the work on the three miles of sewer extension in Beaconsfield is now complete, and the entire work will be finished by the first of November, at a cost of about $30,000.

Victoria, B.C.—Construction is soon to be commenced on the new wharf to be built by the Dominion Government at Nootka Harbor, according to the announcement of Mr. C. A. Pringle, secretary of the Nootka branch of the Vancouver Island Development League. A further appeal is to be submitted by the league to the provincial government for a grant to improve the roads that radiate from the new wharf.

Refined to Definite Standards

BITUMEN 99%

MEXICAN EAGLE ASPHALT

TRADE MARK

Every Barrel Guaranteed Uniform

BITUMEN 99%

Mexican Eagle Paving Asphalt is specially adapted to the Canadian climate. It is not susceptible to changes in temperature. It will not mark in the hottest weather, nor is snow or ice likely to crack it. Dow and Smith, Chemical Engineers, say: "This is a very high quality of asphalt."

ANALYSIS

By DOW & SMITH, Chemical Engineers

"Bitumen soluble in Carbon Disulphide - - - 99%
"Bitumen soluble in Carbon Tetrachloride - - 99%
"Bitumen soluble in Penna naphtha boiling between 40° and 60° C. - - - - - - - 78%
"Penetration at 77° F. - - - - - - - 44
"Ductility unfluxed - - - - - - - 22 cms.
"Penetration of Asphaltic Cement at 77° F. - - 50
"Ductility of Asphaltic Cement at 77° F. - - 45 cms.
"Remarks. This is a very high quality of refined Asphalt and is suitable in every respect for paving purposes."

Every barrel of our asphalt is guaranteed to be uniform and according to analysis. This is the guarantee of our principals, the Mexican Eagle Oil Co. Limited, a Company that has over twenty-five million dollars working capital.

Mexican Eagle Paving Asphalt is superior in purity to Burmudez, Trinidad, Californian or any other asphalt on the market. It is a favorite also for its high cementing value and ductility.

We can also supply different grades of Mexican Eagle Asphalt for asphalt fillers, road binders, roofing asphalts, wooden water pipe coatings, waterproofings, etc. Also Durazzo Sicilian Rock Mastic Asphalt for sidewalks.

For prices, samples and full particulars, please address

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

Illustration below shows a portion of our Mexican plant in the Isthmus of Tehuantepec. Every structure in sight belongs to the plant, but a large portion to the left is unseen. The capacity was recently increased by over fifty per cent. We can get 75,000 tons of the world's very best paving asphalt from this plant in 1914 if the Canadian cities and towns require that quantity.

SECOND-HAND MACHINERY

Contractors' Machinery For Sale Or Rent

We have in stock the following second-hand equipment for immediate delivery.

Get further details and prices.

1—6½" x 8" double cylinder, double drum steam hoist.
1—No. 3 Ransome concrete mixer.
5—6-ft. Ransome concrete carts.
13—5-ft. Sterling concrete carts.
1—8"x 10"x 8" steam driven air compressor.
1—6" x 5" x 7" steam driven air compressor.
1—6" belt driven centrifugal pump.
1—5" belt driven centrifugal pump.
1—15 H.P. semiportable boiler on skids.
1—14 H.P. vertical boiler on wheels.

H. W. PETRIE, LIMITED
Front St. W., TORONTO, Ont.

PANAMA CANAL EQUIPMENT FOR SALE.—The Isthmian Canal Commission will offer for sale in the near future the equipment used in building the Panama Canal, such as rolling stock, excavating machinery, floating equipment, miscellaneous plants, and miscellaneous equipment, including locomotives, cars, steam shovels, cranes, unloaders, earth spreaders, track shifters, rock drills, well drills, dredges, barges, tugs, launches, pile drivers, concrete handling plants, pumps, rock crushers, etc. Inquiries from users of such equipment are invited for its purchase. Catalogues listing the equipment offered for sale and other information may be obtained upon application to the General Purchasing Officer, Isthmian Canal Commission, Washington, D.C. F. C. Boggs, Major, Corps of Engineers, U.S.A., General Purchasing Officer.

FOR SALE.—One model 41 Marion steam shovel, less than a year old; one Porter locomotive; ten 4-yard Western cars; one 40 H.P. boiler. Please address Box 154, *The Canadian Engineer*, Toronto.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received:—1084.—A large importing firm in Brussels, Belgium, wishes to enter into communication with exporters of pulpwood for Canada, with a view to opening up a direct trade between the two countries. 1088.—A firm in Frankfurt, is desirous of obtaining the representation of first-class Canadian firms for Germany, and possibly Europe. The names of the firms making these inquiries, with their addresses, can be obtained upon application to:—"The Inquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary and Chambre de Commerce du District du Montreal.

MONTREAL MARKET LETTER

Montreal, October 14th.

Local iron and steel interests are all keenly on the alert to the effect of the new tariff measures in the United States. An interview given out during the week by Mr. J. R. Wilson, a director of the Dominion Steel Corporation, indicated the possibility, if not the probability, that the lowering of the tariff by the United States might result disastrously to the iron and steel companies in Canada, through the increased competition from American manufacturers which might arise therefrom. He naturally urged protection for the Canadian iron and steel concerns as a remedy for the unfavorable situation which might arise. On the other hand he was hopeful that the effect of the alteration in the coal duty would be advantageous to the Canadian coal companies.

Not even have the financial and industrial circles of the United States determined what will be the effect upon the steel industry of that country. In a general way prices of iron and steel products have declined considerably during the past few days, this decline being generally thought to have resulted from the lowering of the tariff. However, there are those who declare that this decline would have taken place anyway. Meantime, all is mere conjecture, and this being the case, it is not surprising that the iron and steel trade of Canada should be simply occupying a waiting position. The explanation for the falling off in orders on the other side of the border is now offered, that it is not so much a question of price with the purchaser as with the finding of the price. The claim is made that most of the railways are desperately hard up and are unable to place their orders in the way that they would wish, hence they are delaying until the last moment. In Canada it was clearly indicated by Sir Thomas Shaughnessy at the recent annual meeting that construction would show considerable falling off from this forward in the case of the C.P.R., and doubtless this will more or less apply to the other railways, the new transcontinental lines being now nearly completed. The point which is causing some discussion now is as to whether the orders for rolling stock will show a falling off. The Canadian Car and Foundry Company has apparently orders on hand for the next three months. Meantime the new works at Fort William are rapidly being completed and the Eastern car works are ready for operation, so that the capacity of the car companies has considerably increased. Prices are generally the same as a week ago.

NEW INCORPORATIONS.

St. Johns, Que.—The Canadian Clarendon Marble Co., Limited, $100,000. H. J. Trihey, W. P. Kerney, E. Lafontaine.

Windsor, Ont.—Windsor Sand and Gravel Co., Limited, $40,000. H. A. White, M. White, S. E. McDowell.

Chatham, Ont.—The Wallaceburg Oil Refining Co., Limited, $200,000. D. A. Gordon, R. G. Stitt, J. T. Montgomery.

Cookshire, Que.—The Westbury Electric Light and Power Company, $75,000. H. A. Worby, G. W. Allard, R. C. Cowling.

Saint Martin, Que.—St. Martin Lumber Manufacturing Co., Limited, $40,000. J. E. A. Decelles, J. W. Lavoie, L. A. Lavoie.

Montreal, Que.—Gordon Willcocks and Co., Limited, $75,000. J. R. Gordon, M. F. Willcocks, T. B. Gould. Electric Manufacturing Co. of Canada, Limited, $2,000,000. H. S. Ross, E. R. Angers, O. F. Shearer.

CROSBY, LOCKWOOD & SON, Publishers

Screw Cutting for Engineers.—A Handbook for Practical Mechanics and Technical Students. By ERNEST PULL, Assoc. M. Inst. Mech. E. 91 pages, 48 illustrations. Crown 8vo Cloth, **2s. 6d.** net.

Reinforced Concrete Design Simplified.—Diagrams, Tables and other Data for Designing and Checking Accurately and Speedily. By JOHN C. GAMMON, B.Sc. Eng. (London); With an Introduction by H. KEMPTON DYSON, Secretary of the Concrete Institute. Second Edition. Demy 4to. cloth. 122 pp. with Thumb Index. **10s. 6d.** net.

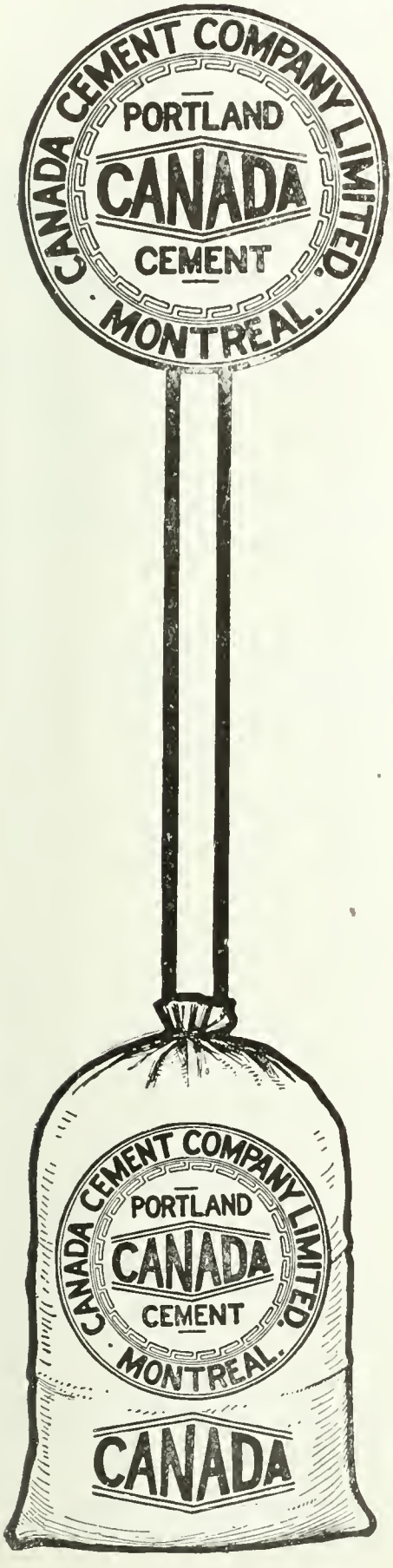
Fire Protection in Buildings.—A Practical Treatise for Engineers, Architects, Surveyors and Property Owners. By HAROLD G. HOLT, A.R.I.B.A. 280 pages. 133 Illustrations. Demy 8vo. cloth. **8s. 6d.** net. *[Just Published.*

Mechanics' Workshop Companion.—Comprising a great variety of the Most Useful Rules and Formulæ in Mechanical Science, with numerous Tables of Practical Data and Calculated Results for Facilitating Mechanical Operations. By WILLIAM TEMPLETON. Nineteenth Edition. Revised by W. S. HUTTON, C.E. 500 pages, 275 illustrations. Fcap. 8vo. leather, **5s.** net.

Complete 100 page illustrated catalogue post free on application

CROSBY, LOCKWOOD & SON, (DEPT. C)
7 Stationers' Hall Court, LONDON, E.C., Eng.

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

ELECTRICAL ENGINEER.

The City of Prince Albert, Saskatchewan, requires an experienced Electrical Engineer as General Manager. Thorough experience in business organization and management and in the designing of steam stations is essential. Give full particulars and state salary required.

Applications must be received by October 31st.

C. O. DAVIDSON,
City Clerk.

Prince Albert, October 1st, 1913.

CITY ENGINEER.

The City of Prince Albert, Saskatchewan, requires a City Engineer with thorough experience in all branches of City Engineering work. Full particulars of past experience and positions held are requested.

Salary $4,000 per annum. Applications by October 31st.

C. O. DAVIDSON,
City Clerk.

Prince Albert, October 1st, 1913.

SALES MANAGER.—District sales manager wanted by an established Consulting Engineering and Construction Corporation, based on co-operative plan, offices in Cleveland, Detroit, Buffalo and New York. The position requires a man with engineering knowledge, one who can take full charge of the sales department. Highest references and $1,000 investment required. Contract, with salary, commission and interest in business guaranteed. Box 158, *The Canadian Engineer*, Toronto.

WANTED.—At once, one or two experienced instrument men for preliminary railway survey work. Present work will last one or two months. Apply 416 Continental Life Building, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

UNIVERSITY GRADUATE in Mechanical Engineering (B.Sc. Durham, with distinction). Age 23. Four years articled to prominent English firm of steam engine and turbine manufacturers. Some drawing office experience. Open for engagement at end of month. Box 152, *The Canadian Engineer*, Toronto..

AN ELECTRICAL ENGINEER; ten years' experience in Western Canada, head office, Winnipeg, is desirous of getting in touch with firms wishing Western Representative. Have managed sales office of one of the largest manufacturing concerns in Canada for the past five years, so am in close touch with conditions. 482½ Main Street, Winnipeg, Man.

WANTED position as resident engineer, instrument man or draftsman. Experience on railroad location, construction and maintenance and general reinforced concrete construction. Location immaterial. W. T. Guedry, Box 241, Aurora, Ont.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

FOUNDRY AND SHOP WANTED.—United States manufacturer desires to lease Canadian foundry and machine shop. Please give full particulars of equipment and state terms desired. All letters confidential. Address Box 156, *The Canadian Engineer*, Toronto.

CURRENT NEWS.

St. John, N.B.—The new water main to the plant of the Atlantic Sugar Refineries, now being constructed on the Ballast wharf, has been completed. The pipe has been laid for a distance of 9,200 feet at a cost of $32,000.

Summerland, B.C.—The big steel girder bridge spanning Trout Creek canyon will be completed by the end of the month, and almost as soon the first locomotive will enter Summerland. The road-bed is ready for a distance of 40 or 50 miles from the bridge for ties and steel, and these will be laid as rapidly as possible when locomotives can pass over the bridge. The only remaining section of railroad to be constructed in the Okanagan, is the three mile line of Kettle Valley Railway east of Penticton, and on this work has already been commenced.

Toronto, Ont.—Vice-president David McNicoll, of the Canadian Pacific Railway and Chief Engineer H. R. Safford of the Grand Trunk system, in company with the General Superintendents of the Ontario divisions of these railways, have inspected the Toronto terminals and have examined the site for the new station. They stated that plans for the new structure agreeable to both companies are completed, and that actual construction work will be commenced as soon as the Dominion Railway Commission gives its final ruling in connection with the dispute concerning the grades.

Toronto, Ont.—The Hon. J. J. Foy has stated that, should the Edison Electric Company of Detroit, make any effort to cross the Detroit River, as is anticipated, steps will be taken to restrain it, and to conserve the rights of Ontario. If the Dominion Government should grant to the Michigan company the privilege of carrying its cables over to Essex, the provincial government can prevent this being done over the water lots which are its recognized property.

Vancouver, B.C.—In August of this year the provincial government commenced the work of stringing telephone wires in the lower coast fire districts. Fifty-five miles of wire have already been used, but further communication to a point 60 miles north of Harriette Bay will be opened up this year. It will be possible to have these provincial lines subsequently incorporated in the Dominion Government's system.

Vancouver, B.C.—The C.N.R. Company is awaiting plans for its entrance into False Creek, which will settle the difficulty of the crossing of the G.N.R. tracks. Until a plan is adopted, nothing can be done concerning the railway company's entrance into Vancouver.

Windsor, Ont.—The Grand Trunk Railway Company have equipped with smoke consumers all the yard locomotives at Windsor as well as at different points on its system. Road locomotives may also be equipped in this way, though the advantages accruing are greater in the case of yard locomotives.

Winnipeg, Man.—To further the sale of power, the city of Winnipeg has decided to offer a commission of 40 per cent. to all citizens who secure a new customer.

Manufacturing 48" Pipe at Berlin, Ontario, Canada.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, October 11th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron, $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1 40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3 45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3 15; 1 in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3 double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4 30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2 10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5 50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8 50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized: ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized: 2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, October 15th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., 52.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10-ft.; 2-inch $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c per ton of 2,000 lbs., either 1-inch, 10c., 2-inch or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto: 40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3 55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2 inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40 60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5 00	16.25
Increasers and reducers	...	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c 'H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, October 14th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in. $3.35 base; machinery, $3 base; share, $4 50 base; share crucible, $5.50; cast share steel, $7.50; toe caulk, $4.50 base tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Oct. 23, 1913

Contents of this issue on page 621

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

THE WINNIPEG-SHOAL LAKE AQUEDUCT

THE 95-MILE WATER SUPPLY LINE FOR THE GREATER WINNIPEG WATER DISTRICT—ENGINEERING FEATURES OF THE PROPOSED ROUTE AND THE DESIGN THROUGHOUT

THE Administration Board of the Greater Winnipeg Water District has not been tardy in getting down to action in the matter of the proposed supply of water from Shoal Lake for Winnipeg. *The Canadian Engineer*, in September 11th issue, published the salient points of the report of Messrs. Hering, Stearns and Fuertes, the board of consulting engineers instructed on May 20th, 1913, to submit a report on the best means of supplying water from this source, together with an estimate of the cost and general plan of the development.

This project has been the acme of interest for some little time as the most desirable source of supply for the city, although distance 95 miles, and great enthusiasm was evinced when the report, mentioned above, pronounced the proposal quite within the latitude of prudence, and, in fact, a very advantageous one for the city. On October 1st the rate-payers strongly endorsed a by-law authorizing, for the supply from this source of 85,000,000 gallons per twenty-four hours, the expenditure of $13,045,600, as estimated in the report. In the issue of October 16th, this journal announced the appointment of Mr. Jas. H. Fuertes as consulting engineer, and Mr. W. G. Chace, as chief engineer, also the formation of a board of commissioners with Mr. R. H. Reynolds as the first appointed commissioner, with others to follow at an early date. The same issue published a special announcement to contractors relative to tenders for the proposed work, and at the present time the ground is being examined along the proposed route, the contractors taking advantage of the season's remaining permissible weather. A study of Fig. 1 will familiarize the reader with the magnitude of the scheme.

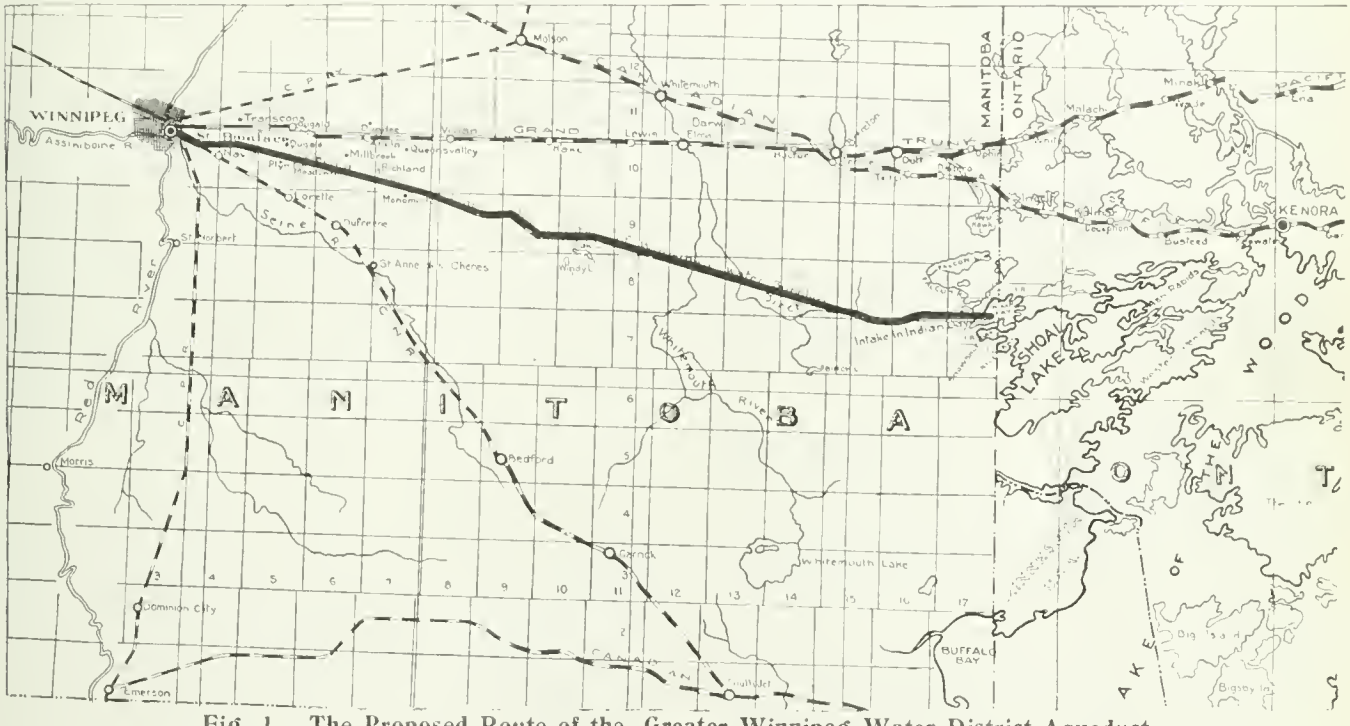


Fig. 1.—The Proposed Route of the Greater Winnipeg Water District Aqueduct.

The main engineering features of the work for immediate construction constitute:—

1. A dyke and channel for the diversion of the Falcon River into Snowshoe Bay.

2. A concrete masonry aqueduct, having a continuous down grade for 84.73 miles from an intake at Indian Bay to a point about one mile east of Transcona, the aqueduct to have a capacity of 85,000,000 gallons of water daily.

3. A pipe 5 feet in diameter, extending from the end of the masonry of the concrete aqueduct, most of the way through streets to Victoria Park on the west side of the Red River in Winnipeg, this pipe to be of steel except under the Red River, where cast-iron pipe laid in a tunnel is recommended.

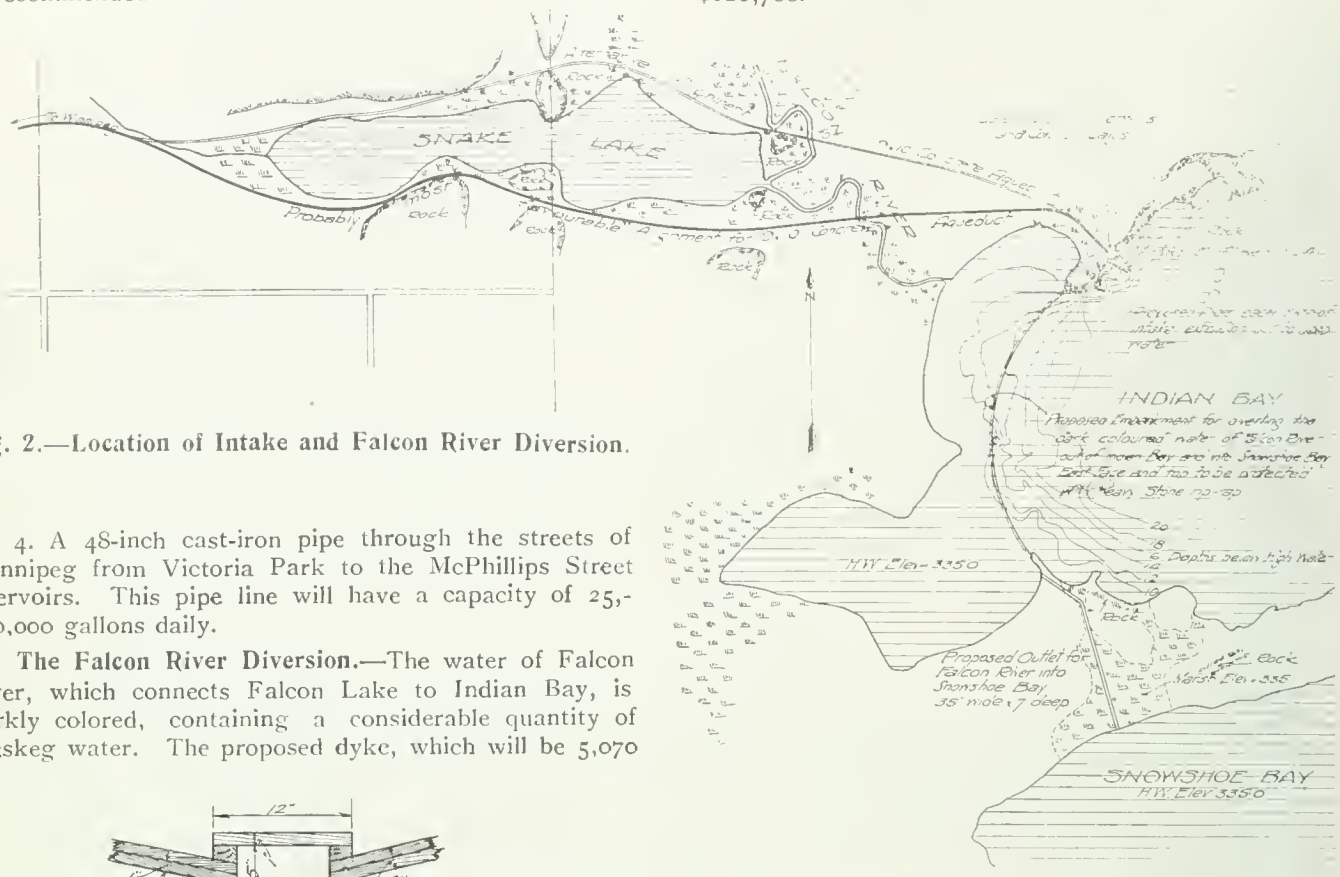


Fig. 2.—Location of Intake and Falcon River Diversion.

4. A 48-inch cast-iron pipe through the streets of Winnipeg from Victoria Park to the McPhillips Street reservoirs. This pipe line will have a capacity of 25,000,000 gallons daily.

The Falcon River Diversion.—The water of Falcon River, which connects Falcon Lake to Indian Bay, is darkly colored, containing a considerable quantity of muskeg water. The proposed dyke, which will be 5,070

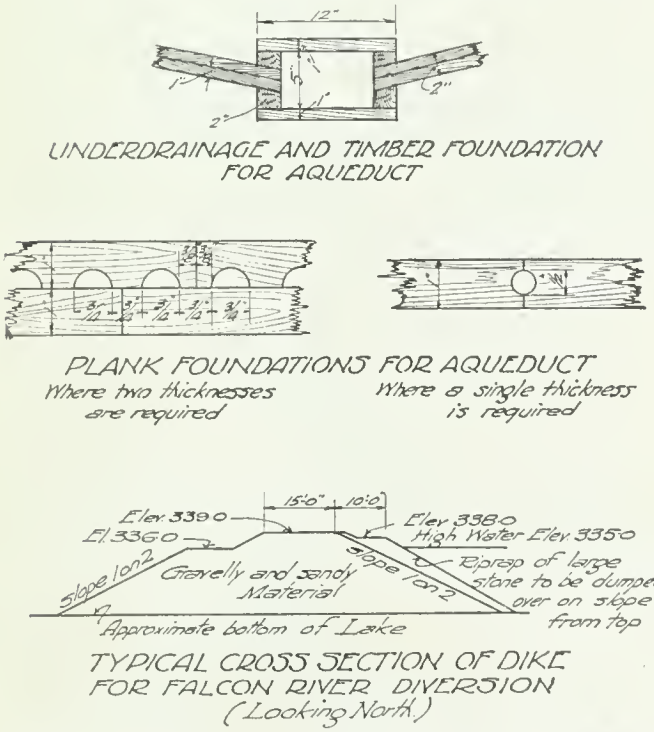


Fig. 3.—Details of Aqueduct Foundation, and Section of Falcon River Embankment.

feet in length, is to divert this water southward to a proposed channel, 3,300 feet long, 35 feet wide and 7 feet deep, which will form an outlet through a shoulder of marshy land only a few feet above the water level, into Snowshoe Bay, where there will be no liability of this discolored water becoming associated with the water surrounding the intake in Indian Bay. Fig. 2 illustrates this diversion, and Fig. 3 gives a typical cross-section of the proposed embankment. The report estimates the Falcon River diversion to cost in the neighborhood of $120,700.

The Concrete Aqueduct.—The concrete aqueduct, to be 447,330 feet in length, extending from Shoal Lake to the site of a proposed reservoir, one mile east of Transcona, is shown in profile in Fig. 4, and various cross-sections are given in Fig. 5. The location of its intake, as denoted in Fig. 2, is at the northwesterly corner of Indian Bay, where the shore is of a rocky nature, and where the water is of moderately receding depth. The intake will be provided with control gates and screen chamber on shore, and will be protected from any material which may drift along the shore, by piers, on either side, extending out 150 feet into deep water. The experts' report suggests, as an alternative to these piers, the laying of a large submerged conduit to bring the water from a point, distant about 150 feet from shore. The gate and screen chamber will be of liberal area to necessitate as little fall as practicable of the water from the bay to the aqueduct. Details of the design are not in hand, except that the report recommends the use of at least two sluice gates, not less than 5 feet wide and 6 feet high, and screens with a total length of not less than 50 feet, and a height extending from the top of the aqueduct to the surface of the water.

With respect to the advisability of using concrete masonry in the construction of the aqueduct, apprehending the disintegrating effect of the presence of sulphates and sulphuretted hydrogen in certain soils, they being adverse to durability, unless the concrete is smooth, impervious, and able to resist these deteriorating agents, the experts had chemical analyses made of the muskeg

waters, and of the materials forming the muskegs and underlying soils. These investigations covered both the Laurentian formation which underlies the greater part of the length of the aqueduct, and the limestone which occurs towards its westerly end. The results show that the sulphates and sulphuretted hydrogen were not present in the former and in minute quantities only in the latter. The method adopted of constructing the aqueduct in a shallow trench, permitting of the drainage of the muskegs nearly as low as the bottom of the aqueduct, will allow very little ground water to come in contact with the concrete. The report doubly emphasizes the use of good materials as a further safeguard against any injurious effects.

For the first 9 miles of the route the land through which the aqueduct will pass is higher than Indian Bay, and necessitates a deep summit cut, for gravity flow. This is shown to advantage in Fig. 4. From this point the gradient is quite variable, although down-grade all the way to Transcona; hence the varying sizes and cross-sections of the aqueduct, as shown in Fig. 5, ranging from one 10 feet wide and 9 feet in height with a sec-

aqueduct reinforced with steel has also been adopted, so that this portion will withstand the pressure resulting from building it 10 feet or more below the regular grade line. The diameter of this particular section is 7.2 feet. At Birch River there is the alternative of carrying the aqueduct over, instead of below, the surface of the water.

At the waste weirs, provision will be made to dispose of any excess of water over the capacity of the pipe line, leading from Transcona into Winnipeg, which might accidentally be permitted to enter the aqueduct at Indian Bay. This may be accomplished by placing stop-planks across the aqueduct to stop or throttle the flow through it. Blow-offs, other than at the locations mentioned above, will be placed where opportunity offers, being convenient for use during the construction of the aqueduct, and while it is being repaired, and to be used in emergencies when the aqueduct is in service.

For the last 26,000 feet of the concrete reservoir leading toward Transcona, the section of aqueduct to be used is designed to withstand the internal pressure that will develop when it is necessary, at some time in the future, to build a large reservoir there, and to provide a

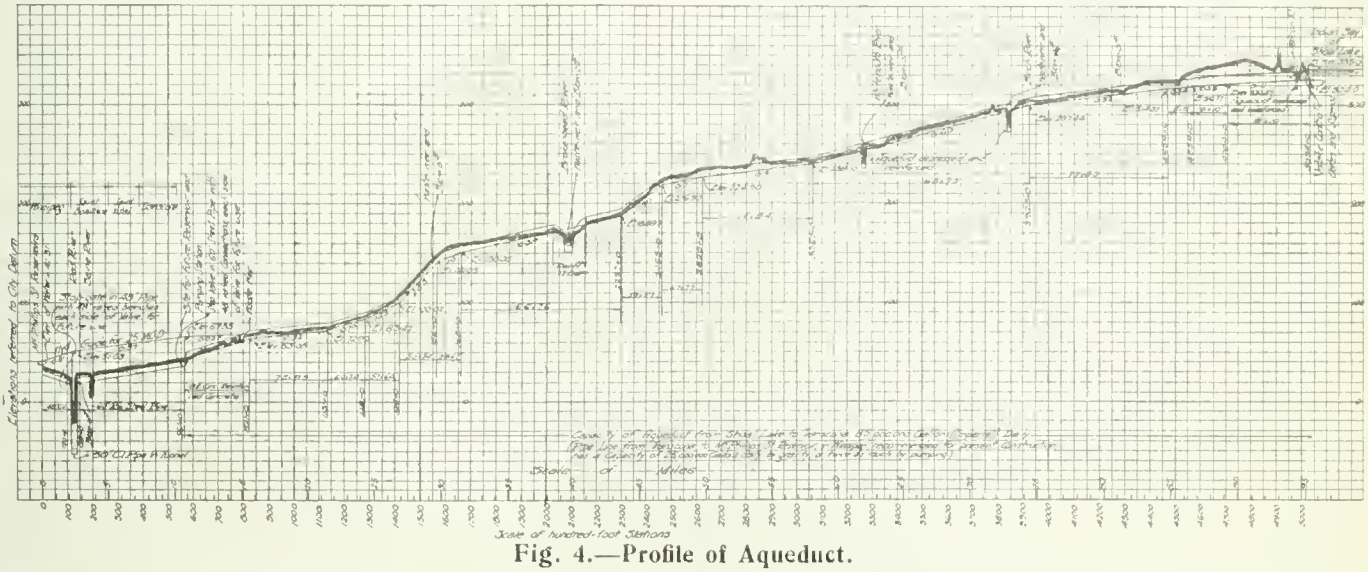


Fig. 4.—Profile of Aqueduct.

tional area of 73.6 sq. ft., with a hydraulic radius of 2.33 feet (used at the summit cut where there is a low gradient) to one 5 feet high and 5 feet wide, with 20.9 sq. ft. cross-section, and a hydraulic radius of 1.24 feet used where the gradient is highest. The profile shows four river crossings, viz., Falcon, Birch, Whitemouth and Brokenhead Rivers, where the aqueduct is depressed and reinforced, and is provided with waste weirs and blow-offs. These crossings require special construction. At the Falcon River depression a pile foundation will be required for about 600 feet, and the depression itself will be 150 feet in length. The top of the aqueduct will be sufficiently low in the water to permit of the passage of boats of light draft. The depressed portion is to be reinforced with steel, and the concrete walls thereat will be considerably thicker than under ordinary circumstances.

The depressions and strengthened sections at Whitemouth and Brokenhead Rivers are similar, although for a part of the distance at the latter crossing, where the muskeg is too steep to permit of the construction of the aqueduct upon a solid natural bottom, a pile and timber foundation will be required. At this crossing also, and through the low-land on either side of it for a distance of 13,000 feet, the circular form of pumping station. This portion of the aqueduct has been designed of circular form, 8 feet in diameter, and provided with steel reinforcement. The section shown in Fig. 6 is designed to withstand the pressure due to 20 feet of water.

As the aqueduct, with the exception of the reinforced portions above mentioned and some other short lengths at river crossings, is not expected to stand any considerable upward pressure on the arch, measures are to be taken to prevent the opening of the sluice gates at Indian Bay to a height which will permit a quantity of water to enter the aqueduct much, if any, in excess of the rate of 25,000,000 gallons daily, which is the limit of the capacity of the pipe line leading from Transcona to the city reservoirs. The waste-weirs already mentioned will act as a further safeguard in permitting the discharge into the crossed streams of excess of water.

The concrete mix recommended for the construction of the aqueduct, for strength, permanency, and water-tightness, is one of Portland cement, two of sand, and four parts of screened gravel. To prevent transverse cracks in the structure, the precaution is to be taken of building in sections not more than 20 feet in length, and where one section joins another, a steel bar about 3 inches

by 1¼ inches will be inserted to act as a water-stop, and prevent leakage at these joints.

It will be noted in the cross-sections of the aqueduct that in each case there is a central wooden box drain and a platform consisting of two thicknesses of 1-inch boards, the upper one being fluted on the under side to furnish channels in which the water may flow from the side to the drain. This arrangement is shown in Fig. 3. The platform furnishes a dry bottom upon which the concrete bottom of the aqueduct will be built and kept dry until it has had time to set. Although the drawing shows a double platform, a single board with grooves in each edge may be used where there is but little water to be taken care of. The boards are to be bedded in sand.

The Steel Pipe Line.—From the end of the concrete aqueduct, near Transcona, a 5-foot pipe line 43,200 feet in length, will convey the supply as far as Red River. This pipe will be of rivetted steel, ⅜ of an inch in thickness. At its upper end a valve it to be provided for shutting off the supply, while above and below this valve there will be branches, each provided with a valve to be used in the future in connection with the reservoir and pumping station to be installed when the 25,000,000-gallon supply to the city becomes inadequate.

Where the pipe crosses the Seine River, a new street has been projected, the design of which provides for the erection of a 30-foot arched culvert, filling over it with earth, and it is intended to lay the steel pipe in this earth.

The Cast-iron Pipe Section.—Reaching the Red River, a tunnel extending about 900 feet horizontally across the river from a shaft in Victoria Park to a corresponding shaft in the opposite side, each 75 feet in depth, will carry the supply in a 60-inch cast-iron pipe, 1.9 inches thick, and provided with a special bell about 15 inches long, so designed as to permit the joints between the pipe lengths to be caulked from the inside with lead wool. The tunnel is to be of only sufficient diameter to permit the placing of the pipe. This provides a minimum of 6 ft. 3 in., although the average diameter, owing to the irregularities in blasting, will be considerably more.

All spaces between the pipe and the sides of the tunnel are to be filled with concrete, as far as it is practicable to place concrete, and the remaining space is to be filled by pumping in cement grout, the aim in using such thick pipe and in filling all spaces with concrete or cement grout being to make absolutely secure this portion of the pipe line which will be inaccessible unless the water is shut off, and the pipe is emptied by pumping.

The remaining 12,000 feet of pipe to McPhillips Street reservoir is to be laid for almost the entire length in the city streets, and a 48-in. cast-iron pipe has been adopted. This for the reason that steel is less desirable in city streets than cast-iron pipe, and that a pipe larger than 4 feet in diameter interferes too seriously with other structures. The pipes which are to be laid in the streets will be laid to such a depth as to permit a 4-foot covering of earth.

East of Transcona, where the aqueduct will not follow the streets, but will be laid through the open country, a cheaper and more expeditious plan will be adopted of building it in a shallow trench from 3 to 4 feet deep, where practicable, and covering it to a depth of 4 feet with an earthen banking, the top width of which will be at least 8 feet, and nowhere less than the inside width of the aqueduct, so as to make the slopes of the embankment 2 horizontal to 1 vertical.

Gradients.—For a distance of 33,000 feet (6.26 miles) from Indian Bay, the gradient of the aqueduct has been made so low that is falls only .11 of a foot in 1,000. This low gradient was adopted for this distance to diminish the depth of the summit cut and is the most economical gradient, all things considered. As stated, the aqueduct through this section is 9 feet high and 10 feet wide.

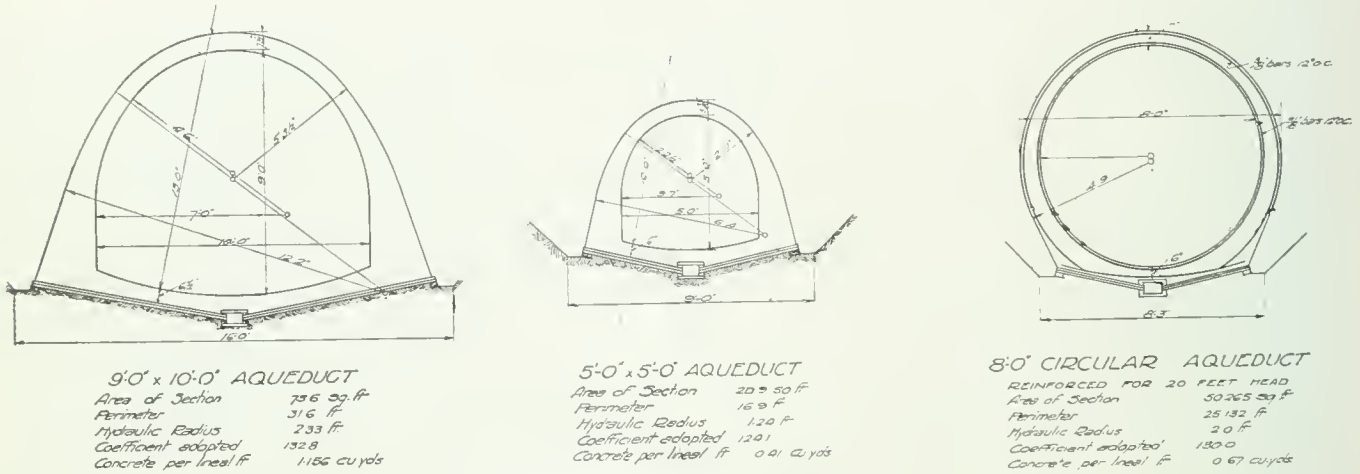

9'-0" x 10'-0" AQUEDUCT
Area of Section 73.6 Sq. ft.
Perimeter 31.6 ft.
Hydraulic Radius 2.33 ft.
Coefficient adopted 1.32.8
Concrete per lineal ft 1.156 cu yds
5'-0" x 5'-0" AQUEDUCT
Area of Section 20.2 50 ft
Perimeter 16.9 ft
Hydraulic Radius 1.20 ft
Coefficient adopted 1.20.1
Concrete per lineal ft 0.01 cu yds
8'-0" CIRCULAR AQUEDUCT
REINFORCED FOR 20 FEET HEAD
Area of Section 50.265 Sq. ft.
Perimeter 25.132 ft
Hydraulic Radius 2.0 ft
Coefficient adopted 1.30.0
Concrete per lineal ft 0.67 cu yds

Fig. 5.—Cross-sections of Aqueduct.

For the next 25,000 feet (4.74 miles), the fall per 1,000 is .25 of a foot. The large sized aqueduct, 9 feet high and 10 feet wide, is continued for 15,000 feet of this distance and a smaller aqueduct, 8 feet high and 9 feet wide, for the remainder of the distance. This design is the result of hydraulic computations, which show that with these sections of the aqueduct as planned 85,000,000 gallons daily will flow through the aqueduct when the water in the bay is 3.75 feet below high-water level, provided the water has such a free entrance through the intake and gate and screen chamber that it does not fall more than .25 of a foot in passing through them.

Beyond the three portions of aqueduct above described, the gradient of the aqueduct has been made to follow approximately parallel with the surface of the ground all the way to its end near Transcona, and a size has been adopted for each gradient, with a few exceptions which would give the aqueduct the standard capacity of 85,000,000 gallons per day.

The quantity of water which will flow through the reinforced section of aqueduct, used for the last 26,000 feet, will not depend upon the gradient of the aqueduct

itself, but upon the hydraulic gradient available when a reservoir is built east of Transcona, and its size has been computed accordingly. Somewhat similarly, the next two portions of the aqueduct east of the reinforced portion, covering a total length of 46,000 feet, have been made a little larger than the size due to the gradient of these portions, on account of the possible back water effect from the proposed reservoir.

The flow through the pipe line is, of course, dependent upon the hydraulic gradient and not upon the gradient of the pipes. For a flow of 25,000,000 gallons daily, this amounts to .37 of a foot per 1,000 in the 5-foot pipe and .81 of a foot per 1,000 in the 4-foot pipe, making a total fall through these pipes of the McPhillips Street reservoirs of 26 feet.

Table I. gives various statistics relating to the various portions of the aqueduct, including lengths, gradients, elevations and dimensions of the different sections.

To. T. R. Deacon, mayor, is to be accredited a great deal of the developments which the City of Winnipeg has experienced this year in the interests of a better and a safer supply of water. The city engineer, H. N. Ruttan, has been one of the strongest advocates of the Shoal Lake scheme, and it was largely through his persistent emphasis last year that the thorough and accurate investigation of the project was made, as the prospective cost had vied so strenuously with the very desirable qualities of Shoal Lake as a source of supply as to render the proposition an apparently prohibitive one.

In a succeeding issue *The Canadian Engineer* will describe the extensions which were recommended by the Board of Consulting Engineers, to be provided when the increased consumption of water renders the capacity of the pipe lines inadequate.

Table I.—Lengths, Slopes, Elevations and Dimensions of the Various Sections of the Aqueduct from the McPhillips Street Reservoirs in Winnipeg to Shoal Lake.

Total Distance from McPhillips St. Reservoirs		Length of section.	Dimensions of Aqueduct		Slope in feet per 1,000 feet	Elevation of hydraulic gradient at end of section.	Remarks
Feet	Miles	Feet	Height Feet	Width Feet		Feet	
0	0					41.31	High water in McPhillips Street Reservoirs.
12,000	2.27	12,000	4 in. diam.	C. I. Pipe	0.81	51.03	These slopes and elevations are for a discharge through the pipes of 25,000,000 gals. daily.
56,100	10.62	44,100	5 in. diam.	Steel Pipe	0.37	67.35	
82,100	15.55	26,000	8 in. diam.	Rein. Conc.	0.025	68.00	
56,100	10.62					61.00	Proposed high water in reservoir east of Transcona.
82,100	15.55		8.0	8.0	0.29	68.54	This slope based on 85,000,000 gallons daily.
						Elevation of inside of aqueduct bottom at end of section	
82,100	15.55					83.0	Beginning of grade conduit.
113,100	21.42	31,000	7.5	8.5	0.32	72.92	
128,100	24.26	15,000	6.4	7.4	0.70	83.42	
141,600	26.82	13,500	5.7	6.4	1.23	100.02	
156,100	29.57	14,500	5.1	5.1	2.83	141.05	
165,100	31.28	9,000	5.8	6.7	1.00	150.05	
229,700	43.54	64,600*	6.6	7.6	0.54	184.93	
246,500	46.69	16,800	5.3	5.7	1.90	216.90	
262,500	49.71	16,000	6.7	7.7	0.50	224.90	
306,500	58.65	44,000	7.4	8.4	0.30	238.10	
392,500	74.34	86,000	6.3	7.3	0.69	297.44	
445,400	84.35	52,900	7.3	8.3	0.32	314.37	
455,400	86.25	10,000	8.0	9.0	0.24	316.77	
470,400	98.09	15,000	9.0	10.0	0.24	320.37	
503,359	95.34	32,959	9.0	10.0	0.11	324.00	
503,400	95.35	41			0.00	324.00	Gate and screen chamber.

*13,000 ft. of this length at Brokenhead River Crossing is 7.2 ft. in diameter and reinforced.

TUNNEL THROUGH JURA MOUNTAINS.

The Mont d'Or Tunnel, between France and Switzerland, on which boring operations were begun nearly three years ago, was pierced recently. The two boring gangs, advancing from the Swiss and French side respectively, met and shook hands. It was found that the engineers had calculated the cutting with the greatest accuracy. The tunnel, which is three and three-quarter miles long, penetrates through the Jura Mountains, from Gresne to Vallerbe, thus obviating a seven-mile detour by Pontarlio. It should have been completed two months ago, according to contract, the work, however, being delayed by the tapping of a number of springs, which had to be pumped dry. The flow of water at one time reached 2,200 gallons a second. It is hoped that the new line will be opened early next year.

SPECIFICATIONS FOR CONCRETE MASONRY IN HIGHWAY BRIDGES.

IN September 11th issue of *The Canadian Engineer* there appeared under the heading "Typical Specification for Steel Highway Bridges," a portion of a set of typical specifications issued by the Department of Agriculture of the United States. The bulletin contains, in addition, a few specifications governing the use of concrete in masonry. Generally, it requires the concrete to be prepared and mixed in very strict accordance with specifications and plans, the cement to be of satisfactory standard conforming with Government specifications, not to contain lumps or any indications of exposure.

Aggregate.—The sand is required to consist of dry, clean, quartz grains and not to contain more than 5 per cent. of clay, loam, or other foreign materials. The grains shall be well graded and of such size that all will pass a ¼-inch mesh screen and not more than 20 per cent. will pass a No. 50 sieve.

The coarse aggregate may consist of either broken stone or gravel. Stone shall be sound, hard, and tough, broken to the sizes hereinafter specified, and when used shall be free from foreign material. No weathered or disintegrated material shall be used. Gravel shall be composed of hard, sound, durable particles of stone, thoroughly clean and well graded in size between the limits specified below.

Unless otherwise especially provided, there shall be three classes of concrete, known as class A, class B, and class C.

Class A concrete shall consist (by volume) of 1 part of cement, 2 parts of sand, 4 parts of coarse aggregate, and water. All of the coarse aggregate shall be retained on a ¼-inch mesh screen and shall pass a 1-inch mesh screen. Not more than 75 per cent. shall be retained on a ½-inch mesh screen, and not more than 75 per cent. shall pass such a screen.

Class B concrete shall consist (by volume) of 1 part of cement, 2½ parts of sand, 5 parts of coarse aggregate, and water. All of the coarse aggregate shall be retained on a ¼-inch mesh screen and shall pass a 1½-inch mesh screen. Not more than 75 per cent. shall be retained on a ¾-inch mesh screen, and not more than 75 per cent. shall pass such a screen.

Class C concrete shall consist (by volume) of 1 part of cement, 3 parts of sand, 6 parts of coarse aggregate, and water. All of the coarse aggregate shall be retained on a ¼-inch mesh screen and shall pass a 2½-inch mesh screen. Not more than 75 per cent. shall be retained on a 1¼-inch mesh screen, and not more than 75 per cent. shall pass such a screen.

Mixing.—The cement and sand shall first be thoroughly mixed dry, in the proportions specified, on a proper mixing platform. Sufficient clean water shall then be admixed to produce a pasty mortar. To the mortar thus prepared shall be added the proper proportion of coarse aggregate, previously drenched with water, and the whole shall be mixed until every particle of the coarse aggregate is thoroughly coated with the mortar. Instead of the above method a mechanical mixer satisfactory to the engineer may be employed.

Concrete shall be mixed in batches of such size that the entire batch may be placed in the forms by the force employed within 45 minutes from the time that the first water is applied. No concrete is to be prepared from mortar which has taken an initial set and would require retempering.

Placing.—All concrete shall be carefully deposited in place and never allowed to fall from a height greater than 5 feet. Concrete shall never be deposited in running water, nor in still water, except under the direction of an engineer skilled and experienced in that special work.

As fast as concrete is put into place it shall be thoroughly tamped in layers not more than 6 inches thick, and the portion next to the forms shall be troweled by using a spade, or by other means, to bring the mortar into thorough contact with the forms.

Concrete shall not be deposited when the temperature of any of the materials composing it is below 35° F.; and if during the progress of the work freezing temperature threatens proper precautions shall be taken to protect from freezing all concrete laid within the four preceding days.

Forms shall be so constructed as to continue rigidly in place during and after depositing and tamping the concrete. If during the placing of the concrete the forms show signs of bulging or sagging at any point, that portion of the concrete causing the distortion shall be immediately removed and the forms properly supported before continuing the work. The amount of concrete to be removed shall be determined by the engineer, and the contractor shall receive no extra compensation on account of the extra work thus occasioned. Forms for exposed surfaces shall be constructed of dressed lumber.

All forms shall be left in place not less than 36 hours and all supporting forms not less than 10 days after the concrete has been deposited. These periods may be increased at the discretion of the engineer in charge.

It is understood that all prices for concrete masonry shall include furnishing all materials and properly constructing all necessary forms.

When the work of laying concrete is to be interrupted for a period greater than one hour and there are no reinforcing rods projecting, provision for a joint shall be made in the following manner: Square timbers 8 by 8 inches, or some other suitable size approved by the engineer, shall be bedded in the concrete throughout the length of the course for one-half their thickness and allowed to remain until the concrete has taken its initial set. When the work of laying concrete is resumed, the timbers shall be removed and the surface thoroughly wet. No joints will be permitted in reinforced-concrete beams, and in floor slabs the joints shall be vertical and parallel to the main reinforcing bars.

Forms covering surfaces of the concrete masonry which are to be exposed shall be removed immediately after the expiration of the period of time necessary for such forms to remain in place, as fixed by the engineer, and all crevices which may appear shall be filled with 1:2 cement mortar. These surfaces shall then be finished with 1:2 cement mortar and a wooden float, so as to present a smooth, neat appearance.

Reinforced Concrete.—All reinforced arches, beams floors, parapets, guard rails, and all concrete masonry measuring less than 9 inches in thickness shall be made of class A concrete, unless otherwise specified on the drawings or directed by the engineer in writing.

Unless otherwise specified on the drawings or in writing by the engineer, class B concrete shall be used for all abutments and wing walls the thickness of which is not less than 9 inches.

Class C concrete shall be used for all footings and cut-off walls, unless otherwise specified on the plans or directed in writing by the engineer.

Unless otherwise specified on the drawings, all reinforcing steel shall consist of bars which have been deformed in some approved manner. No plain bars will be permitted except as shown on the drawings or directed in writing by the engineer.

The steel bars shall have the net sectional area and shall be placed in the exact positions indicated on the drawings.

Unless otherwise specified on the drawings or in writing by the engineer, all reinforcing bars shall be of medium steel having an elastic limit of not less than 35,000 pounds per square inch, and shall be sufficiently malleable to withstand bending cold with a radius equal to twice the diameter or thickness of the bar through 180° without fracture.

When placed in the concrete, the reinforcing steel shall be free from grease, dirt, and rust, and it shall be the duty of the contractor to provide means for properly cleaning the steel.

Thorough contact of the concrete with every portion of the surface of the steel shall be obtained.

Unless otherwise specified on the drawings or in writing by the engineer, necessary splices in reinforcing bars shall be effected by overlapping the ends of the bars a distance equal to 40 times their thickness or diameter.

Inspection and Testing.—All materials used in connection with the work being done under these specifications shall be purchased especially for that work. The contractor shall furnish the engineer with complete copies of all orders for materials, and shall make all orders subject to the engineer's approval of the materials.

The engineer or his representative shall stamp each accepted piece or parcel with a private mark, and any material not so stamped may be rejected at any stage of the work. The engineer's acceptance, however, does not relieve the contractor from responsibility for faulty material or workmanship and wherever such faulty material or workmanship is discovered is shall be repaired or removed and replaced, as the engineer may direct, by the contractor at his own expense.

The contractor shall furnish the engineer or his representative all facilities for testing materials and workmanship at the shop where material is fabricated, and shall notify the engineer well in advance of beginning the shop work.

The contractor shall furnish all facilities for testing the weight and quality of all material at the mill where it is manufactured. He shall provide, free of cost, a suitable testing machine for making the tests and such test specimens as the engineer or his representative may require.

Erection.—Unless otherwise specified in writing by the contracting parties, the contractor shall furnish all labor, tools, machinery, and materials for erecting the bridge complete in place and ready for traffic, in accordance with these specifications and the plans furnished or approved by the engineer.

The contractor shall do all necessary hauling, set all stone or anchor bolts, remove existing structures when necessary, and perform all other incidental work for which express provision has not been made.

The contractor shall so conduct all his operations as not to interfere with the work of other contractors or close any thoroughfare by land or water except by written consent of the engineer.

The contractor shall assume all risks of damage or accident to persons or property prior to the final acceptance of the finished structure.

The contractor shall remove all false work, piling, and other obstructions produced by his operations, and shall perform any additional work necessary to produce a sightly appearance in the immediate vicinity of the structure.

ANALYSIS OF COALS.

An increasing proportion of the coal consumed in the power stations and the larger manufacturing plants is now being purchased under specifications based on chemical analyses and calorimetric determinations of heat units. In the purchase of fuels many matters that have been left to chance are now carefully investigated. It is the aim of mechanical engineers to construct furnaces and to arrange the heat absorbing surface in a furnace with reference to the peculiar character of the fuel which is to be burned. Noting the composition of the fuel and constructing the furnace with reference to it, he can assure efficient and smokeless combustion. Moreover, in any particular market, the choice of coal generally is limited by its quality and by freight rates to one or two fields in which the character of the coal bed is comparatively uniform. Having on hand a representative analysis of the coal from a given bed in any particular district, the engineer can determine whether the coal he receives comes from the bed and the district stated, and whether it is being prepared for market as carefully as it should be. Wide variations in the composition and heating value of the coals from different districts and from different beds make analyses that are comparable, because of the care taken in sampling and analyzing the coal, almost indispensable to engineers having to install boiler or gas-producer plants in different cities, and also to railroads and steamboat companies.

In Bulletin 22, entitled "Analyses of Coals in the United States," the Bureau of Mines has issued information that designing and operating engineers and industrial superintendents will find of great value. Some five thousand samples of coal taken from fifteen hundred coal mines were considered in the report, and much reliable data are presented regarding the chemical composition and heating value of the coals.

The report is in two parts, one giving the methods used in collecting and analyzing the samples, and the results of the analyses, and the other giving the exact location from which each sample of coal was taken, together with a description of the characteristic features of the coal bed at the point of sampling, the nominal capacity of the mine, and such notes on the preparation of the coal as might be useful to consumers. The data contained in these two volumes is not equalled in scope and detail and in value for comparative purposes by the figures that have been published by any other coal-producing country in the world. The Governments of some of these countries have published analyses of coals from different mines and from different districts but, with few exceptions, the samples of coal were not collected and analyzed under a uniform system that would make the results comparable in all respects, and no country has attempted to publish such a large number of analyses that would be comparable, because of the care taken in collecting and analyzing the samples.

ELECTRIC DRIVE IN MACHINE SHOPS.

At the Philadelphia meeting of the American Institute of Electrical Engineers, Oct. 13, 1913, Mr. Charles Fair read a paper dealing with the possibilities of the electric drive for machine tools. He points out the two important questions before the manufacturer as being to increase products and to decrease cost. Since labor is the greatest cost of production, then, where machine tools are a considerable factor in the production, maximum output from the tool is a necessity. Tools that are limited in production because of a lack of power at the tool are a source of expense to the manufacturer. Power cost is low while labor cost is high. The well designed motor-driven machine of to-day shows the motor as one of the main elements of the tool, it having done away with much of the old mechanical drive, and is no longer a mere adjunct to the tool. Mr. Fair's paper is as follows:—

The importance of the motor drive for the machine shop is every day becoming more evident. Due to the great improvement in motors, accessories and methods of application and to the large number and variety of motor-driven tools in service to-day, the relationship of motors and control to machine tools is much better understood by the machine builder and the user than heretofore and, consequently, comparatively little trouble is experienced with either motors or control for the ordinary type of machine tool. Misapplications of both motor and control occur occasionally due largely to insufficient or unreliable information regarding the characteristics of the machine, but the number of these misapplications is relatively small. The tendency to both over- and under-motor machines is constantly growing less, owing to the large number of tests made and to accurate information available. There is still, however, a tendency on the part of some machine builders to over-motor their machines either with the mistaken idea of the strength of their machine or with the idea that possibly prospective customers will be impressed with the enormous power that their "heavy type" machines take. Conversely, other manufacturers want to show how little power it takes to operate their "very efficient" machines and consequently get into trouble. These extremes are gradually disappearing and a more normal condition is taking its place. In a comparatively short time the greatly over-motored and under-motored machine will be a thing of the past, at least so far as the general type of machine is concerned. A number of manufacturers have already recognized three ratings of motor drive on certain of their machines; namely, heavy, medium and light. Much of the existing trouble in motor applications to special machines or to machines rigged for special operations could easily be avoided if only preliminary tests were made with a temporary motor before making the permanent installation. A not uncommon source of trouble, and one that could easily be avoided, is that of attempting to increase considerably the productiveness of a tool by speeding up the machine, increasing the cuts and attaching automatic feeding devices, etc.; all of which increases production but, in doing so, the motor is often overlooked and, if the tool were originally under-motored and the power is not increased, trouble is apt to result. Increased production often calls for an increase in power although there are cases where this is not true.

To increase production and to decrease cost are two important questions continually before the manufacturer to-day. In the majority of cases labor is the greatest cost of production, thus where machine tools are a considerable factor in the production, the importance of obtaining maximum output from the tool is evident. Although the advantages of the motor drive have been dwelt upon at length numerous times, a brief statement of the advantages derived from electrical installations will perhaps be worth repeating:—

Maximum output of tool due to greater power and overload capacity.—Too much stress cannot be laid on maximum output of tools.

Closer speed regulation.—Allows maximum speed for varying materials and size of work.

Power distribution not only for the tools, stationary or portable, but for cranes, lights, etc.—This means that power and light can be had in any part of the building, buildings or yard, permanent or temporary without regard to structural conditions. Numerous belts obstruct light, whether natural or artificial.

Elasticity in the arrangement of tools.—Tools can be arranged to the greatest advantage for sequence of operation in routing work and for light as well as for compactness when necessary.

Ease of adding new tools and of moving and rearranging tools.—Ease of adding new tools means a great deal in growing plants. Rearranging becomes necessary after reasonable growth or to improvements in methods of manufacture which call for a better routing of work.

Head room for cranes, hoists, etc.—For example, note the expensive manner in which work is often handled because of belt or shafting interference with the installation of cranes or hoists.

Facility for running only such tools as are required, for overtime work.

To a large extent the elimination of belts and belt troubles.

Unobstructed light and sanitation.

Under modern structural conditions, avoidance of the well-understood difficulties of line shaft installations in concrete buildings.

The general use of high-speed steel has made it not only possible, but necessary, for economical production that the cutting speed be increased in order to meet competition. Increasing the cutting speed means more power and while much has been said from time to time regarding the increased production and saving in power due to applying power direct to the tool, yet the writer has very serious doubts if anything like the real importance of this direct application of power is realized in many cases even by those who are advocating it. For instance, the saving of power is looked upon generally as a matter of how much can be saved of the transmission friction load, and though this saving may amount to 50 per cent., it is in many cases only a part of the real saving, as proved by numerous tests made by the writer.

The slipping, due to a belt not being able to pull its cut, means waste power and loss of production. If the cut be heavy enough the maximum slip will be reached when the machine is stalled, the power input remaining approximately the same, the loss being entirely one of friction due to slip in the belt. A familiar illustration of the above is that of an operator decreasing the depth of his cut on account of slow down, because the belt will

not carry the load. A natural answer to this would be to increase the size of the belts. This will suffice in some cases, but there are numerous instances where either there is not room to increase the width of the belt or if step cones be used the number of steps will have to be decreased and means (such as multiple counters or additional gearing) taken to complete the speed range. Further, it is difficult to shift large belts, and this method generally results in much loss of productive time. Tools that are limited in their production because of the lack of power at the tool are a source of great expense to the manufacturer, not only on account of the unproductiveness of the tool, but on account of the excessive labor expense due to the additional time required. The power cost of the production is comparatively small, roughly, varying from one to three per cent., while the labor cost is usually a very heavy item of the production cost, say, fifty per cent. or upward. If, therefore, by increasing the power on a given tool its output can be increased, the conclusion is obvious.

Up to a few years ago in the majority of shops where motors were used they were usually belted to the lineshaft or countershaft of the tool. Adjustable speed motors were not so commonly used then as now nor were they made in the great variety of sizes and speeds now obtainable. To-day, especially in the case of new tools with their requirements of high power and close speed regulation, it becomes not only more convenient, but in many cases almost a necessity to apply the motor directly to the tool.

In driving tools with individual motors it will be noted that the motor not only supplies the power and speeds best adapted to the tool, but that in the case of the variable speed tools the speed range of the adjustable speed motor, alone, will in many cases cover the entire speed range of the tool. The motor and its controlling apparatus should, whenever possible, be connected direct to the tool, thus making a compact unit which has also the additional advantage of allowing the tool to be moved by simply disconnecting the leads and connecting them in the new position. In the case of portable tools this, of course, is an absolute necessity.

Many tests have been and are being made to determine the kind and horse-power of motors that should be used for different types and sizes of tools, but up to the present time the motor is generally thought of only as a means of driving the tool and not as to its possibility of becoming one of the main elements of the tool construction. Recent motor improvements will produce many new designs in tools with corresponding higher efficiencies.

While there are numerous motor applications to machine tools which are a decided credit to the machine designers and for which due credit should be given, there are still many motor applications where it is only too plainly seen that the motor is an ofter-thought and thus much of the advantage of the application is lost. In order to derive the greatest advantages from the motor drive, the motor should, as far as possible, be direct-connected to the machine. For example, a recent up-to-date motor application to a machine in common use and one that had been motor-driven for several years, abolished belts, three sets of bevel gears, two splined shafts and considerable other gearing; the motor being applied directly to the machine spindle. There are to-day many cases where motors are driving machines through unnecessary auxiliary apparatus such as belts, gearing, etc. This additional apparatus not only takes up valuable floor space and wastes power, but fails to give the maximum output available when the motor could be connected directly to better advantage and in some cases at actually less cost. From the foregoing it will be seen that the advantages derived from an up-to-date direct method of applying the motor not only increases the productiveness of the tool, but decreases the actual power required to the extent of the friction load short circuited, and also decreases the first cost of the motor on account of the less capacity required. The writer knows of cases where improved drives have cut the power required to half and even less. A cheap first cost is often an expensive investment.

The advantages of the individual motor drive for large tools and for certain of the smaller tools have been conceded for years, but there are many tools where either the cost of the motor or the cost of applying the motor to the tool on account of the construction of the machine is prohibitive. The motor should be a part of the tool rather than a mere addition to it.

Better drives are possible now than formerly, due to the greater motor speed ranges obtainable and to the decrease in dimensions per horse-power of the motors, to more perfect balance of the rotating parts and, to a certain degree, to improvements in gears which allow higher speeds without excessive vibration and noise.

The improvements in control appliances have kept pace with the motor development. Much more exacting requirements of both motor and control are now demanded. Motors driving machines reversing ten times per minute, twenty-four hours per day are now not uncommon. Duty cycles that were impossible to meet only a short time ago are now not only practicable but common. With the great variety of motors and controllers now on the market and the large quantity sold, sometimes without the manufacturer even knowing for what service they will be used, it would be surprising if trouble did not occasionally occur.

Much of the success of a motor-driven machine depends on its control. Magnetic control, which is coming into more general use than formerly, somewhat complicates the control situation. While the possibilities of magnetic control are infinitely greater than the older types of control, likewise the chances for misapplication are greater. However, as the characteristics of the different types of control become better known these complications will disappear.

In the report of Mr. J. McLeish, issued by the Department of Mines, Ottawa, on Economic Minerals and Mining Industries of Canada, the production in 1912 of the three following minerals was as follows:—Lead, 35,763,476 lbs., at the value of $1,597,554; Corundum, 1,960 tons, at the value of $239,091; graphite, 2,060 tons, at the value of $117,112.

In the report of Mr. J. McLeish on Economic Minerals and Mining Industries of Canada the following statistics are given for 1911 and 1912 for the total value of the outlay of clay products in the following provinces, thus:—In British Columbia, for 1911, $675,505, for 1912, $996,568, showing an increase of $321,063; in Alberta, for 1911 $1,052,751, for 1912, $1,356,184, showing an increase of $303,433; in Ontario, in 1911, $3,916,575, in 1912, $4,864,700, with an increase of $948,125; in Quebec, in 1911, $1,341,467, in 1912, $1,680,300, with an increase of $338,833; in Nova Scotia, in 1911, $274,249, in 1912, $272,053, showing a decrease of $2,196.

SWEDISH WATER POWERS AND THEIR UTILIZATION.

In respect of total water power Sweden ranks third among European countries, coming next after Norway and Austria-Hungary. Dr. Helmer Key, a recent writer on the trade and resources of Sweden, states that the water power is equal to 4,000,000 h.p. or 5,000,000 h.p.; while that of Norway is five or six millions, and that of Austria-Hungary four to six millions of horse-power. The Swedish waterfalls are more difficult to exploit than those of Norway, which are usually higher and more compact; but have often the advantage of flowing from the great lakes, which form natural storage basins. The horse-power already harnessed amounts to 600,000 or 700,000 h.p., of which about half is converted into electricity, to be transmitted to a distance, and the rest is directly employed upon water wheels for use on the spot or at a short distance. Almost all the towns are lighted by electricity, or will be so lighted shortly. A great part of Central and Southern Sweden is now intersected by electric conduits belonging to the State or to private enterprises. Electric energy is frequently used for small industries and for agriculture, though for the latter purpose it is far from general. The Government power stations are much more important than the private concerns. In 1893 the State was whole or part proprietor of 800,000 h.p. of waterfalls, and since that date many more falls have been acquired. A plan has been elaborated for electrifying the railways, but can only be completed in the distant future. A power station has been erected at Trollhättan, to tap one of the largest falls in Europe, yielding about 200,000 h.p. The State has alreads invested nearly a million sterling in the enterprise. It has been intended to transmit part of the current at high tension to Copenhagen, but home consumption seems likely to render this unnecessary, and it is expected that the power provided by this fall will act as a potent stimulus to industry in South and Central Sweden.

Probably the industries which will benefit most from the utilization of water power are those connected with iron and steel. Other metal industries, too, as well as the industries which use timber for their raw material, will doubtless receive great encouragement. For centuries Sweden has been one of the most important mining countries. Time was, indeed, when it was the chief producer both of iron and of copper. The production of copper is now small, for the well-known Falun miners are becoming exhausted. But the output of iron ore has never been so great as it is to-day. The Swedish smelting industry suffered severely from the discovery that iron ore could be smelted with coke instead of with charcoal; but in recent years the output of pig-iron and steel in Sweden has increased rapidly, partly because the native ores are exceptionally pure, and the demand for high-grade steel enables charcoal smelting to be conducted profitably. The mean production of pig-iron grew from 177,000 tons per annum in the years 1856-60, to 471,147 tons in 1891-5, to 528,255 tons in 1901-5, and to 615,778 tons in 1907. The extent to which the crude ore is worked up in Sweden is, however, still very limited. A large amount of ore is exported in the raw state, mainly to Germany. Of the pig-iron produced in Sweden a large amount (134,000 tons in 1910) is also exported, though it is true, on the other hand, that a considerable quantity of foreign pig-iron for foundry purposes is imported. About 60 per cent. of the pig-iron produced in Sweden is said to be manufactured into steel—the best steel in the world. The iron smelting plants consist of a curious mixture of large and small furnaces, the new existing side by side with the old, but the old furnaces are rapidly being driven out of the trade. The use of electricity in the smelting of iron and other ores is one of the most momentous questions of the day in Sweden, for the solution of the difficulties connected with this matter would signify that a further step had been taken towards counteracting the absence of coal. Already water power, converted into electric energy, performs many of the same industrial functions as coal, but the progress of invention can, of course, never make the two completely interchangeable. Some success has already been achieved in the smelting of iron in electric furnaces during the last few years. As a general rule, however, the electric process is suitable only for making iron of good quality, and the process can only compete with blast furnace smelting if water power is cheap. Phosphorus is not eliminated by the electric process, but as the consumption of charcoal, which contains phosphorus, is barely one-third of what is used in ordinary blast furnaces a smaller quantity of phosphorus is found in the pig-iron. Sulphur is not eliminated either in electric smelting, and to produce the best quality of iron it is necessary to use ore with little or no sulphur. Electric pig-iron is suitable for conversion into steel in open-hearth furnaces.

The most important iron mines in Sweden are situated in the province of Norrbotten, within the Arctic circle, in a district which, until the opening of the iron mines, was inhabited only by Nomad Laplanders. The deposits are amongst the largest in the world, and are believed to contain several thousand millions of tons of workable ore. They have been known for centuries, but their exploitation dates only from 25 to 30 years ago, when a railway was built to carry the iron to the coast. The most important mines are those of Gällivara, Luossavaara, and Kürunavaara, the two later forming part of the same deposit. At many points the ore crops up on the surface. The Tuolluvaara mine is another important mine, and is exploited on behalf of some blast furnaces in Central Sweden. There are several mines belonging to the State. The Norrbotten ores all contain a very high percentage of metal, amounting in every case to at least 60 per cent., and sometimes 68 per cent. or 69 per cent. or more. The amount of phosphorus is also usually high, but there is some ore with a proportion of only .05 per cent. of phosphorus. The proportion of sulphur rarely exceeds .05 per cent. to .08 per cent. The iron district of Norrbotten is owned by the Trafikaktiebolaget Grangesberg Oxelösund, a company which forms a sort of iron ore trust. It does not, indeed, control the Swedish market, but is said to exercise a close control over the export of Swedish ore, or at least of the ore rich in phosphorus. In 1907 an agreement was reached between the State and the company regulating the export of ore. The company was to have the right to increase its export each year until the end of 1921, in such a manner that the total export in 1921 and during each of the following 10 years would be 5,100,000 tons. At present only a very small part of the Lapland ore is smelted in Sweden. The rest is exported, principally via the port of Narvik, which is open all the year round, to England, Germany, Belgium, and France. In 1909 the United States began to buy Swedish ores, and it may be expected that the new American tariff will encourage this trade.

PRODUCTION OF POLES AND CROSS-TIES, 1912, IN CANADA.

THERE were 608,556 wooden poles reported in Bulletin No. 39, Forestry Branch, Department of the Interior, as having been purchased in Canada in 1912. This number is an actual increase of 22,853 poles, or 3.9 per cent. increase over the figures for 1911. While this increase is slight, it follows a decided decrease from 1910 to 1911. The average pole has a life of at least ten years, and the demand for poles is, therefore, more or less intermittent, depending on the building of new pole-lines.

Altogether nine kinds of wood were reported for poles in 1912, with Eastern cedar heading the list as in past years. Cedar has been, and probably will be for some time, the most popular wood for telegraph, telephone, and other pole-lines, although the purchases in 1912 show a decrease. Wood for this purpose need not be especially strong or hard, as there is little or no mechanical strain to be endured. Durability in contact with the soil, lightness and a slender tapering form are most essential, and cedar seems to fit those requirements better than any other native wood used in an untreated state.

The use of the British Columbia species of cedar has increased in the last few years with the decrease in the supply of poles of the Eastern species in the greater length-classes. While these poles are not so strong or so durable as those of Eastern cedar, they can be obtained in greater lengths, and the source of supply is more easily accessible. The two species of cedar together formed over 85 per cent. of the total.

Balsam fir was reported for the first time in 1912. This wood is being used more and more each year for all purposes, especially in the Maritime Provinces where the supply of pine is beginning to fall below the demand. As far as form and lightness are concerned, this species should make excellent pole material if its lack of durability were made up for by some preservative treatment. Increases are noted in the use of Western cedar, tamarack, spruce, and chestnut, with balsam fir added to the list; and decreases in the use of Eastern cedar, jack pine, Douglas fir and hemlock. No poles were reported in 1912 of red, white or yellow pine.

The average value of poles in 1912 was $1.83, an increase of only 3 cents over 1911. A slight increase was recorded in the case of Eastern cedar, and other increases were in the value of poles of spruce and jack pine. All other kinds of wood decreased in value and the balsam fir reported in 1912 was valued at an average price below the general average for 1911.

Steam railways, and telephone and telegraph companies reported the purchase of 549,560 poles in 1912. This number is an increase of 5.4 per cent. over the total for 1911, and is noticeable in the cases of Western cedar, tamarack, and the newly added material, balsam fir. All other woods show a decrease in number, although Douglas fir and chestnut were added to the list of woods purchased by steam railways. The average value of $1.51 per pole is an increase over that of 1911. The average values of poles purchased by this class of pole-line companies is always less than with the electric railway, power, and light concerns, as the steam railway and telephone companies are usually closer to the source of supply and purchase their poles in greater quantities. They also use more poles of the shorter length-classes. These companies used all the poles purchased of balsam fir, tamarack, jack pine, Douglas fir, and chestnut. They purchased 90.3 per cent. of all the poles used.

The electric railway, power, and light companies purchased a total of 58,996 poles, 9.7 per cent. of all the poles purchased in 1912. This number is a decrease of 5,135 or of over eight per cent. from the total in 1911. These companies used only four kinds of wood, namely, cedar (Eastern and Western), spruce, and hemlock. Hemlock was not reported in 1911 by these companies, and poles of Douglas fir, chestnut, yellow pine, and tamarack reported in that year were dropped from the list in 1912. The electric companies, as a rule, purchase the best class of poles of the greatest length and seldom obtain their supply locally. These facts are probably responsible for the high values, the average value per pole of $4.79 representing an increase of 24 cents over 1911.

Of the total 608,556 poles, 66.1 per cent. were from 20 to 25 feet in length and were valued at $1.15. Over twenty per cent. were in the 26-to-30-foot class, and were valued at an average of $2.42. In the 31-to-35-foot class, 7.8 per cent. of the poles were placed, and these were valued at $4.01. The 36-to-40-foot poles formed 3.4 per cent. of the total, at $5.38, and the poles of 40 feet and over, at a value of $6.68, made up the remaining 1.5 per cent.

Cedar poles formed the greater part of each length-class and made up practically all the poles in the greater length-classes (36 feet and over). Tamarack and spruce poles were also used in the greater length-classes and formed a large per cent. of the poles between 26 and 35 feet. The jack pine poles were all in the 26-to-30-foot class and practically all the poles of Douglas fir, chestnut, and hemlock were less than 25 feet in length.

The spruce and chestnut poles in the greatest length-class (40 feet and over) were purchased for special purposes, and their low prices do not indicate their relative value.

Many of the pole-line companies use preservative treatments of different kinds to prevent decay and insect injury. These include impregnation of the butts of the poles with creosote, zinc chloride and other chemicals. In some cases the bark is left on that part of the pole which comes into contact with the soil, and this tends to increase the life with some kinds of wood. Painting the butts of the poles with hot tar or creosote will increase their life by several years. Many companies have found that the increased life which is secured by preservative treatment brings about a considerable saving in the annual cost of the upkeep of a pole-line. By thorough treatment with preservatives many non-durable woods, such as balsam fir, are being used satisfactorily where their use in an untreated state would not have been possible.

Cross-Ties.—There was purchased in Canada in 1912 a total of 21,308,571 cross-ties. This was an increase in actual numbers of 6,919,347, or a 48.1 per cent. increase over 1911. This increase took place on almost all the railways in Canada and was especially noticeable on transcontinental lines.

Nineteen different kinds of wood were used, with jack pine still leading. The use of each material increased from 1911 with the exception of Eastern spruce and red pine. Balsam fir and Western spruce were added to the list of woods in 1911, and poplar and black ash were dropped.

The use of the cedar tie has varied greatly from year to year. In 1908, 1909, and 1910, cedar ties headed the list, although the numbers purchased showed decreases each year. In 1911 cedar ties formed only 10 per cent. of the total and fell back to fourth place on the list. In 1912 the use of this material increased by some 1,898,710 ties, and this wood moved up to second place on the list, forming 15.6 per cent. of the total.

Douglas fir has steadily increased in use since 1909, when data concerning its use were first obtained. Oak and the other five hardwoods—chestnut, beech, maple, birch, and elm—have also increased remarkably. There seems to be a tendency on the part of the management of older-established steam railways to reduce the use of soft, light material for cross-ties, especially where fast trains and heavy rolling stock are used. Some of the eastern roads have ceased to purchase cedar, pine, hemlock, and tamarack ties and use only the hardwoods. The use of imported hard pine has increased with the hardwoods, and that wood was used in making 3.1 per cent. of the ties purchased in 1912. Western larch formed 5.6 per cent. of the total number, over a million ties of this wood having been purchased.

The average value of ties, at the point of purchase, increased from 39 to 44 cents in 1912. Increases are noted in the case of jack pine, cedar, hemlock, tamarack, Eastern spruce, chestnut, beech, maple, white pine, birch, red pine, and elm. The increases in the values of beech, maple and birch were probably due to the fact that ties of these three materials were treated chemically in considerable numbers to prevent decay, and their cost materially increased on this account. The decreases were in the values of Douglas fir, oak, hard pine, and Western cedar. Western larch ties were purchased at the same price as in 1911.

The values in all cases, being based on the cost at the point of purchase, can never be considered to represent exactly the relative values of the different kinds of wood for cross-ties. So many variable factors enter into this cost that only in those cases where ties of a certain kind of wood are used in large numbers can the values be said to indicate the intrinsic value of the material.

Steam railways in 1912 reported the purchase of 20,825,209 ties, this number forming 97.7 per cent. of the total for all Canada. The total is an increase of 7,025,227 ties, or an increase of 50.9 per cent. over 1911.

Steam railways paid an average price of 44 cents for their ties as compared to 50 cents paid by the electric lines. The steam railways paid less for every kind of wood used by both classes, with the exception of Eastern spruce. These companies are usually closer to the source of supply, buy in greater quantities, and have better facilities for transporting their tie material than have the electric roads. The steam railways used all the ties purchased in Canada in 1912 of the following kinds of wood: Western larch, chestnut, beech, maple, birch, red pine, and balsam fir.

It is interesting to note the increased use of hardwoods by steam railway companies. In 1911, woods such as oak, chestnut, beech, maple, birch, elm, and black ash together formed only 1.8 per cent. of the ties purchased. In 1912 this percentage increased to 6.7 per cent. through increased purchases of 1,148,578 hardwood ties.

Electric railways in Canada reported having purchased 483,362 cross-ties in 1912. This is a decrease of 18 per cent. from 1911, and, where the purchases of these railways in 1911 amounted to over four per cent. of the total, they formed less than three per cent. in 1912. As stated previously, the values of ties of every kind of wood used by both classes of roads were greater in the case of steam railways, with the single exception of Eastern spruce.

The greater part of the material used by these companies was of the softer, lighter woods. Coniferous woods formed together 99.4 per cent. of the total. The only hardwoods used were oak and elm and these together formed only 0.6 per cent. of the total. Imported hard pine, however, is used to a slight extent, and this material is, in reality, much harder than many of the native so-called hardwoods.

Decreases in the number of ties purchased by electric railways are noticeable in the case of cedar, Douglas fir, oak, and white pine; and these woods together form the bulk of the material used. Increases are seen in the use of hemlock, tamarack, jack pine, and Eastern spruce.

Ties of Western cedar, Western spruce, hard pine, and elm were reported for the first time in 1912. The use of red pine, and chestnut was not reported by electric roads in 1911. These companies used all the Western spruce ties reported in 1912.

Preservative Treatment.—Many Canadian railway companies are now beginning to realize the value of preserving at least a part of their tie material from decay and insect injury. The practice of chemical treatment of railway ties has been carried on by railways in the United States for some years with apparently satisfactory results.

The practice in Canada is just beginning, but is increasing rapidly with the increasing cost of tie material and the constantly decreasing supply. In 1910 practically no treated ties were used by Canadian railways. In 1911 some 206,209 ties received chemical treatment before being placed in the roadbed. This number, while forming only 1.4 per cent. of the total number of ties used, was, nevertheless, an indication of the increase in this particular form of conservation. In 1912 a total of 1,818,189 ties were chemically treated. This number forms 8.5 per cent. of the total number of ties purchased. Steam railways used 1,798,189 of these treated ties and electric roads used 20,000.

The treated ties were mostly hardwoods, as it has been found more economical to treat the heavier, stronger woods than those which are liable to fail from mechanical wear before they have time to decay. The greatest actual saving by preservative treatment is found in the use of the so-called "inferior woods," provided that these are properly protected from mechanical wear. Until the price of the durable woods becomes excessive, the railway companies will not resort to expensive treatment of inferior woods on account of this cost of protecting them from mechanical wear.

SERIOUS RIVER POLLUTION IN SCOTLAND.

During the recent drought the necessity of purifying some of the rivers in the Border district of Scotland was very obvious. In one short stretch of the River Ettrick, extending for about a quarter of a mile opposite the burgh of Selkirk, five spinning mills, four dyeworks and seven tweed-weaving factories were discharging waste liquids into the river or into a mill lade which in turn discharged into the river; while the burgh gas works stand on the edge of the mill lade. The river being very low these polluting materials were not carried away as is usually the case, and the result was an accumulation of the waste matters from all the works and the poisoning of large numbers of fish.

SAND TRAVEL IN HARBORS.

At the Birmingham meeting of the British Association a paper by Ernest R. Matthews, entitled "Harbor Projections and Their Effect Upon the Travel of Sand and Silt" was read to the Engineering Section. The author pointed out that any seaweed projection on a coast has the effect of arresting or more or less checking the travel of the sand, whether the projection is a groyne extending to low-water line, a breakwater, a harbor pier or arm of 1,000 ft. in length, or a natural promontory extending some miles from the coast line. In the case of harbor arms extending at right angles to the coast, this obstruction (especially on a sandy shore) impounds the travelling material on one side and often causes serious erosion on the other side. The sea-front at Yarmouth, Shoreham, Lowestoft and other places has extended seaward during the past half-century, the first mentioned, at an average of 300 ft., due almost entirely to the construction of the harbor.

At Madras (India) 650,000,000 cu. ft. of sand have accreted on the south side of the harbor within a distance of three miles of the harbor, and 450,000,000 cu. ft. of land has been eroded in the north side within a similar distance. The Madras authorities are now contemplating an extension of the harbor seaward at an estimated cost of about $15,000,000 in order to reduce the extent of the silting of the harbor.

The only method of escaping from the impounded material seems to have been to periodically extend the arm of the harbor further seaward, as proposed for Madras. This means a tremendous cost, and the results are often not satisfactory, for as the pier is advanced the shore also advances. It has been suggested that openings should be left through the shore ends of the harbor arms, for the sand to pass through. This is not practicable, for immediately the travelling material passes through the opening the wave behind it does not possess sufficient force to move the material through, especially where the width of the harbor is considerable.

The author suggested that in order to modify this trapping of the sand the piers should not run out at right angles to the coast, or approximately so, but on the side facing the direction of the travelling material should project from the coast at an angle of 45 degrees. The additional area thereby enclosed by the harbor piers could be utilized, among other purposes, for that of wharfage. The travelling material would, he stated, pass around the harbor projection if the plan of the harbor was on these lines, and would supply the coast on the lee side of the harbor with a natural protection of sand and shingle.

In another paper, entitled "The Transport and Settlement of Sand in Water and a Method of Exploring Sand-Bars," and illustrated by experiments, Dr. John S. Owens dealt with certain phenomena accompanying the movement of sand in water.

Sand ripples were shown travelling under the influence of a current; the grains being swept by the current from the back of the ripple and deposited on its face, the ripple-form moved forward with the current by a process of erosion of its back and accretion of its face. This was demonstrated by means of a trough with semi-circular ends and a longitudinal partition in the middle, thus forming two channels. The water was made to circulate up one channel and down the other, and the movements of the ripples were seen on the sand forming the bottom. The formation of quicksands was illustrated by means of a tank containing ordinary sea-sand, and it was shown that when water was caused to flow upwards through the sand the latter acquired all the properties of a quicksand and swallowed heavy bodies placed thereon. The effect of obstacles lying on a sandy bed in the path of a current was demonstrated by means of a model. Stones, models of piles, and improperly made groynes were placed on sand in the path of a current in a small glass tank, and localized erosion around the obstacles resulted in each case owing to the deflection and increased local velocity of the current. The curious effect of suspended matter on the specific gravity of water was illustrated by means of a glass cylinder containing water in which sand was shaken up; it was shown that while the sand was suspended the specific gravity, measured by a floating hydrometer, was raised above that of water. The influence of such a rise in specific gravity in increasing the intensity of impact of the water, and consequently its erosive power, was indicated.

A tall glass tube filled with water was exhibited, and in this bodies of different shape were allowed to sink; in every case, whether discs, rectangular plates or rods, the bodies settled in the position offering the greatest resistance to movement. It was shown that this property might result in more rapid settlement in running than in still water, and also in a cleavage in sedimentary rocks.

A model of an instrument for exploring sand-bars and river-beds, which was also shown, consisted of two tubes arranged concentrically, connected at the top, but separate at the bottom. A cock-and-hose attachment was fixed on the upper end of the inner tube, and a second cock, with a spout, communicated with the top of an annular space between the two tubes. At the bottom the inner tube ended a short distance above the end of the outer tube. Water, if forced down the inner tube, must pass out at the bottom when the cock to the annular space was closed; in this case the instrument sank if placed on a sandy bottom. When at any desired depth the cock to the annular space was opened the water returned up the outer tube, carrying a sample of the sand with it, and delivering the sample from the spout. By means of this instrument the depth and nature of bars and shoals might be easily ascertained.

HAMMERED PISTON RINGS.

If the rings on a piston are not accurately turned and ground, so as to make a steam or gas-tight joint between it and the cylinder walls, the efficiency of the engine will be impaired, power will be lost, and consequently fuel will be wasted. If the tension of the ring is not approximately the same at every part it will exert greater pressure in one direction than in another; the cylinder will be worn out of shape and soon require re-grinding or re-boring. Further, an unevenly-tensioned ring produces friction, and so causes loss of power.

A special form of piston ring which is claimed to possess many advantages is being made by a patented process, by which the rings are of the same thickness throughout their periphery; and as they are machined concentric, they are seated uniformly in the grooves provided in the piston. Special plant is, of course, necessary for the manufacture of the rings, and a patented system of hammering is used whereby, it is stated, the spring action of the concentric rings can be reduced to a minimum without affecting their efficiency. The result of the hammering is to ensure a perfectly even and constant pressure on the walls of the cylinder. The rings, which are of cast iron, are accurately ground after hammering and are supplied ready for use.

LOCK WORK ON THE PANAMA CANAL.

THE placing of concrete in the locks of the Panama Canal has covered a period of approximately four years. It began on August 24, 1909, at Gatun; on September 1, 1909, at Pedro Miguel; and, with the exception of 102 cubic yards laid in 1909, at Miraflores in July, 1910. The end of the fourth year sees the concrete work at all locks practically completed.

Mass masonry at Gatun and Miraflores Locks was completed in the latter part of May, 1913, and at Pedro Miguel Lock, several months earlier.

The work at Gatun since September 1, 1912, as summarized in The Canal Record, has comprised building the lower wing and approach walls, and completing the upper approach wall, which was within three per cent. of completion a year ago.

At Pedro Miguel, during the same period the approach and wing walls at the upper end and the east wing wall at the lower end, were built, and the lower approach wall was extended about 300 feet.

At Miraflores, the lower lock, which was about half done on September 1, 1912, was brought to completion, and the wing and approach walls at both entrances were begun and completed.

Recent and future concrete work at the locks embraces a multitude of relatively small finishing operations around machinery and tracks, etc. Portable mixers are being used in the remaining construction. All of the large mixing and placing plants have been closed and are being dismantled.

Lock Gates.—Over half of the material in the lock gates was erected during the past 12 months. On September 1, 1912, the total quantity erected at all locks was 24,787 tons, or 42 per cent. of the required 58,000 tons; to-day, the lack of completeness of erection is designated by fractions of one per cent. Since September 20, the gates of the west flight at Gatun, and the east flight at Pedro Miguel, have been ready for the passage of vessels, and the west flight at Miraflores Locks was practically completed by the end of the month. All gates at Gatun and Pedro Miguel are to be mechanically completed by January 1, and at Miraflores by March 1, 1914.

Gate works at the locks began on March 21, 1911, in preparing the bearings for the upper guard gates at Gatun. The erection of these leaves began on May 17, 1911, and they were the first to be swung closed. This occurred on August 4, 1912, and the footwalk over them was completed in September, 1912. A year ago, all the leaves in the upper and intermediate levels at Gatun had been erected to full height, and work had just begun on the safety gates in the lower level and the lower guard gates. The first girders for these eight leaves were placed on August 29, 30 and 31, 1912; the lower guard gates were closed, and sea water admitted against them, on June 14, 1913. On September 1, 1913, erection, reaming, and riveting for the gates of Gatun Locks were all within less than one-half of one per cent. of completion.

At Pedro Miguel, gate work began at the upper guard gates, on August 7, 1911. On September 1, 1912, these gates had just been closed, the skeletons of all leaves were at full height, and those in the upper level had been sheathed. To-day, erection and reaming for all gates are within one per cent. of completion, and the finishing work is over 80 per cent. completed.

At Miraflores Locks, work on the gates began first on the upper guard gates and the safety gates of the upper level, in August, 1912. The upper guard gates were closed about the middle of June, 1913, and the lower guard gates on August 20, 1913. At present, all 28 leaves have been erected to full height, reaming is 98.5 per cent. completed, riveting, 90 per cent., and finishing, about 65 per cent. completed.

Emergency Dams.—The emergency dams are to be held in reserve for exigencies if the lock gates should get beyond control and allow a rush of water through the flight. The floating caisson dams are for use only when the water is under control, and are not attached to the lock structures; the first of these is now under fabrication at the Union Iron Works at San Francisco, and will be towed to the Isthmus when completed.

The placing of steel in the emergency dams began in August, 1912, with the laying of the circular track and pivotal base for the east dam at Gatun. Erection of superstructure proceeded directly thereafter and the dam was completed, except for final painting, in May, 1913. The contractor, the United States Steel Products Company, began the final operating tests on May 20, under supervision of testing engineers of the Canal Commission. Erection of the west dam at Gatun began about the middle of November, 1912, and tests were completed on August 15, 1913. This dam was swung across the chamber, and its wickets and gates dropped into place, in 35 minutes. Trained operators will be able to do this in 30 minutes, or less.

At Pedro Miguel, erection of the west dam was undertaken first, beginning on February 1, 1913. This structure was first swung across the approach chamber on September 2, and is now under test. Erection of the east dam, which began on April 1, is about 98 per cent. completed, and the structure will be ready for testing by the time the tests on the west dam are completed.

The Miraflores east dam erection began on June 1, and that for the west dam on July 1. All material for all of the dams, weighing a total of 13,400 tons, had arrived on the Isthmus by August 1, and erection was 80 per cent. completed on September 1, being practically confined to the two dams at Miraflores. These are slightly lighter than those at Gatun and Pedro Miguel, because of the lower head of water against which they will be used; each of them weighs approximately, 1,987 tons, as compared with 2,305 tons at Pedro Miguel and Gatun Locks. The east dam at Miraflores will be finished the latter part of October, and the west dam in November.

Operating Machinery.—In addition to the masonry, gates, and emergency dams there is a great amount of auxiliary machinery contained within the machinery rooms and operating galleries of the walls or in the culverts. This apparatus embraces the rising stem gate valves, which control the flow of water in the 18-foot culverts at the bottoms of the side and centre walls; the cylindrical valves, controlling the 6-foot culverts which run laterally from the wall culverts and pass water to the lock chambers, through the floors; the auxiliary culvert valve machines, which control the flow through a short auxiliary culvert designed to maintain the water at the same elevation on both sides of the upper guard gates; the guard valves and machines, controlling the intake of water into the side wall culverts at the upper end of the locks; the miter gate moving machines, to swing the leaves of the gates; the miter forcing machines, to draw the leaves tightly together when closed, and prevent leakage; the mechanisms which cause the handrails on top of the leaves to fold down when the leaves are swung back into their recesses in the walls; the pumps for unwatering sumps in the miter gate leaves, and in the pits

of the fender chain machinery rooms; the machinery for actuating the fender chains, at all upper and lower guard gates, and at the intermediate and safety gates in Pedro Miguel Lock and upper chambers of Gatun and Miraflores Locks; the tracks and conductors for the towing locomotives; and the posts for the illumination of the locks.

Ancillary to the foregoing is an elaborate system of electrical generation and transmission to the transformer rooms in the lock walls, from which power is distributed to the various motors, and the interior and exterior lights. The opening motors number 334 at Gatun Locks, 206 at Pedro Miguel, and 252 at Miraflores; and at each set of locks their operation will be managed from a central control house.

All of this work, as well as the installation of operating machinery in the spillways for Gatun and Miraflores Lakes, controlling 22 "Stoney" gates, each 47 feet long by 19 feet high, has been carried on by the erection subdivision of the First Division of the Office of the Chief Engineer.

SANITARY SURVEY OF RIVERS.

By R. O. Wynne-Roberts,
Consulting Engineer, Regina.

A BULLETIN of the Illinois State Laboratory of Natural History, published last June, comprises an article by Mr. Stephen A. Forbes, Ph.D. LL.D., and Mr. R. E. Richardson, A.M., which is a compilation of scientific information on the biological and chemical analyses of the Illinois River. It is well known that Chicago constructed a huge drainage canal at a cost of $50,000,000, including power-plant, to dispose of its sewage by dilution. This sewage discharges into the river near Lockport.

The article is comprehensive, covering over one hundred pages, and the reader who desires details that are not contained in the following review is advised to obtain a copy of the bulletin. As much attention is now being paid to the purification of rivers, the writer has deemed it of interest, and perhaps of service, to review the work done by the authors of the article, which is largely referred to, in the following paragraphs, by extracts and references:—

"The Illinois River is peculiarly characteristic of the State of Illinois, and, next to the prairies, is its leading natural feature. The level richness of the central plateau of the State is reflected in the turbid waters and the broad, sluggish current of the stream; and its wide bottom-lands, originally covered with huge trees, completely flooded when the river is highest, and holding many marshes and shallow lakes at its lowest stages, are a relic of the time, not so very far remote, when the limpid waters of the Great Lakes rolled down its valley in a mighty flood on their course to the southern gulf. It was not an accident that this river was the first great artery of transportation into and through the State, or that the first colonial settlement and the first fortified post in Illinois were established on its banks. After the railroads had deprived it of its commerce it was discredited and neglected for many years, and the second city in the country and the second city in the State have long used it as a mere convenience for the discharge of their organic wastes.

"These are temporary conditions, however, and the time seems now at hand when the people of Illinois will learn to appreciate and develop this great gift of nature in the various directions in which it may be made to serve their interests and their pleasures. Its frequently beautiful and occasionally picturesque scenery is attracting more attention every year; and when, as is sure to happen in due time, a superior highway follows its course between Chicago and St. Louis; when the attractive building sites on its banks are relieved, as they now might generally be, from the midsummer plague of mosquitoes; when its most interesting situations are converted into parks, and its fisheries are protected and enriched by means of State reservations for the breeding and feeding of fishes; and when, as must eventually come to pass, it becomes once more an indispensable central link in a principal line of traffic between the Great Lakes and the Gulf, it will take for all time, for the State at large, the place which Lake Michigan now holds for our greatest city.

"The senior author of this work began work as a biologist, on Illinois River problems, some thirty-six years ago; and the junior author has virtually lived on the river for purposes of investigation during the last four years. The Natural History Survey of the States has published in the meantime more than 2,500 pages of contributions to its biology; and it is now rounding this work to a close, and bringing its results to bear, in practical ways, upon the economic problems most pressing and important at the present time.

"**Objects of the Investigation.**—The Illinois River work of the Natural History Survey, pursued at irregular intervals since 1877, became virtually continuous at Havana for five years, from April, 1894, to March, 1899, after which it seemed expedient first to diminish, and in 1903 to suspend, field operations in order that more important scientific results might be organized, reported, and published.

"The opening of the Chicago Drainage Canal in 1900 was a revolutionary event in the biological history of the river; and, as the most important period of our earlier work was that immediately preceding this event, an examination of its consequences to the general system of aquatic plant and animal life was an important part of our object in recommencing systematic study. As the Illinois is a rather peculiar member of the great Mississippi River system, it was also much to be desired that comparative studies should be made on the life of the more closely related companion streams; and, as the Illinois is economically one of the most productive rivers in the United States, it was evidently time to study the subject of the conservation and possible increase of its values in the light of the knowledge we had gained, and intended to gain, of its physical, chemical and biological conditions and requirements.

"The reports of the work of the earlier period were largely on the minute plant and animal life of the stream —its so-called plankton—which forms a considerable part of the food of many kinds of fishes, and nearly all the food of the young of almost every kind; and the plankton product of the waters of the Illinois under the new conditions, as compared with those prevailing before the opening of the sanitary canal, was one of the first topics to commend itself to us for careful study. Involved in this subject of food production for fishes, river mussels, and other useful aquatic animals, was the economic effect of a great increase in the flow of the stream, the rise in its levels, and the consequent expansion and longer continuance of its overflows, which, there was reason to suppose, might so increase the food supply and enlarge the breeding and feeding grounds of fishes as to increase the fisheries products of the stream. It was also a matter

of interest and importance to learn the effects, both direct and indirect, of the increased inflow of sewage by way of the sanitary canal and the Des Plaines, upon the fishes and mollusks of the waters of the stream and systematic collections from it at various points on its course, under various conditions and at different times of the year."

The investigations of special interest to municipal engineers are those commenced in 1911, when chemical determinations and biological collections for an analysis of seasonal conditions on the upper Illinois and in related waters, were begun July 18th, and repeated at frequent intervals until Dec. 13th. Similar trips were made in Feb. and Mar., 1912, for a study of winter conditions; and in July, 1912, an elaborate series of oxygen determinations was made for the entire length of the river. Aug. 21st to Oct. 12th two such series were obtained for the upper Illinois; and in Nov. two more, for the whole system, with comparative tests for the Mississippi, below and above the mouth of the Illinois. The situations thus brought more or less closely into comparison were the sanitary canal at Lockport, the Des Plaines River at the same place and at its mouth (Dresden Heights), the Kankakee, just above its mouth, and the Illinois River at Dresden Heights, Morris, Marseilles (both above and below the dam which crosses the river there), Ottawa, Starved Rock, Peru, Hennipin, and Chillicothe. The distances of these points from the mouth of the Chicago River are approximately as follows, in miles: Lockport, 35; Dresden Heights, 53; Morris, 62; Marseilles, 80; Ottawa, 86; Starved Rock, 95; Peru, 102; Hennepin, 116; and Chillicothe, 145, ninety-two miles of this last-mentioned distance being on the Illinois River itself.

"Finally, in Mar., 1913, samples of the bottom sediments were collected from all the five Illinois River dams, and from some other points in the main channel, for physical and chemical examination, with a view to ascertaining the condition of the river bottom when the river water has been for some months at or near the freezing point."

Messrs. Forbes and Richardson, for reasons stated, take the years 1897-8 and 1909-10 as the basis of comparison of the plankton production and quality of the waters. The above years are before and after the opening of the Drainage Canal, and, as in the former year the plankton was 3 c.c. per cubic metre of water and in the latter 5.07, "we have sufficient reason for concluding that the plankton production of the stream has been largely increased per unit of volume as a consequence of the opening of the drainage canal, and that, so far as the evidence goes, the ratio of the present yield to the former is at least as 5 to 3. Remembering, further, that the most important plankton product is that of the spring months, when the young fishes are hatching from the egg and are dependent upon the plankton organisms for their earlier growth as fry, we find a special significance in the fact that the plankton yield of the river for the months of March, April, May and June was 2.85 times as great in 1910 as it was in 1898.

"If to these facts concerning the increase, in recent years, in the percentage of plankton contained in the waters of the Illinois, we add those concerning an increase in the average volume and area of the waters themselves, we shall see that their total plankton must have been many times multiplied, and that the fisheries of the stream should feel the effects of this greater abundance of this important element of fish food.

"The importance of an abundance of organic matter in the water as a means of producing a rich plankton is, in fact, so well known that growers of pond fishes in Europe deliberately manure their ponds to increase the supply of food for their fish; and there is considerable evidence, also, that the plankton of the Elbe is largely increased by the sewage of Hamburg and Altona poured directly into that stream."

The Des Plaines River near Lockport in Sept., 1911, was heavily loaded with sewage wastes, and septic organisms were at the maximum. "The most conspicuous of these was the well-known fungo-bacterium, *Sphœrotilus natans*, a filamentous form, which grows in long, loose, hanging tufts and branches in septic and polluted waters. The stony bottom of the Des Plaines, between Lockport and Dresden Heights, was carpeted with this plant, and with it were associated a considerable variety of *Protozoa*, all characteristic foul-water species."

Sir Rupert Boyees, F.R.S., the eminent English biologist and analyst, when giving evidence at the High Courts of Justice of England in an important Welsh river pollution case, stated that there are two kinds of sewage fungus—*Sphœrotilus* and *Leptomitus*. The first was probably known by the obsolete name of Beggoatoa Alba. It is like flock or cotton fluff, and flows in the water near the surface. It usually sticks to twigs in preference to stones and gravel, and the information given by Messrs. Forbes and Richardson is interesting in this respect.

The authors next describe the condition of the Illinois from Dresden Heights to Marseilles. "In July, 1911, it was in an especially saprobic or septic condition, culminating at Morris, if we may judge by the number of septic organisms in the plankton." "The most abundant of these were Sphœrotilus natans, detached filaments of which made about 90 per cent. of the number of the plankton organisms in this and the following section." "Flagellate, colorless Protozoa, which feed upon bacteria, were also extremely abundant in this section. The largest number of *Oikomonas termo*—a bacterium-eating protozoa—were found at Marseilles above the dam."

"In the Starved-Rock-Chillicothe section of the river the outstanding feature of the plankton was the marked increase in diatoms and other chlorophyll-bearing unicellular organisms, plant and animal, which became sufficiently abundant by the time Hennepin was reached to give the water a characteristic greenish tinge. This greening up of the water below La Salle was noticed, in fact, on a down-stream trip in June, 1910, and was conspicuous to the naked eye in both 1911 and 1912, most noticeably so at lowest water levels."

The dissolving oxygen of the water in the sanitary canal at Lockport ranged from 0.4 of one part per million on Nov. 1st, 1912, to 9.3 parts per million on Feb. 17th, 1912. As temperature has an influence on oxygen-dissolving capacity of waters, the above figures require to be reduced to the percentage of saturation at the temperature observed at the time when the test was made. Consequently, the first was equal to 3.5 per cent. of oxygen saturation and the latter equal to 64.9 per cent.; the average of six observations made was 4 parts per million, or 31.9 per cent. of saturation. Fish were found, but these were either dying or dead, overpowered by the toxic contents of the stream. There were no signs of animal life, and the only insects seen in or on the water were a back-swimmer (*notonecta*) and several water-boatmen (*corixa*), both of which, as they breathe air, can afford to be indifferent to the deficiency of oxygen.

(To be continued.)

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ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

International Highways 621
Mathematics as an Engineering Study 621
Concrete Construction 622

Leading Articles:

The Winnipeg-Shoal Lake Aqueduct 606
Specifications for Concrete Masonry in Highway Bridges 610
Electric Drive in Machine Shops 612
Production of Poles and Cross-Ties, 1912, in Canada 615
Sand Travel in Harbors 617
Lock Work on the Panama Canal 618
Sanitary Survey of Rivers 619
A Departure from Common Practice in Sewage Disposal 623
A Canadian Electric Steel Furnace 627
Highway Accounting With Special Reference to Maintenance 630
The Service Railway of the St. Lawrence Pulp and Lumber Corporation 631

Coast to Coast 632
Personals 634
Coming Meetings 634
Railway Orders 73
Construction News 76
Technical and Municipal Societies 94

INTERNATIONAL HIGHWAYS.

It is to be hoped that Deputy Minister Campbell will be successful in his efforts to persuade Premier Borden to appoint a commission to co-operate with the Joint Congressional Committee on Road Legislation of the United States. Such an international body could do a vast amount of good work in reaching a sound understanding that would make many great international highways possible in the future. It would be highly advantageous to have equitable, uniform road legislation in all the Provinces of Canada and the States along the Canadian border. Road construction could be correlated so that the important roads of each Province would connect with the important roads of the other Provinces and of the adjoining States. This would greatly promote the trade and friendly relations between the two countries. The commission might also consider allowing United States autoists to tour Canada with the minimum of trouble and expense at the border. It is for the benefit of the Dominion to make the roads as inviting and pleasant as possible to United States autoists. The tourists are frequently capitalists, and a better knowledge of Canada would cause many of them to invest more money here.

MATHEMATICS AS AN ENGINEERING STUDY.

The value of a thorough study of mathematics in engineering training is a much-discussed topic. An engineer does not advance far into his profession before he contracts the thought and dwells reflectively upon it.

No science is so intimately connected with engineering as mathematics. Arithmetic, geometry, algebra and trigonometry are regularly employed, while an amalgamation of the science with physics has produced the derivation of stresses, moments, radii of gyration, energy, etc., that form the daily food for engineering thought and accomplishment. Yet, of the science of mathematics the average engineer has forgotten, five years after he graduates, fully two-thirds of the amount he had, at one time, carefully mastered; and when one reviews its scope he is surprised to find the infrequent applications of its higher attainments. It will be noted that the calculus is used comparatively seldom, and a text on analytical geometry finds little entertainment in the routine practice of an engineer. This is apparently as it should be, though, and memory need not be brought to task to have the old and intricate pathways repaved.

Yet the student struggle in the mathematical gymnasium goes on apace, and the study forms the chief channel for his intellectual development. It is, therefore, timely to acquaint those of our readers who are preparing for entrance into the profession, with the necessity of such devoted attention to a study, much of which will later be forgotten.

This is best answered by suggesting to the student of engineering that, when he becomes a graduate, he will take time to reflect upon the mental training derived from it, which is the sum of the necessity for a considerable part of the study. Again, like many commodities that might be mentioned, he will find that when he needs its application he needs it badly. Herein lies a vital point. Though an engineer, eminently successful, may have forgotten everything but the bare principles, a clear

knowledge of how to apply them to his work spells its importance to him.

The young engineer must remember that engineering is not merely the getting and holding of jobs, or the handling of a big contract. There is the *science* as well as the *practice* of engineering, and experience shows that the men who have played a prominent part in the development of both have seldom been those who have had an aversion to mathematics.

While there is an excuse for the scarcity of purely mathematical treatises in an engineer's library, in that mathematics is a member of the family of "pure" sciences, it is not to be inferred by the young engineering student that the owner has not still a working acquaintance with the principles, at least, of the science.

CONCRETE CONSTRUCTION.

In every line of construction in which Portland cement has been used, the first objection raised by the layman has been that such skilled construction methods are necessary that frequent failures are likely. Because concrete looks so unstable when first poured, and takes years to reach its height of perfection, it is likely to be condemned even by city commissioners. So, it is not surprising to find many officials vigorously opposing concrete roads because "it requires such a lot of care and watching to get them laid right."

But are faulty construction methods or dishonest contracting any more fatal to concrete roads than to roads of any other type? We hold no brief for concrete roads. As a matter of fact, we believe they will have their limitations of usefulness, just as have macadam and brick. But some of the concrete roads that have been built are so excellent that concrete—properly constructed—must be given place as a paving material worthy of consideration along with other materials. It must not be tabooed merely on account of poor contracting being likely to ruin the road.

Dishonest, careless or incompetent construction can as readily spoil sheet asphalt, brick, bituminous macadam or other pavements, as it can concrete.

EDITORIAL COMMENT.

Dr. J. A. Amyot and Mr. F. A. Dallyn, C.E., water bacteriologist and chief engineer, respectively, of the Provincial Board of Health, have reported as follows concerning the Thirty-One Mile and Pemichangaw Lakes scheme of water supply for the city of Ottawa. (See *The Canadian Engineer*, Oct. 16th, p. 595):

"Investigation of the waters and catchment basin of the proposed water supply for Ottawa at Thirty-one Mile and Pemichangaw Lakes, together with the perusal of the report of Sir Alexander Binnie, convinces us of the feasibility and value of the scheme. We have no hesitation in recommending its approval by the provincial board in preference to any other source and supply heretofore proposed."

* * * *

A couple of weeks ago our esteemed contemporary, "Canadian Machinery," published a proposed design for a new Machinery Hall at the Canadian National Exhibition. The idea is excellent. There certainly should be a new machinery building. The reproduction of the suggested design in our columns is unnecessary, as it is entirely unofficial, but we desire to support heartily the general scheme.

The plan offered by Mr. Hare in "Canadian Machinery" may possibly meet the needs of the machinery firms, but the Exhibition's architects will likely further improve upon it. We would suggest to the Exhibition Board that, when the design of the building is under contemplation, they consult a score or more of the leading machinery manufacturers and obtain their views of their own requirements.

LETTER TO THE EDITOR.

Electrification of the Canadian Northern Tunnel.

Sir,—In your issue of October 9th, you say, on page 571: "Of all the great railway systems of the world using electricity for the operation of their terminals, there is not one which has not adopted this system only after previously using steam. The Canadian Northern terminal in Montreal, therefore, will be the first to be operated entirely by electricity from the commencement. No steam locomotive-drawn trains will enter the tunnel. Specially constructed electric locomotives will be exchanged for the steam engines at the Back River yards."

A few days ago some local newspapers, commenting on the contract awarded to the Canadian General Electric Company for the electrification of the Canadian Northern terminal in Montreal, also stated that this would establish a record, being the first time any railway terminal would be operated by electricity from the beginning. This, of course, is quite wrong, as it is exactly what was done on the Pennsylvania Railroad when, in 1901, it decided to bring its trains to New York, exchanging steam engines for electric locomotives at Newark, some 12 miles away. Aside from the construction and electrification of a new line and of subaqueous and land tunnels it included the construction of a new terminal which, of course, was operated entirely by electricity, as it should be, from the commencement in January, 1910.

Long before this, however, the same had been done in Paris. The Orleans Railway Company decided in 1897 to extend its lines 2.5 miles from the Austerlitz station to a better and more central location in the city of Paris, to its present terminal called the Quai d'Orsay station. This involved the construction of 2.5 miles of tunnels and of a new terminal which were operated by electricity from the beginning of operations in 1899.

Far from changing from steam to electricity, these improvements were designed for electric operation and nothing else.

Mr. A. J. Cassatt, President of the Pennsylvania Railroad, when in Paris in 1900 was so well impressed with the electrical operation of the Quai d'Orsay station and of the practicability of exchanging locomotives on the outskirts of the city to bring the trains in a new terminal that he began at once to orient the policies of the Pennsylvania in that direction.

Many books and technical papers have described these undertakings which it is needless to enumerate in detail. I might, however, mention among them Revue Générale des Chemins de fer et des Tramways, Nos. of February and November, 1898, and of May and July, 1901; and Transactions American Society of Civil Engineers, Volume XLI., LXVIII. and LXIX.

Yours very truly,

PAUL SEUROT.

Montreal, October 13th, 1913.

A DEPARTURE FROM COMMON PRACTICE IN SEWAGE DISPOSAL.*

By Alexander Potter, C.E.,
Consulting Engineer, New York City.

THE city of Springfield, Mo., is located two hundred and forty miles southwest of St. Louis, among the foothills of the Ozark mountains, 1,400 feet above sea level. During the last decade the growth of the city has been very rapid. The population in 1900 was 23,000 and in 1910 it was 34,000. The present estimate is placed at 46,000. The area of the city is fourteen square miles.

The built-up part of the town is sewered and recently sewer extensions have been built into the fast growing outlying districts of the city. Up to the present time over 105 miles of public sewers have been completed.

A ridge running east and west divides the city into two distinct drainage areas, known as the northern and the southern areas. The northern area, which is the smaller of the two, takes in about two square miles and is drained by a number of small streams which discharge into the Sac River. The southern area takes in all of the thickly populated districts, including the new addition south of the city, and drains southwesterly into Jordan and Wilson creeks, tributaries of the James River.

Necessity of Sewage Disposal.—During the greater portion of the year the natural flow of all the streams is so small that they are unable to assimilate the large quantities of sewage that are constantly discharged into them. In the spring of 1911 the nuisance from raw sewage discharged into these streams became so serious that the city authorities realized that unless immediate steps were taken to abate this nuisance the city would make itself liable for damages.

Before calling in an engineer to design the much-needed improvements to the sewerage system, the city appropriated $100,000 to construct sewage treatment plants at two sewer outlets. After appropriating this money the city proceeded to call for bids upon contractors' plans and specifications. This plan was abandoned, however, before the contract was let, and the city retained the writer to design and supervise the necessary sewage disposal plants.

Outline of Improvements.—The ridge extending east and west through the city made it necessary to construct two sewage disposal plants. The most logical location for the sewage disposal plant for the northern district was near Doling Park, directly north of the city limits at the mouth of the existing sewer. In the southern district the ordinance called for the construction of a sewage disposal plant at the mouth of the main outlet sewer. To construct a sewage disposal plant at this point was not recommended. The site is low, subject to inundation, and pumping would have been necessary.

On account of the small quantity of water flowing in Wilson and Jordan creeks during the greater portion of the year, the treatment of the sewage in settling tanks alone would not give a sufficiently pure effluent to abate the nuisance. Some additional treatment, such as contact beds or intermittent filters, was therefore absolutely necessary. To obtain a head at the southern outlet sufficient to operate a filter would back up the sewage in the main outfall sewer for a distance of at least 3,500 feet. This sewer, which is an egg-shaped brick sewer, 28 inches x 42 inches, was not strong enough to withstand any internal hydrostatic pressure without rebuilding. Above its mouth the outlet sewer for a distance of 3,200 feet has a fall of only 4.0 feet; at this point there is a two-foot drop and the grade increases to 4.1 feet per thousand. It was recommended that the treatment plant be built at the point where this change in grade occurs. To obtain at this point the necessary head to operate the plant only 2,000 feet of sewer would be surcharged. For a distance of 1,436 feet, that portion of the length where the hydraulic gradient falls above the natural surface of the ground, the existing egg-shaped brick sewer was replaced with 36-inch reinforced concrete pipe of the Meriwether type, designed to resist this pressure. This reinforced concrete pipe has been found very satisfactory

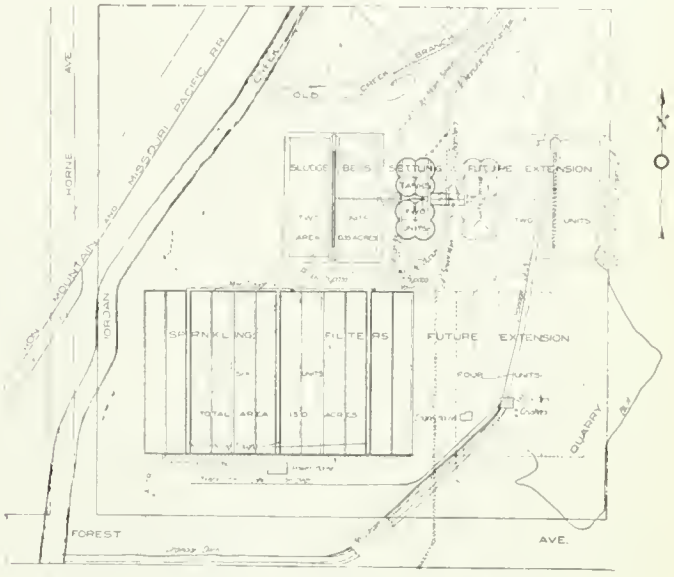

Fig. 1.—Location Plan of Southern Sewage Disposal Plant.

under the head to which it was subjected, viz., from 3 feet to 10 feet, and the line appears to be practically watertight. The existing sewer below the sewage disposal plant was not rebuilt and is used to convey the effluent from the plant to the outlet.

Type of Plant Recommended.—On account of the limited area available it was deemed advisable to use intermittent filters instead of contact beds. The ordinary type of sprinkling filter could not be used, as such a filter requires a head of at least five feet to operate the nozzles. Such a head could be obtained only by pumping. Mechanical distribution was therefore recommended. The distributor selected is operated with a head of only 12 inches.

Fig. 1 shows the general arrangement of the plant as built. It consists of a grit chamber built in duplicate, two settling tanks of the two-story type, a sprinkling filter divided into six units, each 53 feet 9 inches wide and 200 feet long, a sludge bed 0.35 acre in extent, and a final settling basin of 150,000 gallons capacity, located at the outlet, 3,600 feet from the remainder of the sewage disposal plant.

Grit Chamber.—The grit chamber is constructed in duplicate. The flow in the grit chamber is retarded sufficiently so as to retain only the suspended mineral solids

*To American Society of Municipal Improvements, 20th Annual Convention, Wilmington, Del., Oct. 7th to 10th, 1913.

which would interfere with the operation of the settling tanks. Provision is made so that during times of flood the back pressure on the outfall sewer can be readily and quickly relieved, thus scouring out whatever deposits may have formed in the 36-inch reinforced concrete pipe.

Settling Tanks.—Concrete, either plain or reinforced, is practically the only structural material available for constructing sewage settling tanks of the dimensions required for a large municipality. So far as the writer knows, the circular tank has been used in this country only in constructing the smaller units; for the larger sizes it has been customary to use rectangular construction. The rectangular form under all conditions, and especially when a large portion of the tank is above the surface of the ground, is a more expensive form to build. The Springfield sewage tanks are neither square nor truly circular. Each unit is four-leaf-clover shaped, consisting as it does of four semi-cylindrical segments 26 feet in diameter. This type of construction is peculiarly

done, and different stresses are used for the tie rods than are used for the shell, the shell, instead of being subjected to simple tension, will be subjected to bending. The tie rods are fastened to a steel plate 8 inches wide, ⅞-inch thick, bent to a 5-inch radius. By means of double nuts the reinforcement is kept in accurate alignment, which insures equal distribution of the tension among the larger number of tie rods.

The cylindrical segment must be free to expand in all directions. If the expansion is in any way prevented by interior construction, such as the troughs, false bottoms, beams, etc., the shell, instead of being under tension only as contemplated by the designer, will be subjected to heavy bending, often sufficient to cause the fracture of the structure. To permit of the free expansion of the shell when under internal pressure, all interior construction, except at the intersection of the ties and struts with the shell, is separated from the shell by expansion joints.

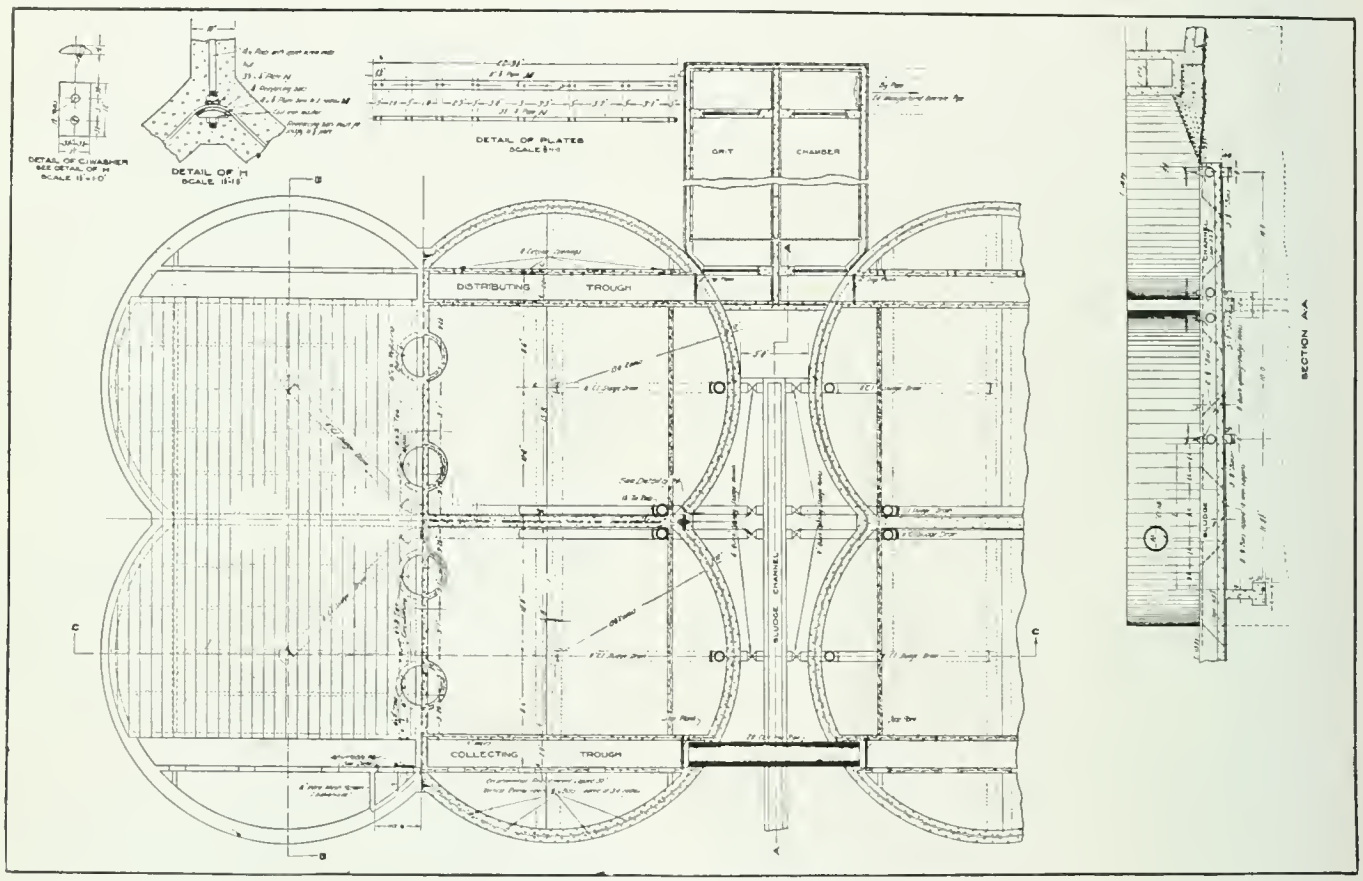

Fig. 2.—Plan and Details of Settling Basins.

well fitted not only to resist the water pressure from within, but also the earth pressure from without when the tank is below the ground and empty. The construction features of the tank are clearly shown in Figs. 2 and 3. The shell of the semi-circular segments is 12 inches thick, reinforced vertically with ¾-inch bars spaced 3 feet centres and circumferentially with ¾-inch square bars spaced so that the unit stress does not exceed 14,000 lbs. per square inch. The unbalanced tension at the point where the semi-circular segments intersect is taken up by 1¼-inch circular rods embedded in concrete struts, as show in detail H of Fig. 2.

The steel reinforcement in these ties is designed to to resist the tensile forces at the same unit stress as the circumferential reinforcement in the shell. If this is not

After passing through the grit chamber, the sewage enters the distributing trough, which is 2 feet wide, and holds, under normal conditions, about 2 feet of liquid. (See Fig. 3.) Eight 8-inch circular openings, placed in the sides of the trough near the bottom and on the side next the outer wall, admit the sewage to the settling compartment. At the end of the trough is an additional opening, placed so as to be but half submerged, so that whatever scum may tend to collect in the distributing troughs is carried over into the settling compartments. Each settling compartment has a capacity of 111,000 gallons, which gives an average period of retention of 1.4 hours when the plant is operated at 4,000,000 gallons, its capacity. The flow in the settling compartment is parallel to the direction of the slot. To prevent eddies

and other disturbances from being set up in the settling compartments which might interfere with the settling efficiency, the liquid is admitted to the settling compartment in a direction opposite to that which it must take in passing through the compartment. The clarified sewage leaves the settling compartment over eight 15-inch weirs discharging into the collecting trough.

The presence of the concrete struts in the settling compartment does not in any was interfere with the efficiency of the tank. Where necessary, they can be capped with wedge-shaped pieces of concrete having slopes of at least 45 degrees.

In that circular segmental area between the distributing trough and the shell of the tank, all of the floating matter is collected and forms a very heavy scum, requiring slight attention from the operator.

To increase the settling efficiency of tanks of the type described, the writer uses vertical circulation. The amount of sewage thus circulated is very small and does not exceed two per cent. of the total amount of the sewage treated. To accomplish the vertical circulation mentioned, a 6-inch cast iron main with four 4-inch circular openings is laid in the digesting chamber of each tank, about 6 feet above the slot. (See Figs. 2 and 3). This circulating main terminates in a small chamber located in the segment between the collecting trough and the shell, which chamber has an adjustable weir to control the flow from the digesting chamber into the collecting trough. In the Springfield plant the liquid thus drawn off is mixed with the effluent from the settling compartment and the resultant mixture is treated on the sprinkling filters. In other plants that the writer has built, the liquid drawn off from the digesting chambers is returned to the distributing troughs. Circulation such as that used in Springfield is especially of value when the sewage to be treated reaches the plant in a more or less septic condition. The plant has not been in operation long enough to determine the exact value of the circulation system.

Sludge Digesting Chamber.—The suspended organic and mineral matter which settles out of the sewage in the settling compartment, slides down the inclined plane through the 8-inch slots located in the bottom of the wedge-shaped settling compartments into the sludge digesting chamber. The sludge digesting chamber has a capacity of 150,000 gallons below the opening. The bottom of this compartment is formed by four cone-shaped depressions in which the decomposed sludge ultimately collects. To draw off the sludge, 8-inch cast iron sludge pipes extend down into these cone-shaped depressions, the sides of which slope at an angle of 30 degrees. The lower ends of these pipes terminate in bell-mouths supported on spiders. The sludge pipes are carried up inside of the tank to the top, giving ready access for cleaning. The sludge outlets, of which there are four for each unit, discharge under a 5-foot head into a reinforced concrete trough which conveys the sludge to the drying beds. The open channel used for conveying the sludge is preferable to the closed pipes generally used. In an open channel the sludge drawn off is at all times visible to the operator, and therefore the character of the sludge drawn off can be controlled far better than when a closed sludge conveyer is used. There is positively no odor during the operation of the sludge valves, either in the trough or upon the sludge beds.

The Springfield tanks have been found to be very economical in construction. Concrete and steel are used under ideal conditions to resist the pressures to which the tank is subjected. From the contractor's standpoint also the cost of constructing the tank is not excessive. To construct the conical bottoms of the digesting chamber a vertical pipe 2 inches in diameter was placed in the centre of each cone and firmly braced. From this pipe was suspended a wooden triangle adjusted at such an elevation that the hypotenuse described the interior surface of the cone when rotated about the pipe. The concrete was mixed rather dry and placed in 4-inch layers and tamped as much as it would stand, the last layer being carefully brought to a true line by the swinging template. A ½-inch coating of 1 to 2 mortar was applied to the interior of the cones to give them a smooth surface.

To construct the outside shell of the settling tank the contractor used wooden forms made in 5-foot sections 2 feet high. A complete set of inside and outside

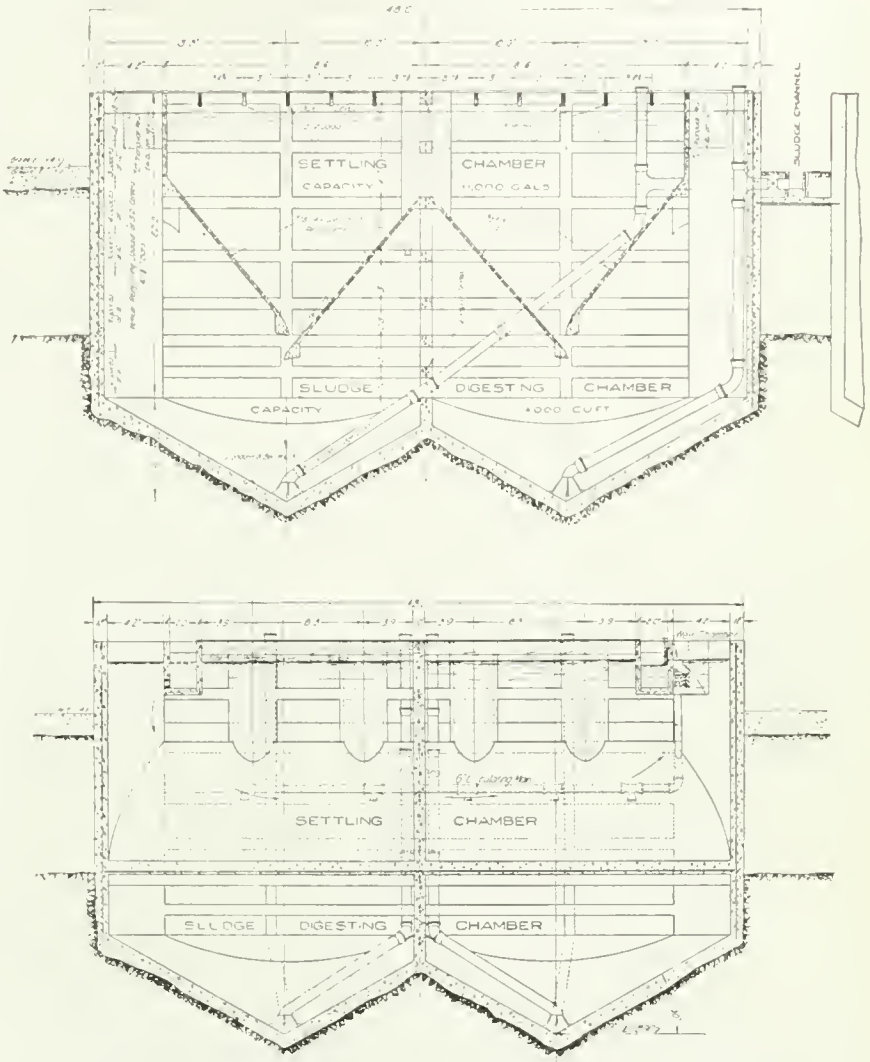

Fig. 3.—Detail Sections of Main Settling Tank.—Upper Section on CC., Lower Section on BB.

forms was built extending entirely around one tank, and a complete ring 2 feet high was poured at one time. The following day the sectional forms were raised 2 feet and wired in place at the new point. No trouble was found in shifting the forms and holding the walls plumb and true to line. The false bottoms of the settling compartments were built of No. 28—4-rib hyrib plastered with mortar to a thickness of 2½ inches. The circular ventilators also were built of hyrib and plastered with cement mortar, no other forms than templates being used.

Intermittent Filters.—To reduce the loss of head to a minimum power-driven mechanical distributors are used to distribute the sewage on the filters. There distributors were manufactured by the Ham Baker Company, of London, England. They are designed to distribute the sewage upon the beds with a loss of head, not to exceed 12 inches when the liquid is applied at the maximum rate of 720 gallons per square yard per day. Fig. 4 shows

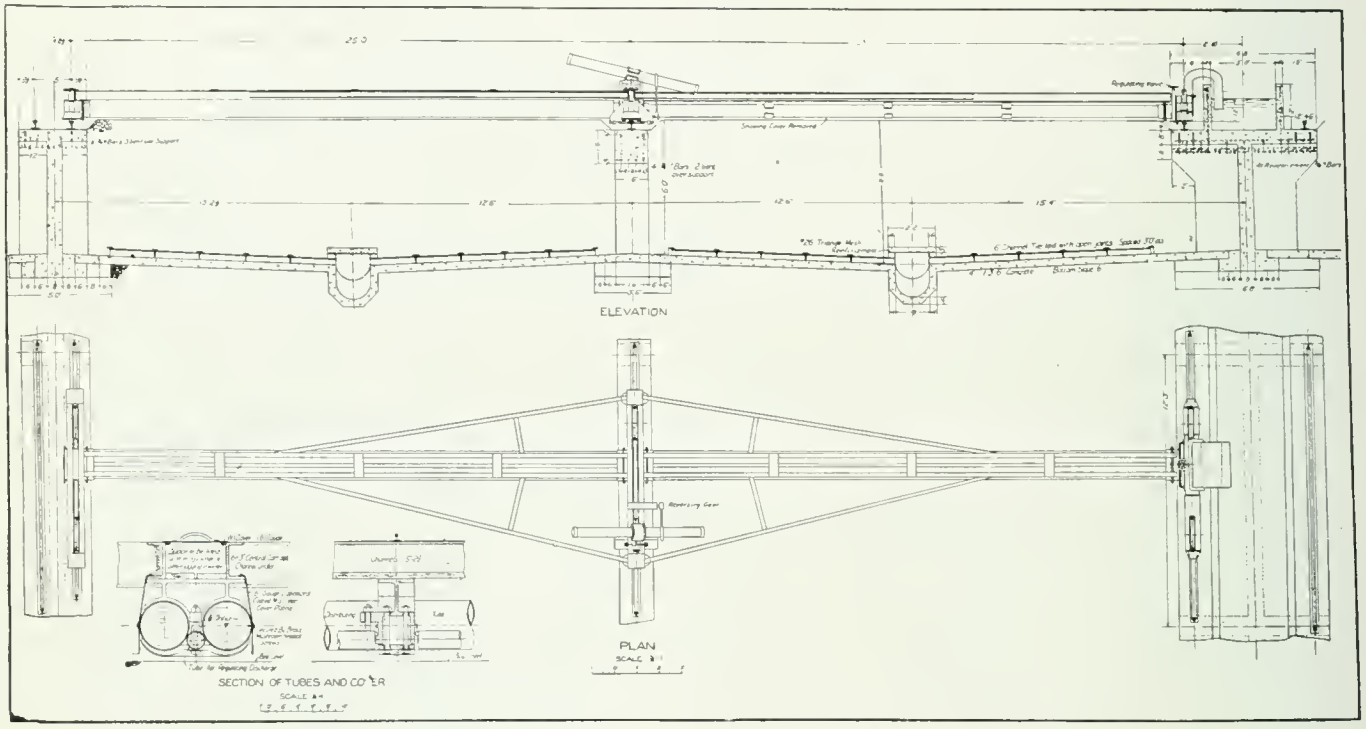

Fig. 4.—Section of Filter Unit Showing Traveling Distributor.

the construction of one of these distributors. Each distributor is supported on three rails, spaced 25 feet on centres. The length of the travel is 200 feet.

The effluent from the settling tanks is conveyed by a 24-inch reinforced concrete pipe to a main distributing trough located at the north end of the filters. The lateral distributing troughs which supply the traveling distributors are fed by 3-foot weirs from the main distributor. The object of these weirs is to insure a uniform distribution of liquid to the distributors. Fig. 4 also shows the construction of the sprinkling filters. The depth of the filtering material ranges from 6 feet 6 inches in the centre to 6 feet at the sides. The underdrains were not built as shown on the drawing. Instead of using 6-inch channel tile, the contractor was given permission to construct 6-inch semi-circular channels in the concrete floor and cover them with vitrified tile slabs. The main collectors are semi-circular in shape, 18 inches in diameter and of variable depth, the distance between them being about 25 feet. The rails on which the distributors travel are supported by concrete girders carried by piers spaced 12 feet, 5¼-inch centres. The area covered by each distributor is enclosed by an 8-inch concrete wall. The winter temperature of Springfield is sometimes so low that it may be questionable as to whether the traveling distributors can be successfully operated in extreme weather. Should the traveling distributors go out of commission or any of them break down, it is possible to utilize the filters or any unit thereof as a contact bed to be operated by hand, suitable gates being provided for this purpose.

Operation of Distributors.—Extending down the centre of the filters between two of the traveling distributors is a 3-foot rectangular conduit in which the normal depth of sewage is 16 inches. A cast iron siphon, 24 inches long and 8 inches in width, conveys the liquid from this trough to the distributor. This siphon is provided with a gunmetal air cock and brass air exhaust pump for starting the flow. The siphon discharges into the feed tubes, of which there are two. These feed tubes are made of wrought iron 3/16-inch thick and have an external diameter of 7⅜ inches. The feed tubes are supported at each end and at the centre by a cast iron carriage braced together by rolled steel beams so as to form a rigid structure. In each feed tube just above the centre are located ⅝ x 4-inch orifices, spaced about 15 inches lengthwise. The even distribution on to the beds is accomplished by a distributing tube 2½ inches in diameter, located between the feed tubes. This distributing tube is built in sections and can be raised or lowered as required to control the flow of sewage upon the beds. The feed tubes are protected with galvanized sheet iron covers provided with hinged access doors. The protection extends to within one inch of the surface of the bed in order to conserve the heat in the sewage as much as possible, especially during the cold weather. It also acts as a preventative of flies. A space is provided between the two channels supporting the feed tubes, which during the cold

weather is to be filled with moss, leaves or other insulating material.

Each pair of distributors is operated by an endless wire cable. All three sets of cables are driven by one 6-horse-power Otto gasoline engine, which gives the distributors a speed of 38 feet per minute. The change in direction of the distributors is accomplished by means of the reversing lever shown in Fig. 4.

The distributors have realized every expectation. Less than two horse-power is required to drive all six distributors. The writer believes that the distribution of the liquid over the bed is more uniform than can be obtained by the methods now in use in this country. The more uniformly the liquid is distributed upon a filter, the greater the quantity of sewage that can be applied to the filter to obtain the same degree of purification; or, with a given quantity of sewage, the more uniform the distribution, the greater the purification.

To the knowledge of the writer this is the first time that power-driven traveling distributors have been used in this country. The range of temperature at Springfield makes this installation an important one as indicating possible limitations of service in extreme winter weather without covering the filters.

Final Treatment of Filter Effluent.—The existing sewer conveys the filter effluent to the final settling basin located near the mouth of the existing sewer. This final settling basin is 150 feet long and 50 feet wide and has a capacity of 150,000 gallons. A reinforced concrete channel admits the sewage to the basin at the upper end and at the lower end a similar channel conveys the settled liquid through a short length of the existing sewer to the outlet into Wilson creek. It has not been deemed necessary to sterilize the effluent.

Sludge Disposal.—The sludge which is drawn off from the main settling tanks is conveyed by a concrete trough laid to a grade of 5/10 of 1 per cent. to the sludge beds. The sludge bed, which takes in an area of .35 of an acre, is divided by wooden partitions into twelve units, each unit being 25 feet wide and 50 feet long. Each sludge bed is underdrained with graded gravel 18 inches deep at the centre and 12 inches deep at the sides. Down the centre of each unit extends a 6-inch vitrified underdrain laid with open joints. The surface of the gravel is covered with a thin course of mortar sand to prevent the sludge from working its way into the gravel. The bed is given a slope of 1 inch in 10 feet away from the sludge inlet to assist in the distribution of the sludge over the entire bed.

The sewage disposal plant for the northern district, located near Doling Park, has a capacity of 500,000 gallons in 24 hours and, with the exception of the distribution of the sewage over the filter, is in all respects similar to the plant just described. Instead of mechanical distribution, nozzles are used to distribute the sewage over the beds.

The general movement towards the thorough and adequate equipment of Canada's great trade portals, Halifax, St. John, Quebec, Montreal, Vancouver and Victoria, as well as the development of harbors along the great lakes—such as, Toronto, Hamilton, Port Arthur and Fort William—is one which will, when completed, place our country in a position to compete effectively and successfully for its legitimate share of the world's trade.

A CANADIAN ELECTRIC STEEL FURNACE.

By T. R. London, B.A.Sc.,
James, Loudon and Hertzberg.

IN 1906 the Dominion Government issued the results of extensive investigations on the electric furnace iron and steel industry of Europe. Since the publishing of this report, which has been and still is a reference of great value, there has been very little evidence in Canada of commercial interest in electric smelting and refining, as far as the actual iron and steel industry has been concerned. Several electro metallurgical plants of great importance have grown up, but none of these has made any attempt to manufacture pig iron, or place steel products on the market on an extended scale. In 1911, the published results of the successful electro smelting of iron ores in Sweden added greatly to the hopes of those interested in electric metallurgy, as it was proven by these Swedish experiments that practical electro smelting was an accomplished fact, provided power and ore were sufficiently low. Canada was naturally looked to as a possible field for the new Swedish processes, as it is well known that Canadian

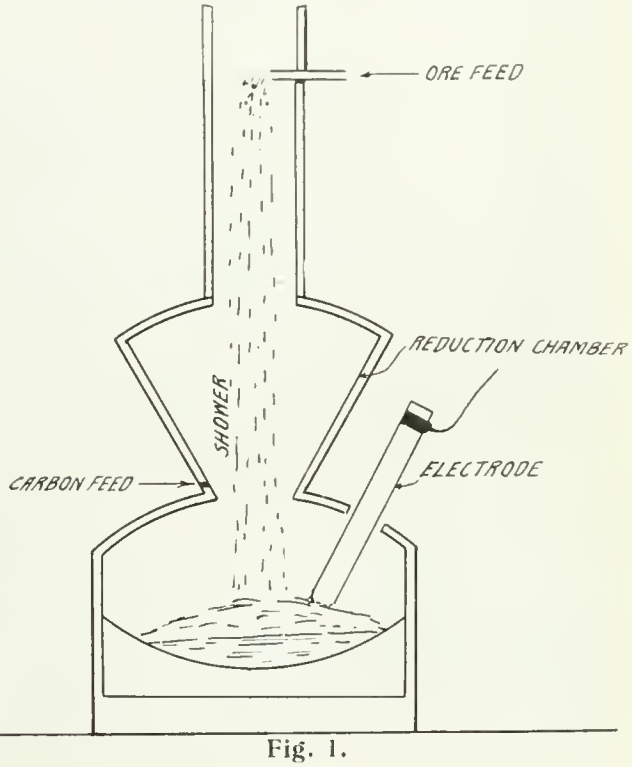

Fig. 1.

iron ores are not suitable for smelting in the ordinary blast furnace without concentrating and briquetting, but can be handled by electro-thermic method. In fact, the Dominion Government electric furnace experiments at Sault Ste. Marie were carried on with a view to making use of these ores. Interesting as the Swedish experiments were, nothing resulted commercially in Canada.

There are, of course, many economic reasons why the electric furnace has not been used in Canada in the steel industry; but, over and above these economic reasons, there exists one that is very largely responsible for the lack of advancement after the beginning made in 1906. This reason may be concisely stated by the well-known phrase, "lack of experience." These new processes required operators familiar with the actual run-

ning of electric iron and steel furnaces, and these men are few and far between. Lacking this experience, which, by the way, was confined to a few European countries, Canadian investigators have been working along their own lines, taking what could be gleaned at intervals from the little that is heard of other similar investigations in foreign parts.

In view of all this, it is particularly gratifying from every standpoint to note that an actual commercial electric steel plant has at last made its appearance in Canada. Quite recently an announcement was made of the incorporation of the Moffat-Irving Steel Works, Limited, having for its object the electro thermic reduction of iron ores and refining to steel.

Fig. 2.

The experiments of which this plant is the outcome have covered a period of some years, and have been of an extremely thorough nature. As intimated above, the difficulties met with in such work are of such a nature that those who persevere and overcome them deserve great credit.

The form of furnace finally adopted differs very slightly from the original design, the main differences being in details rather than principle. Fig. 1 is a diagramatic elevation of the furnace. The crucible is built on a substantial base of concrete. Above this hard-burnt red brick were used for a few courses, and finally, the silica brick forming the main body of the crucible were built up as represented in the cut (Fig. 2). The hearth is of rammed magnesite, giving a good basic bottom.

As indicated in Fig. 1, the ore particles are fed into the upper stack by a mechanical screw feed. The requisite limestone is also fed in at the same level. The carbon, in the form of finely ground coke, is fed into the crucible at the level indicated. The electrodes, three in number, for this furnace which operates on three-phase current, project into the crucible at an angle of about 60°. One of these electrodes is shown in Fig. 1. The remaining two are spaced at equal intervals around the furnace. In falling, the ore particles come in contact with a strongly reducing hot atmosphere of carbon monoxide gas and partial reduction takes place. The final reduction takes place in the crucible.

As would be gathered from the furnace having a basic hearth, the process as carried out is basic. It is well known that in the electric furnace it is possible to bring about a degree of refinement in the metal that is unattainable in the usual industrial processes. In fact, it is practically impossible, under ordinary conditions, to get the sulphur content of steel below a certain limit. Not that this limit leaves a bad steel, but, to get as far below as is possible in the electric furnace means a very high-grade metal. Another very distinct advantage claimed

for steel made under electro thermic conditions, is that it is possible to deoxidize the molten metal to a high degree of perfection. This has been entirely borne out in the work on this furnace. In fact, it was soon apparent in the early stages of the work that the solid condition of the steel, due to this absence of oxides, made the metal very desirable for steel castings. The steel resulting from

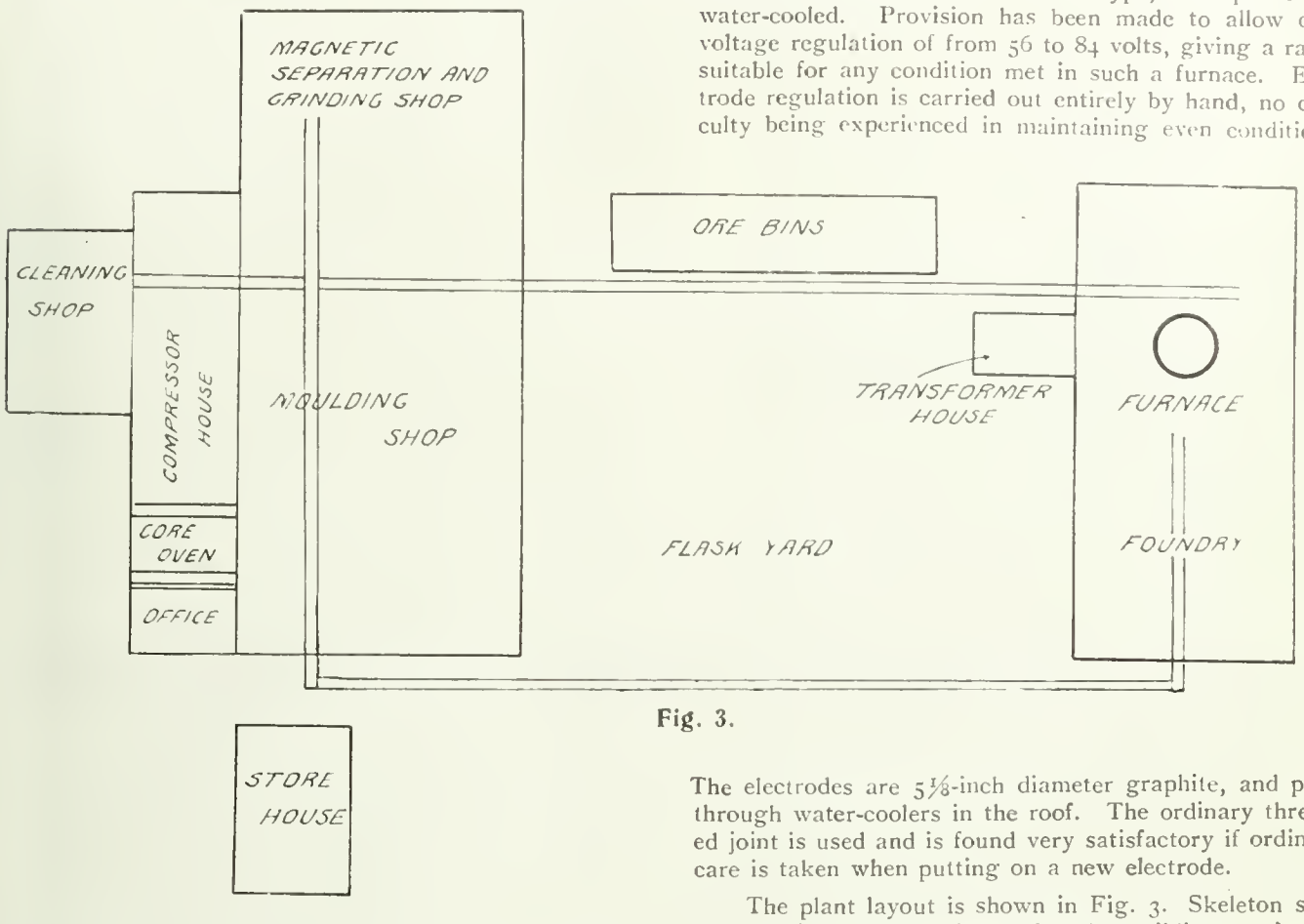

Fig. 3.

the process had very much the qualities of the best crucible steel, and physical tests show a tensile strength well above the average; but, this alone does not explain the wearing qualities of castings made from this steel. Indeed, it is only on the basis of the purity of the metal that any explanation of the quality can be made. So far no actual analyses for the presence of oxides and other injurious elements have been made, but the heat analyses for the ordinary elements looked for, show a high-grade metal. The following are some samples:—

C	Si	Mn.	P	S
.20	.30	.71	.03	.010
.30	.25	.78	.03	.010
.32	.25	.75	.035	.010

It is particularly noticeable that there is no difficulty in getting good metal heat after heat, due, of course, to the excellent control of temperature and slag conditions obtainable in the electric furnace.

The furnace, which was built to take 300 kw., is very seldom operated to full capacity, except at the end of a heat, so as to obtain a high temperature in the metal before tapping. A very complete system of oil burners has been installed for ladle heating which has proven to be an important item in the production of good castings. These ladles are of two-ton capacity, but are seldom called on to take off a heat of more than a ton at a time.

A great deal of care has also been spent in experimenting with various mixes of moulding sands, etc. The extremely high temperature attainable in the furnace gives a very fluid metal, suitable for the most intricate steel casting, but which requires facings and sands refractory enough to withstand being completely fused. Steel flasks made by bending channel iron are used entirely. The transformer is of the core type, three-phase and water-cooled. Provision has been made to allow of a voltage regulation of from 56 to 84 volts, giving a range suitable for any condition met in such a furnace. Electrode regulation is carried out entirely by hand, no difficulty being experienced in maintaining even conditions.

The electrodes are 5⅛-inch diameter graphite, and pass through water-coolers in the roof. The ordinary threaded joint is used and is found very satisfactory if ordinary care is taken when putting on a new electrode.

The plant layout is shown in Fig. 3. Skeleton steel construction was used in the foundry building, a view of

Fig. 4.

which is shown in Fig. 4. The stack B (Fig. 4) is for leading off the waste gases from the reduction chamber. The transformer house A (Fig. 4) is a separate unit containing all the instruments and the electrode control ap-

paratus. The moulding and cleaning shops are equipped with compressed air.

It is hoped to be able to give some more detailed results of the process in the near future. There is no doubt that the problem of handling Canadian ores has been solved in this process. The steel made in the furnace, as intimated above, supports all the predictions and published results up to the present as to the superiority of electro-thermic steel.

HIGHWAY ACCOUNTING, WITH SPECIAL REFERENCE TO MAINTENANCE.*

By Halbert P. Gillette, M. Am. Soc. C.E.

THE time is at hand when accounting and cost-keeping methods that have proved so effective in the management of private enterprises will also be universally applied to public works. There is fundamentally no economic difference between a road and a railway. Hence accounting methods that have been developed in the construction and operation of railways should prove efficacious in road construction and maintenance.

Every well-managed railway has an itemized plant or property account. How many ledgers relating to a system of highways will show the itemized investment in the entire mileage? Every well-managed railway has an itemized maintenance account that shows the monthly and annual maintenance expenses by divisions. Of how many road systems can the same be said? Every well-managed railway is careful to distinguish between expenditures that add to the investment in plant and expenditures that merely renew superseded and worn out parts of the plant. How many road ledgers show equal care in this vital matter? And it is vital, economically, not to confuse renewals with betterments; yet we all know of many recently published statements of road maintenance costs wherein more than half the cost was not maintenance at all.

When an old waterbound macadam is scarified and enough new metal added to bring it to its *original* thickness, the cost thereof is a maintenance expense. But if metal is added in amount sufficient to make the macadam 8 ins. thick where it was 6 ins. thick at the time of original construction, then the added 2 ins. is not a maintenance expense, but is an addition or betterment which should be charged to the property account. Even to a more marked degree is this true when a waterbound macadam is given a bituminous surfacing.

The editor of at least one prominent engineering periodical has recently written about the almost prohibitive cost of road maintenance, and has cautioned the public against bonding for road construction because of the short life of modern roads. This serious editorial error is the result of inadequate knowledge of proper accounting methods, for published road maintenance data are apt to deceive those who think that "maintenance" means what it should mean. As a matter of fact "maintenance, as commonly used to-day in reference to roads, means true maintenance and betterments combined, and is, therefore, a deceptive term.

Maintenance expense should never include anything else than repairs and renewals. Any expenditure that adds to the inventory cost of a road is an addition or betterment and should be charged to the property account. By this criterion it follows that if a worn 6 in. macadam is scarified and increased in thickness to 8 ins., the first cost of a 6 in. macadam is deducted from the first cost of an 8 in. macadam, and this difference is charged to the property account. The balance of the expense involved in scarifying, metalling, rolling, etc., should be charged to the maintenance account under the head of renewals.

The writer prefers to keep distinct the two kinds of maintenance—repairs and renewals. Under repairs are charged patching, patrolling, and other small or continuous maintenance expenses. Under renewals are charged general resurfacing and all renewals of large parts or units. Thus, in the case of a bridge the cost of painting is a repair expense; but the replacement of an old bridge by a new one is a renewal.

Since it is rare that a highway official will find a properly kept set of construction and expense ledgers left by his predecessor, the question arises whether it is worth while to inventory or appraise the existing roads. Most emphatically it is worth while. One of the best ways of rating the annual maintenance cost of any structure or machine is as a percentage of its first cost. Obviously this cannot be done where the first cost is not even vaguely known. Estimates of future maintenance expenses are often best determined by taking percentages of the first cost of each item. These reasons alone warrant making an appraisal of any plant, but, in addition the owners of a plant are entitled to know how much capital is invested in it. Who can tell, with any degree of accuracy, how much capital is now invested in the roads of any large State in America?

The writer has made a rough estimate of the investment in roads in each State, and it serves at any rate to disclose sad disparity in capital invested in roads compared with railways. Accurate figures of this sort for each State should serve to awaken the public to realization of its past niggardliness in road improvement. Now that the Interstate Commerce Commission has begun the appraisal of all the railways, it will soon be possible to contrast the investment in railways with the investment in roads, provided we begin soon to appraise our highways.

In opening a property account for a system of roads, it will be well to study the printed instructions to railway accountants issued by the Interstate Commerce Commission; also the printed instructions issued by various State public service commissions.

The writer would suggest a property account for roads as follows:—

Road Property Account.

1. Engineering, Superintendence and Inspection.
2. Administration and Legal.
3. Real Estate and Right-of-Way.
4. Clearing and Grubbing.
5. Grading.
6. Retaining and Slope Walls.
7. Bridges, Culverts and Drains.
8. Fences and Signs.
9. Trees, Sod and Foliage.
10. Paving.
11. Buildings and Fixtures.
12. Furniture and Instruments.
13. Stores and Supplies.
14. Tools and Machinery.
15. Miscellaneous.
16. Bond Discount.
17. Interest During Construction.

All existing roads should be appraised at the cost of reproduction *new*. The depreciated condition may be

* Read at American Road Congress, held at Detroit, Mich., Sept. 29th to Oct. 4th, 1913.

ascertained, but it is the cost new that should always appear in a plant account. It is now considered bad accounting to "write off" any part of plant value because of depreciation. Preferably a separate account called Depreciation Reserve is provided.

Having opened the construction ledger of a system of highways, using the appraised cost of reproduction new to start with, the cost of every new road and every betterment should be entered in that account, item by item. Many of the 17 items above given should be classified into sub-items. Of course, each new road improvement should have its own separate itemized account, and it would be well to adopt the method used by railways in designating each improvement by a numbered A. F. E. An A. F. E. is an "Authorization for Expenditure." It is made by filling in a printed blank with an itemized estimate of quantities and cost of the proposed improvement and the reasons why the improvement should be made. It is given a serial number, and signed by various officials. Care should be taken to keep the record of actual cost in such a way that it can be entered in detail on the original A. F. E. in a column parallel to the column of estimated cost. If the totals of the two do not check within 10 per cent., reasons should be given for the difference. Instead of extending a given A. F. E. to cover more work than was originally contemplated, the writer prefers to issue a separate A. F. E. for the extension.

Corresponding to the A. F. E. for large additions and improvements is the W. O., or "Work Order," for minor betterments and maintenance. Work orders should be numbered serially, and, where possible, should contain detailed estimates of cost as well as the actual cost in equal detail. In addition, a work order should show in detail how the actual cost is prorated between Maintenance and Improvements.

The location of the work should be described on each A. F. E. and W. O., but, in addition, there should be a map record of every A. F. E. Care should be taken to enter on the map the number of the A. F. E., and on the A. F. E. should be recorded the map number. If this is not done, it often becomes difficult in subsequent years to correlate the maps and A. F. E's.

In addition to a system of accounts that find final summary in two sets of ledgers, namely, Construction Ledgers and Maintenance Ledgers, there should be a separate system of unit cost-keeping records. Ledger accounts must be precise. Cost-keeping records, however, need only be approximate; for the main object of cost-keeping is to ascertain unit costs with sufficient accuracy to determine whether work is being economically done. Of course, unit costs also serve for estimating the cost of projected work, but this is a matter of small importance contrasted with the use of unit costs as a criterion of efficiency. Accounting is a function of book-keepers and accountants, but cost-keeping is a function of engineers. By this I do not mean to imply that engineers should not understand accounting, nor do I mean that there should be entire divorce of accounting from unit cost-keeping. To attempt to record in ledgers the data needed in calculating all unit costs results in greatly complicating the accounting system. Moreover, a good accounting system lacks the flexibility so essential in a good system for recording unit costs. As a rule, the engineer in charge of work finds it desirable to change the method of recording unit costs to fit the local conditions, the character and magnitude of the work, and the sort of men available for keeping the records. An accounting system, on the other hand, should remain the same for all jobs and from year to year.

Of course, unit cost records should show labor and material costs separately. It is desirable that the same separation should also be followed in the accounting system. When this is done it is possible to check roughly the total payroll charged in the ledgers against the total labor cost recorded by the engineers on their cost blanks. Similarly with the total cost of materials. Errors are thus frequently disclosed, and occasionally the "padding" of payrolls and other dishonest acts are brought to light.

Too much stress cannot be laid on the economic necessity of detailed unit cost-keeping. Even for the smallest of jobs, unit costs should be ascertained, if for no other reason than to show that unit costs on small jobs are often several fold as great as on large jobs of the same character. Much money is annually wasted in puttering. Once the total waste is expressed in dollars it usually is seen that most of the puttering can be done away with entirely. This is particularly true of road maintenance. The writer is of those who believe that too much road maintenance consists of patching in small units. There is not a little economic falsehood in applying too literally the "stitch in time" policy. Unit costs, and nothing but unit costs, will show to what extent it is economic to use a parole system of repairing.

To unit costs we must also look for the answer to the question whether day labor or contract labor is more economic. Practically all the recorded unit costs relating to road construction indicate that contract work is cheaper than day labor work The *a priori* reasons for this are numerous; but since there are not a few men who believe they can "save the contractor's profit" simple justice demands that they prove it by recording and publishing the unit costs that occur when they attempt to do so.

In conclusion, the writer would repeat the suggestion that the accounting methods of railways and other public utilities be thoroughly studied by those who are in charge of highway construction and maintenance.

It is not sufficient merely to know the principles of double entry book-keeping as it is commonly applied in business enterprises. Public utility accounting is a special science that involves many departures from the ancient art of book-keeping from which it has evolved.

THE SERVICE RAILWAY OF THE ST. LAWRENCE PULP AND LUMBER CORPORATION, PABOS MILLS, GASPE, P.Q.

By E. S. M. Lovelace, B.A.Sc.,
Civil and Consulting Engineer, Montreal.

THE St. Lawrence Pulp and Lumber Corporation, after purchasing the valuable timber limits and other holdings of the old Pabos Lumber Company, have set about to develop its property along the most modern lines. A sulphite plant with a capacity of over 100 tons of pulp per day is being erected, and saw and rossing mills are also under construction. A townsite is being laid out in the vicinity and, in addition, a standard gauge railway to the interior is now well under way. The writer has been engaged throughout the summer on the location of this railway, and there are a number of points connected with it that will be of general interest.

The peninsula of Gaspé is about one hundred and fifty miles long by seventy-five miles wide, and forms a veritable hog's back between the St. Lawrence River to the north and the Baie de Chaleur to the south. As the height of land in the interior rises considerably above sea-

level, the streams on either side of the divide necessarily have heavy falls. The water is thrown off very rapidly and even in time of freshets these streams, for the most part, carry no great body of water. As a consequence of this lack of stream flow, driving operations have not proven very successful, and have hitherto been confined almost exclusively to a few of the larger streams, leaving whole areas of spruce, balsam, birch and cedar quite untouched by the axe. Any method, therefore, by which this vast quantity of timber might be placed on the market, either in the form of pulp or otherwise, should, and in due course must, receive the serious attention and consideration of those engaged in the lumbering industry in the province.

In the development of the plant under consideration, it is proposed to largely follow methods which have proven successful in the State of Virginia, where the president of the corporation, Mr. Robert Whitmer, of Philadelphia, has other large interests. The main line of railway running back from the mill site at Pabos Mills to the timber limits in the interior, will have maximum grades of about 3 per cent., with curves up to 20 degrees being employed. The main-line locomotives being rod engines of special design, are guaranteed to take curves of even 50 degrees, if necessary. So far as the line was located it has been found possible to have, with the loaded trains, either down or level grades, so that only the trains going back light to the woods have any up grades to encounter. This will naturally reduce the cost of operation.

The rails used are sixty lbs. with standard angle-bar connections. The main-line has been substantially built, but lacking, of course, the same degree of excellence required in a line intended for passenger traffic. From the main-line, branches will be constructed, as required, down the various gullies to the lumber camps. On these branch lines engines of a different type from those in use on the main-line will be employed. They are known as the Shea engines, and are specially constructed for climbing heavy grades, the drivers and tender wheels on one side being geared to a longitudinal shafting. There is thus no dead centre, and such engines will lift a load up grades that for ordinary rod engines would be quite out of the question. Grades of even 6 and 8 per cent. can be easily operated upon with such engines. Their speed, however, is slow, about ten miles per hour under favorable circumstances being the limit. It is for this reason that on the main-line there will be an advantage in using the ordinary type of rod engine.

The construction work on the railway this season was done entirely by day labor, but next spring some further sections may be let out to contractors. The main-line has now been constructed a distance of 4 miles into the interior, where it connects with a branch to the first lumber camp. Cutting will therefore proceed through the entire winter at this camp, the wood being brought to the mill by train.

There is a deep water wharf at Pabos Mills, with connecting siding from the mill, so that in summer, when required, shipments can be made by water. Sidings from the mill also connect with the line of the Atlantic, Quebec and Western Railway, and shipments over this railway make connections at Metapedia with the Intercolonial.

The corporation was organized early in 1913. Mr. H. W. Racey, who for some years was connected with the lumbering interests of Price Bros., Limited, Quebec, and of Mackenzie-Mann & Company interests in the far West, is general manager. The corporation is composed of a group of capitalists, most of whom are, or have been, heavily interested in lumbering operations throughout the United States.

COAST TO COAST.

Esquimalt, B.C.—A new system of 128 lamps has been installed and put into operation by the British Columbia Electric Railway Company at Esquimalt, and has marked a new departure in the history and progress of the municipality.

Saskatoon, Sask.—The initial thirteen and a half miles of municipal street railway was set in operation on January 1st, 1913, and almost from the first showed a margin over operating expenses. This margin has increased from a negligible quantity to a gratifying profit.

Toronto, Ont.—An endeavour is being made to bring about reciprocity in boiler inspection by the public works departments of British Columbia, Ontario, Saskatchewan and Alberta. The standards of the provinces are almost identical, and no obstacle should stand in the way of the desired reciprocity.

Port Arthur, Ont.—The C.P.R. has under way an extensive piece of work at Current River. The river has been turned off to one side, and steam drills are being employed at excavation work prior to the construction of the subway under the bridge. Before the subway can be completed, a large quantity of rock must be removed, which is now part of the bed of the river.

Le Pas, Man.—A new wireless station has been built by the Marconi Wireless Company at Le Pas, in connection with the construction of the Hudson Bay Railway, and as soon as all the apparatus in connection with the station is complete, the company will be prepared to receive commercial business along this and connecting wireless chains. This new station will eventually be a link in a chain that will be perfected when the Hudson Bay and Strait have been opened to navigation.

Regina, Sask.—There now seems every likelihood that the City of Regina will enter into an agreement with Mr. A. S. Porter, which will result in a material reduction in the cost of electrical energy. Mr. Porter owns large deposits of lignite coal in the southern part of the province, and he has advanced several propositions to the city, one of which is that a company in which he will be interested will generate power from the lignite coal, and sell the power at a low rate to the city, the city to retail and distribute it. Mr. Porter is now in the city for the purpose of going further into detail with regard to the proposition. Readers will remember mention of this proposal some time ago in *The Canadian Engineer*

St. John, N.B.—Some interesting data has been furnished concerning dredging operations, which have been in progress from April 1st up to the present, at the St. John harbor, exclusive of Courtenay Bay. The work accomplished has been the dredging at the mouth of the channel required to straighten its entrance, the removal of foul ground, the dredging of the Beacon Bar and the making of the berths at the West Side, where the new wharves are being constructed, the clearing up of the present berths, the deepening of Wellington and Nelson slips, the dredging of the Navy Island Bar in the course of the ferry boat, and the deepening of the West berth at the I.C.R. wharf. In all, these operations represent the dredging of one and a quarter million cubic yards of material.

Brantford, Ont.—Another favorable report on railway construction has been given in connection with the L. E. and N. Railway. The track-laying is in progress, and the rails have been laid southward from Galt to a point 1,200 yards below the power-house at Blue Lake. From the Grand Trunk Crossing at Blue Lake to Paris, and from the crossing of the same railway to the city of Brantford the road bed is ready to have the rails laid. Just as soon as the subway under the Grand Trunk tracks at Blue Lake and Paris are completed, the rails will be laid into Brantford and the ballasting will be done. Contractors are pushing the subway work as fast as possible and Mr. Kellett still has hopes that the Northern branch will be running before the close of 1913.

Fort William, Ont.—The work of drilling and blasting the solid rock under Lake Superior for the new tunnel which will supply Port Arthur with a new water service, has been started and considerable progress made. About 10 feet is being accomplished every 24 hours. Owing to the fact that air pressure in the tunnel will be kept at twenty pounds to the square inch, the work cannot be very rapid; since the very strongest men can not stand being in twenty pound air pressure, or even less for more than a very few hours. The work in the water intake tunnel will be done in shifts of a specified number of hours each. Mr. J. Gass, superintendent of the work, states that in all probability the work will not be finished until next April.

Rogers Pass, B.C.—The C.P.R. will take four years to complete the tunnel now under construction at Rogers Pass in the Selkirk range. This huge tunnel which will require an expenditure of 15,000,000 dollars for its completion is being built for the purpose of lowering the grade through the mountains. Five and three-fifths miles of its total length of 20 miles must be driven through solid rock, and on either side there will be an approach of 7 miles. To carry out the construction, shafts a mile deep will have to be driven through the mountains. The company has undertaken one of the greatest pieces of railway construction work in this age, and one which will dwarf into insignificance all other tunnels in the world.

Regina, Sask.—The Grand Trunk Pacific Railway has opened recently a 105-mile piece of road on its new Calgary-Biggar branch. This stretch of 105 miles lies between Biggar and Loverna, which lies on the boundary line between Saskatchewan and Alberta. Permission has been granted by the Board of Railway Commissioners also for the operation of 50 miles of the Regina-Moose Jaw and Northwesterly branch of the G.T.P., which have been completed to a short distance beyond Mawer, Sask. Ballasting on the Tofield-Calgary branch of the G.T.P. has been finished to Calgary, and first-class passenger service will be established as soon as the terminals at Calgary are completed. This line is a solid construction, and as a consequence will give a splendid service between Calgary, Tofield and Edmonton.

Vancouver, B.C.—In the opinion of Mr. H. H. Stevens, M.P., the people of the Vancouver district should proceed in a business-like way with the construction of the Second Narrows bridge, making no further requests for aid from either the Provincial or Dominion Government. Mr. Stevens emphasized the need of a strong expression of public opinion on the subject to enable the city and municipal authorities to advance plans for procuring the money necessary for the bridge construction. The subsidies subscribed by the governments, and the amounts authorized by the councils of the various districts have brought the total subscription up to $750,000 of the necessary $2,500,000. The councils interested should exercise now their borrowing powers and proceed at once with the erection as a good business proposition.

Halifax, N.S.—That work has been commenced by terminal builders at Halifax may be verified by a picturesque quotation from a local daily paper. "A blackened swath of desolation, gashed through over a mile of what once was the finest of all the natural beauty of Halifax, now marks the preliminary work on the fantastic south end terminal scheme, and fire and axe are daily advancing the work of devastation. Some of the finest public grounds and seven of the beautiful private estates in the city have already been irreparably ruined. From the harbor front a pathway over one hundred yards wide has been gouged along the line of the proposed ditch railway which is to increase the length of the passenger and freight haul to this city from every point to which Halifax has railway connection."

St. John, N.B.—Though the engineers of the J. S. Metcalf Company, contractors to the Federal Government for the building of the new grain conveyers, have made their surveys, the building of the conveyers has not been started. The galleries for the conveyers are to be constructed on hard pine timbers, 54 feet long and 12 inches square, and these timbers have to be secured in the United States. This may be the cause of delay in the work; but if the conveyers are to be available for the shipment of grain at the commencement of the season, very rapid operations will be necessary to complete their construction before the opening of the winter port season. The new conveyers will be more than 2,000 feet long, and will have about 8,000 feet of rubber belting 36 inches wide, costing about $1.00 per foot. These belts will be driven by four 75 horse-power electric motors installed in towers on the galleries. The work of building the conveyers progresses very rapidly when once begun, as while the foundations are being made the gallery tressel is prepared. At Sand Point now it appears that to supply the new berths with conveyers necessitates construction work as extensive as that represented by the conveyers already built. At the present time conveyers are built on berths Nos. 1, 2, 3 and 4. It is probable that the new conveyers will continue from the end of No. 1 berth, and cross the head of the slip along Union Street and then pass down the face of the berths Nos. 5, 6 and 7.

Port Nelson, B.C.—Mr. H. E. Penrose, writing from Port Nelson to the Winnipeg Free Press, says:—"Amongst Canada's great engineering achievements—and these are not a few—the completion of the harbor at Port Nelson will probably rank with the foremost. Whilst the site and climatic conditions of the harbor are by no means perfect, the difficulties are being gradually surmounted; step by step accurate survey and charting have been accomplished, and with the mass of information obtained, plans have been drawn up and the work of construction begun." To carry out the undertaking so that it will be of permanent good, and free from danger of destruction, two breakwaters will have to be built at a point 15 miles up the river to protect the wharfs and harbor works from ice coming down stream as well as to break the force of the current, which has been quoted as one of the arguments against the ultimate success of the project. Below these breakwaters, it is proposed to build an elevator capable of dealing with large quantites of grain at a rapid rate, and to dredge a channel so that ships of moderate tonnage may come alongside. A further suggestion has been the use of floating elevators either in conjunction with or separate from the larger one on shore. Close to the construction camp is the site of the wireless station which will communicate with Le Pas. This high power station acting in conjunction with the proposed chain of stations along the bay to the entrance of the strait, and a possible government scout operating along the track, could communicate full information to ship captains regarding the condition of the route many hours before entering the straits.

PERSONAL.

J. L. LANG, B.A.Sc., has accepted a position in Galt as assistant to the City Engineer, C. D. Campbell.

C. R. HOLMES, B.A.Sc., has joined the Chicago staff of the Hoskin Manufacturing Company, of Detroit, as salesman for electric furnaces, pyrometers, etc.

T. G. HASTIE, Division Engineer in British Columbia for the Great Northern Railway, is conducting the inspection of development work on the Victoria and Sidney Railway, B.C.

WYNN MEREDITH, Consulting Engineer for Victoria on the Sooke Lake water supply project, is recovering from a severe illness in a Los Angeles hospital, and is expected in British Columbia soon again.

M. T. CANTELL, Lic. R.I.B.A., A.S.I., Professor of Architecture and Civil Engineering, Municipal Technical College, Brighton, Eng., and author of "Reinforced Concrete Construction," has become associated with the Success College of Science and Trade, Winnipeg, as Principal.

RUSSELL G. SWAN, B.A.Sc., an honor graduate in Civil Engineering, University of Toronto, has been promoted to the position of Chief Engineer of the British Columbia Hydrographic Survey of the Department of the Interior. As Mr. Swan has had considerable experience in hydrographic survey work, especially in connection with water powers in various parts of the West, he is well qualified for his work. Mr. Swan's headquarters will be in the Dominion Government offices at Vancouver.

A. M. BEALE, B.Sc., Engineer of the Water Power Branch of the Department of the Interior, is now in the West making an investigation of the question of the development of small water powers of less capacity than 200 horse-power which would be of advantage to small communities. It is understood that there are at present a number of applications before the Department for the right to develop such small schemes in various parts of the Provinces of Manitoba, Saskatchewan and Alberta. While these are of small capacity, they are in many cases of great importance to the particular district affected. Mr. Beale's investigations will be watched with considerable interest, as the question of the utilization of power for farm and small mill purposes has been already demonstrated to be a success in various States of the Union, and also in our own Province of Ontario, where the Ontario Hydro-Electric Commission has been able to demonstrate that the milkmaid and the old hand-pump are no longer an absolute necessity.

N.T.R. CONSTRUCTION.

At the October meeting of the Canadian Railway Club, held at the Windsor Hotel, Montreal, Mr. R. F. Uniacke, Bridge Engineer of the National Transcontinental Railway, gave a most interesting illustrated lecture covering some of the difficulties encountered in the construction of the road, showing in some detail the undertakings, their problems and the solutions.

Some of the greatest difficulties he mentioned were due to clay subsoil not capable of bearing the weight of a heavy fill. In one instance the approach to a bridge was shown where the concrete pier at once end and the first span had been entirely carried away. Another was of a deep fill which began to move down along the river, which it approached, as soon as completed, and refused to be stayed. These and similar difficulties were constantly being met.

The speaker stated that the rails were now joined from Moncton to Winnipeg, with the exception of the crossing of the St. Lawrence at Quebec, which awaited the completion of the bridge. Meanwhile a ferry was being built which would be in operation next May. There had been difficulties to overcome in ferrying trains across the St. Lawrence, both winter and summer, in the flow of ice, the rise and fall of the tide, and, as a consequence of this latter, the freezing of the water on the sides of the docks, which sometimes reached a thickness of eight and nine feet. The ferry boat finally decided upon was to be constructed with a tidal deck, with a rise and fall of eighteen feet, and with an "apron" at each end, which joined the rails of the boat with those of the docks.

ONTARIO ASSOCIATION OF ARCHITECTS.

At the twenty-fourth annual convention of the Ontario Association of Architects the following officers and Council were elected for the year: President, C. H. Acton Bond, Toronto; first vice-president, Herbert E. Moore, Toronto; second vice-president, L. Fennings Taylor, Ottawa; treasurer, J. P. Hynes, Toronto; registrar, Franklin E. Belfry, Toronto; and Colborne P. Meredith, Ottawa; J. W. Powers, Kingston; W. R. Gregg, Toronto; W. W. Stewart, Hamilton; Charles E. Langley, Toronto, Council.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS.

At the annual meeting, held in Wilmington, Del., recently, the following officers were elected for the ensuing year: President, Edward H. Christ, of Grand Rapids; first vice-president, W. A. Howell, of Newark, N.J.; second vice-president, A. F. Macallum, of Hamilton, Ont.; third vice-president, N. S. Sprague, of Pittsburg; secretary, C. C. Brown, of Indianapolis; treasurer, W. B. Howe.

Boston was selected for the 1914 convention.

COMING MEETINGS.

NATIONAL SOCIETY FOR PROMOTION OF INDUSTRIAL EDUCATION.—Annual convention to be held at Grand Rapids, Mich., October 19th to 25th. Secretary, C. A. Prosser, 105 E. 22nd Street, New York City.

AMERICAN MINING CONGRESS.—Annual convention will be held at Philadelphia, Pa., October 20th to 25th. Secretary, J. Callbreath, Majestic Building, Denver, Colo.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—Annual convention will be held at Montreal, Que., October 21st to 23rd. Secretary, C. A. Lichty, 319 N. Waller Avenue, Chicago, Ill.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

NATIONAL MUNICIPAL LEAGUE.—Annual meeting will be held in Toronto, November 12-15. Secretary, C. R. Woodruff, 705 North American Building, Philadelphia, Pa.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The annual meeting will be held in New York, December 2nd to 5th, 1913.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20505—October 6—Approving location C.P.R. station yard in block of land lying north-westerly of Haskell Street and south-easterly of Fox Street, town of Port Hope, Ont., at mileage 125.70 from Glen Tay.

20506—October 6—Approving locations of C.N.O.R. station grounds, Dist. Nipissing, Ont., as follows:—Master, mileage 111.05 from Ottawa, township of Master and Kathmore, mileage 115.5 from Ottawa, township of Master.

20507—October 6—Directing that C.P.R. provide and construct an additional track to present siding accommodation for use of Dodge Manufacturing Co., Limited, at their works, at West Toronto: work to be completed within 60 days from date of Order.

20508—October 7—Authorizing C.P.R. to construct, at grade, tracks of spur to Broadacres Ballast Pit across highway between Secs. 7 and 8, Con. 36, Rge. 21, W. 3 M., on C.P.R. Kerrobert North-easterly Branch.

20509—October 7—Authorizing C.P.R. to operate two (2) bridges—namely, Bridge No. 27.4 St. Stephen Subdivision, Atlantic Division, and Bridge No. 13.9, St. Stephen Subdivision, Atlantic Division.

20510—October 7—Authorizing C.P.R. to construct bridge No. 15.6 over Eagle River, Shuswap Subdivision, B.C. (double track).

20511—October 7—Authorizing C.P.R. to operate Bridge No. 30.5, Gibson Subdivison, Atlantic Division, of its line of railway.

20512—October 7—Extending until December 31st, 1913, time within which G.T.R. install interlocking plant at Paris Jct., Ont., approved by Order 18734, dated February 18, 1913.

20513—October 7—Authorizing, temporarily, G.T.P. Branch Lines Co., to carry traffic over portion of Cutknife Branch between Battleford, mileage 0, and Rossman Station, mileage 33.6, Sask.: operation of trains over said line be limited to speed not exceeding 15 miles an hour.

20514—October 6—Directing that, within 60 days from date of this Order, M.C.R.R. Co. install an illuminated electric sign and an improved type of automatic electric bell at crossing of highway at Townsend Station, between Cons. 8 and 9, Co. Haldimand, Ont.: cost of installing said sign and bell to be paid out of "The Railway Grade Crossing Fund," and remainder by Railroad Co.

20515—October 7—Approving revised location C.N.R. Delisle-Alsask Branch in S.E. ¼ Sec. 9-26-17, W. 3 M., Sask., mileage 62½.

20516—October 6—Amending Order No. 19731, dated July 3rd, 1913, to provide that Winnipeg, Selkirk and Lake Winnipeg Ry. Co., operate its cars and trains across C.P.R. from 6 a.m. to 11 p.m., instead of between hours of 9.45 a.m. and 2 p.m. and 12.30 a.m. and 6.30 a.m.

20517—October 7—Authorizing C.N.O.R. to construct bridge to carry its railway over White's Creek, mileage 64.9 from Ontario, Ont.

20518—October 11—Approving, subject to terms of agreement, proposed station site and station of G.T.P. Ry. at Fort Fraser, mileage 372.8, Prince Rupert East, in Sec. 26-15-5, Coast District, B.C.

20519—October 9—Authorizing G.T.P. Branch Lines Co., to construct Tofield-Calgary Branch across highway at mileage 196.6, between Sec. 33-23-29, and Sec. 4-24-29, W. 4 M., Dist. South Alberta, Alta.

20520—October 14—Authorizing G.T.P. Ry. to construct across two (2) highways in B.C.—namely, 1. Mileage 370, Prince Rupert East, Lot 2004A, Rge. 5, Coast District, and 2. Mileage 373, Prince Rupert East.

20521—October 8—Amending Order No. 20402 dated September 24th, 1913, by striking out words "Grand Trunk Pacific Railway" where they occur in said Order, and substituting therefore words "Grand Trunk Pacific Branch Lines Company's Regina-Boundary Branch."

20522—October 7—Granting leave to G.T.P. Branch Lines Co., to operate its trains over crossing of C.P.R. Co.'s Calgary to Edmonton Branch, in city of Calgary, pending installation of interlocking plant required to be provided at said crossing, subject to certain conditions.

20523—October 9—Authorizing G.T.P. Ry. to construct across highway between Secs. 22 and 23-40-23, W. 3 M., and construct road diversion in N.E. ¼ Sec. 22-40-23, W. 3 M., mileage 15.8, Rural Mun. Round Valley, No. 410, Sask.

20524—October 8—Authorizing C.P.R. to use and operate bridges Nos. 36.5, 43.8, 43.4, 43.3, 34.4, 24.8, 30.7 and 32.2, on its Farnham Subdivision, Eastern Division.

20525—October 6—Authorizing London Street Ry. Co., to operate its trains over crossing of Adelaide Street, London, Ont., without their being brought to a stop.

20526—October 7—Authorizing C.P.R. to construct an additional track (double track) across St. Francois-Xavier Street, mileage 6.89, and Jacques-Cartier Street, mileage 6.5, at grade, town of Farnham, P.Q.

20527—October 11—Authorizing C.P.R. to construct crossing over its railway at Station 3100-10, Ensign, Alta.

20528—October 8—Authorizing C.P.R. to open for traffic that portion of double track between mileage 70 and Herbert, mileage 81.9, Swift Current Subdivision, Sask.

20529—October 10—Authorizing C.L.O. and W. Ry. to divert, upon terms agreed to between Tp. Bedford and Ry. Co., road in Lot 26, Con. 1, Tp. Bedford, along Con. Line, between Cons. 1 and 2, to a crossing at mileage 23.71, authorized under Order No. 16758, dated June 15th, 1912. Work authorized hereunder, with exception of fencing, be done by Tp. and completed by July 31st, 1914.

20530—October 14—Approving location and revised location C.P.R., Weyburn-Stirling Branch, from a point in Sec. 32-6-15, W. 4 M., mileage 24.74, thence in easterly direction to a point in Sec. 13-6-9, W. 4 M., mileage 64.34.

20531—October 14—Authorizing C.P.R. to construct bridge No. 19.8, Farnham Subdivision, Eastern Division, over Chambly Canal, St. Johns, Quebec.

20532—October 14—Extending, until May 1st, 1914, time within which C.P.R. construct and complete spur for Coquitlam Terminal Co., Limited, Vancouver, B.C., across Dominion, 5th, 6th and 7th Avenues.

20533—October 14—Authorizing C.P.R. to construct, by means of a grade crossing, tracks of its gravel pit spur, at Waldeck, across highways between N.W. ¼ Sec. 18-16-12, W. 3 M., and N.E. ¼ Sec. 13-16-13, W. 3 M.; and between N.W. ¼ Sec. 19 and S.W. ¼ Sec. 30-16-12, W. 3 M., Sask. Div., Swift Current Subdivision.

20534—October 7—Anthorizing C.P.R. to construct spur for Calgary Stock Yards Co., Limited, situate in N.E. ¼ Sec. 11-24-1, W. 5 M., Alberta, subject to terms and conditions of agreement, with exception of condition referring to removal of said spur from off said street (Burns Avenue, Calgary), when ordered by city to do so. Rescinding Order No. 19472, dated June 4th, 1913.

20535—October 9—Authorizing C.P.R. to construct siding into premises of D. L. Streight, Lot 7, Con. A, Tp. Etobicoke, Co. York, Ont., at Islington, Ont.

20536—October 8—Authorizing C.P.R. to use and operate three (3) bridges on Farnham Subdivision, Eastern Division—namely, No. 35.8, 26.6 and 28.8.

20537—October 9—Authorizing C.L.O. and W. Ry. to construct bridge over Smithfield Creek, near mileage 93.7, Ont. .(Murray-Brighton Road Diversion.)

20538—October 14—Approving location C.P.R. station in Part Lot 28, Con. 2, Tp. Clarke Co. Durham (West Riding), Ont., at mileage 143.03 from Glen Tay.

20539—October 10—Authorizing C.P.R. to construct spur for city of Moose Jaw, from a point on existing spur on North Bridge Street, thence across North Bridge Street and across Subdivision, Lots 5, 6, 7 and 8, Block 142, City of Moose Jaw, to and into premises of city of Moose Jaw, in Block 142.

20540—October 9—Authorizing C.P.R. to construct spur for J. K. McInnis, Regina, Sask.

20541—October 10—Authorizing C.P.R. to construct bridge No. 117.42, Shuswap Subdivision, B.C. Division, British Columbia.

20542—October 10—Authorizing C.P.R. to construct spur for (1) Imperial Oil Co., Limited, situate in Lot 1, Block A, town of Bassano; and (2) Calgary Brewing and Malting Co., Limited, situate in Lot 2, Block A, town of Bassano, Alta.

20543—October 13—Authorizing C.P.R. to construct, by means of a grade crossing, its passing track and leg of wye across road allowance between Secs. 35 and 36-14-13, W.P.M., on Minnedosa Subdivision, Manitoba Division.

20544—October 6—Authorizing C.P.R. to construct, at grade, tracks of extension to town siding at Ekoba, across public road between N.E. ¼ Lot 19, and S.E. ¼ Lot 18, Tp. McDonald, District Algoma, Ont., in village of Ekoba.

20545—October 9—Approving C.P.R. plan, as amended by Chief Engineer of the Board, showing proposed interlocking plant to be installed on temporary trestle at Pitt River, Bridge 109.7, Cascade Subdivision, B.C. Division.

20546—October 13—Authorizing Esquimalt and Nanaimo Ry. Co. to open for freight traffic portion of its railway from McBride Jct., to Courtenay, Vancouver Island, a distance of 8.5 miles: Provided speed of trains be limited to rate not exceeding 12 miles an hour.

20547—October 8—Authorizing C.N.R. to open for carriage of freight traffic its line of Ry., from St. Albert westerly to mileage 22, a distance of 22 miles, Alta.

20548—October 14—Approving and authorizing clearances as shown on plan showing clearances of Moose Jaw Cold Storage Co., Limited's building on C.P.R., subject to conditions that Ry. Co. order its men to keep off sides of cars; and that speed of cars on siding be limited to speed not exceeding four (4) miles an hour.

20549—October 6—Approving location C.P.R. station in Lot 25, Con. 10, Tp. Mara, Co. Ont., at Uptergrove, at mileage 55.64, Port McNicoll Subdivision, Ont. Division.

20550—October 14—Authorizing ratepayers of Tp. Osgoode, Co. Carleton, Ont., at their own expense, to construct highway crossing over C.P.R. Co.'s gravel pit spur in Lots 27 and 28, Con. 1, Tp. Osgoode.

20551—October 9—Authorizing T.H. and B. Ry. to open for traffic that portion of new second track from Welland River to Fenwick Station, mileage 1.35 to mileage 6.47 from Welland.

20552—September 18—Dismissing complaint of certain residents of Tps. March and Torbolton, Co. Carleton, Ont., against location station by C.N.O.R., at mileage 22 from Ottawa, Tp. March, approved under Order No. 17342, dated August 27th, 1912.

20553—October 11—Extending, until December 1st, 1913, time within which B.C. Electric Ry. Co., complete work at crossing of tracks of Esquimalt and Nanaimo Ry., near Russell, B.C., required under Order No. 18733, dated February 18th, 1913.

20554—October 10—Relieving Red Mountain Ry. Co., from fencing certain portions of its right of way from International Boundary, south of Patterson, to Rossland, B.C.

20555—October 10—Relieving V.V. and E. Ry. and Nav. Co., from fencing certain portions of its right of way from Midway, B.C., to International Boundary, west of Bridesville, B.C.

20556—October 10—Authorizing Edmonton, Dunvegan and B.C. Ry. Co., to construct across fifteen (15) highways in Prov. Alta.

20557—October 9—Directing that G.T.R., at its own expense, provide and construct farm crossing over its railway where same crosses farm of Charles Ellis of Toronto, in Lot 45, Front Range, Tp. Rama.

20558—October 13—Authorizing G.T.R. to reconstruct bridge No. 278, at mileage 73.75, Thirteenth Dist., over Nottawasaga River, near Beeton, Ontario.

20559—October 14—Authorizing G.T.R. to construct siding into premises of Canada Brick and Fireproofing Co., Limited, on part of Lot 27, Con. 11, Tp. Esquesing, Co. Halton, Ont.

20560—October 13—Authorizing G.T.R. to reconstruct Bridge No. 101, at mileage 309.14 on its 32nd Dist., Ottawa Div., carrying its railway over Joe Creek.

20561—October 10—Authorizing G.T.R. to operate its trains over swing bridge across Welland Canal, and railway crossing at Port Colborne, without their first being brought to a stop.

20562—October 14—Authorizing C.P.R., for purpose of constructing a reservoir for sufficient maintenance and operation of its railway, to take all that portion of S.E. ¼ of Sec. 8, Tp. 12, Rge. 19, W. 2 M.

20563—October 13—Approving location C.L.O. and W. Ry. (C.P.R.) station in port Lot 26, Con. 2, northwesterly of Beech Street and easterly of Brock Street, town of Whitby, Co. Ont., Ont., at mileage 164.17 from Glen Tay.

20564—October 8—Rescinding Order No. 20245, dated August 30th, 1913.

20565—October 9—Authorizing C.N.O.R. to construct across and divert Second Avenue, town of North Bay, Ont.

20566—October 6—Relieving M.C.R.R. from maintaining cattle-guards at crossing of Plymouth Road, town of Welland, Ont.

20567—October 15—Extending, until December 1st, 1913, time within which C.P.R. install bell at crossing of highway at mileage 0.91 from St. Martin's Junction, Que., required under Order No. 19905, dated July 25th, 1913.

20568—October 8—Approving location C.P.R. station in north half of Lot 21, Con. 8, Tp. Richmond, Co. Lennox and Addington, Ont., at mileage 53.00 from Glen Tay, at Overton: Provided whenever it develops that traffic on highway is blocked for more than 5 minutes at any one time by reason of location hereby approved, Board shall be at liberty to re-locate said station.

20569—October 7—Approving location C.N.O.R. station grounds, at Remi, parish Ste. Genevieve, Co. Jacques Cartier, Ont.

20570—October 8—Establishing collection and delivery limits of Dominion Express Co., in city of Kelowna, B.C.

20571—October 8—Establishing collection and delivery limits of Dominion Express Co., in town of Knowlton, Que.

20572—October 15—Authorizing C.P.R. to construct diversion in Sec. 30-22-26, W. 3 M., Sask.; and construct its Swift Current Northwesterly Branch Line across said Diversion, at mileage 90.13.

20573—October 15—Authorizing C.P.R. to construct, by means of a grade crossing, across Government Road, in Lot 2567 (Provincial Government Survey), Kootenay Dist, B.C., at mileage 42.37.

20574—September 11—Approving location C.P.R. proposed station at Empress, on Swift Current Northwesterly Branch.

20575—October 7—Authorizing C.P.R. to construct siding, from a point on southerly limit of right of way, Easterly Div., Sherbrooke Subdivision, Lot Cadastral No. 1539, Sherbrooke, Que., for Canadian Connecticut Cotton Mills Co., Limited.

20576—October 7—Authorizing C.P.R. to construct a relocation of siding into premises of J. A. Villemaire, situate in Lot 9, Rge. 3, Tp. Campbell, Co. Ottawa, Ont.

20577—September 23—Amending Order No. 16671, June 1st, 1912, by striking out words, "as provided by the Ry. Act," and substituting therefore words, "by special arbitrator to be appointed by the Board." Also amending Order No. 18906, March 14th, 1913, (1) by adding words, "acquired previous to the year 1904," after word "properties," in 17th line on page 16. (2) by adding words, "as to all the properties taken," after word "shall," in 19th line of page 16. (3) By adding words "acquired previous to the year 1904," after word "lands," in 6th line from bottom of page 16. (4) By adding words, "as to properties acquired previous to year 1904," after word "awards," in 4th line from bottom of page 16 and (5) By striking out words, "in accordance with the provisions of Sec. 192 of the Rly. Act," at end of said Order.

20578—October 14—Authorizing Kettle Valley Ry. Co. to construct bridge over Fraser River, at Hope, B.C.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Chocolate Cove, N.B., extension to wharf and dredging	Oct. 29.	Oct. 9.	80
Halifax, N.S., ocean terminals	Oct. 25.	Oct. 16.	88
Kincardine, Ont., breakwater	Oct. 29.	Oct. 9.	86
Ottawa, Ont., conveyance of mails	Nov. 14.	Oct. 16.	86
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Poupore, Que., training pier, &c.	Oct. 27.	Oct. 2.	80
Regina, Sask., power house equipment	Oct. 25.	Sept. 11.	86
Saskatoon, Sask., sewer and water mains		Oct. 16.	78
St. Jean Port Joli, L'Isle Co., Que., wharf improvements	Oct. 28.	Oct. 9.	80
Summerland, B.C., wharf	Oct. 31.	Oct. 2.	82
Thornbury, Grey Co., Ont., harbor improvements	Oct. 29.	Oct. 9.	80
Toronto, Ont., steelwork for bridge	Nov. 25.	Oct. 16.	84
Toronto, Ont., pumping engines, &c.	Nov. 25.	Oct. 16.	84
Toronto, Ont., sub-contracts for Methodist Book and Publishing Co.		Oct. 16.	82
Wellington, Ont., harbor improvements	Oct. 29.	Oct. 2.	88
Winnipeg, Man., gate-valves	Oct. 24.	Oct. 16.	80

RAILWAYS—STEAM AND ELECTRIC.

Calgary, Alta.—The city commissioners have recommended the building of approximately a half of mile of street car line to connect the two stub lines extending west on Twenty-Sixth and Thirty-Fourth Avenues. The estimated cost is about $5,000.

Calgary, Alta.—It has been stated that the route of the C.N.R., north of Athabasca, has been mapped out, and that the legislature will be called upon forthwith for its approval. The line is to built from Athabasca on the south side of the river to a point five miles north-west of the town, where it will cross the river, and be constructed so as to give service to Peace River Landing and the intermediate towns.

Edmonton, Alta.—Engineers in the employ of Mr. J. D. McArthur have been engaged for some time on the preliminary surveys for the Alberta and Great Western Waterway. When the legislature of the province has accepted Mr. McArthur's proposal to build the road on a bond guarantee of $20,000 per mile, it has been officially announced that actual construction work will be begun.

Ottawa, Ont.—The acting minister of railways, the Hon. D. S. Reid, has approved the route map of the C.N.R. between Sturgis and Hudson's Bay, and the revision of the C.P.R. Swift Current branch running north-westerly near Empress. Further information must be given before approval of the revision of the C.N.R. line from Morris southwesterly, or of the Alberta Central revision in townships 26 and 27, range 24 west of the 3rd, will be granted.

Ottawa, Ont.—At the next session of parliament, an application is to be made for an act to incorporate a railway company, called the Ungava Railway Company, having power to construct a line from the Hudson Bay Company's post at the mouth of the Great Whale River, or the most desirable point thereabout, in an easterly or southeasterly direction to Aylmer Sound, or to another suitable point on the Gulf of St. Lawrence.

St. John, N.B.—A conference has been held between Secretary Hopper, of the Street Railway, and business men interested in Courtenay Bay property, and the request of residents for an extension of the railway to Little River was discussed. The outcome may be that the company will make an extension from Kane's Corner to Crouchville this fall or next spring, and further extensions thereafter when the company shall be in a position to continue the work.

Toronto, Ont.—The Dominion Railway Commission has declared that the railways must proceed with the erection of the new Union Station and the construction of the Esplanade viaduct without further delay. The work of wrecking the buildings and of cleaning up the sites for the station and viaduct is to be started within two weeks. Mr. Leonard has stated that the Union Terminal Company will doubtless make known its final plans inside of two weeks. With regard to the viaduct, Chairman Drayton assured the railway officials that, while the order had not been officially signed as yet, this was but a formality that would not interfere with the railways.

Vancouver, B.C.—The city is considering immediate action in the purchase of the B.C.E.R. The company's franchise does not expire until 1919, but Mr. Glover has stated to Mayor Baxter that the company will consider any reasonable proposition.

Vancouver, B.C.—The first reading of an agreement, which is to be incorporated in a by-law giving the P.G.E. railway right-of-way through D.L. 237, has been given in council. It is proposed to change the right-of-way setting it back some distance from the water front, and the company is to abandon its right to water fronts.

Vancouver, B.C.—The British Columbia Electric Railway has found it impossible to cope with the wishes of residents of Lulu Island, South Vancouver, and adjoining districts, and for the present cannot consider the laying of a track across Lulu Island for the benefit of the citizens in this locality.

Vancouver, B.C.—Mr. A. Reed, of Winnipeg, has visited the city, it is believed, with the object of securing a charter from the Provincial Government for a line to connect Kamloops with Quesnel and Barkerville. This will open up a splendid stretch of rich mining country. Full details of plans are expected to be issued shortly.

Vancouver, B.C.—The city solicitor was instructed by the board of works to draw up an agreement between the city and the C.P.R. Company, admitting certain conditions by which the city will take over the street and railway trackage between Homer Street and the yards.

Winnipeg, Man.—Plans have been filed for the spur line of the Midland Railway Company between Ross and Elgin Avenues, and are to be considered by the works and property committee.

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GARBAGE, SEWAGE AND WATER.

Burlington, Ont.—The citizens of Burlington are demanding a sewer system which will cost in the neighbourhood of $150,000. Though agitation has been started, the construction will probably not be undertaken for a year or more.

Fort William, Ont.—Progress in improvements being undertaken in the coal dock district is reported as favorable. It is a difficult problem to get a system here that will drain the land after a heavy rainfall. Sewer has been laid on McLaughlin Street, and the street has been raised and levelled. The old ditches at the sides of the roads have been filled in and new ones dug inclining slightly towards the lake. Until the streets in the vicinity are paved, this is all that is practical to do.

Fort William, Ont.—The report of the works committee recommended the laying of sewers in several of the city streets, and the letting of contracts from tenders submitted by various local contractors.

Kerrisdale, Point Grey, B.C.—An agreement is pending awaiting ratification by the council by which the R. McLean Company will build a sewer costing $100,000 in Eburne. The company are constructing at present a sewer costing $87,000 in D.L. 540, and also have the contract for a $13,000 sewer which will be an extension to the Wilson Creek sewer in D.L. 472.

Ottawa, Ont.—The waterworks committee have decided that 180 new fire hydrants are to be installed on different streets throughout the city, within the next year at a cost of $20,000. The resolution will have to be placed before the city council asking that authority be sought from the Ontario Government to raise the money required by debentures. In the meantime, City Engineer Currie has been instructed to expend $5,000 in new hydrants.

Ottawa, Ont.—The City of Ottawa has decided to expend upon securing a pure water supply from Thirty One mile lake in the Gatineau region, Quebec, the approximate sum of $8,000,000, towards which the Dominion Government has promised a subsidy of $100,000 per year.

Regina, Sask.—The Regina works committee has decided to extend the sewerage system so as to provide drainage for the low lying land in the north-east section of the city, and also to serve the abattoir. Several additional extensions will be made in other sections of the city.

Swift Current, Sask.—Tenders will be received up till October 28th, 1913, for two contracts for the laying of sewers. Plans and specifications may be obtained from George D. Mackie, Esq., Town Engineer, Swift Current, Sask.

▲—**Toronto, Ont.**—Tenders will be received up till November 4th, 1913, for the construction of several sewers. Plans and specifications may be obtained from H. C. Hocken (Mayor), Chairman, Board of Control, Toronto, Ont.

Vancouver, P.C.—Tenders will be received up till October 29th, 1913, for the construction of the Point Grey partnership pipe from Stanley Park to Bodwell Road in alternate routes. Plans and specifications may be obtained from the City Engineer, City Hall, Vancouver, B.C. Signed, Wm. McQueen, City Clerk.

Vancouver, B.C.—The city waterworks committee has under discussion the question of acquiring the Seymour Creek timber lands for the purpose of conserving the area as a watershed and of forming a reservoir. The city cruiser has reported $319,000 as a fair valuation of the timber land and limits. However, timber limits connected with other estates would have to be purchased, and would raise the expenditure necessary. A by-law will doubtless be submitted to the people in January; for the land must be reserved by the city to obviate the risk of being polluted by campers.

Verdun, Man.—The town council has succeeded in securing $200,000 for civic improvements. The sewers to cross Church and Wellington streets will be commenced at once, so that they will be completed this fall, and pavements may be constructed on these streets early next spring. Other sewers will also be commenced this fall and if possible completed.

Victoria, B.C.—A conference of the city authorities was held in connection with the north-west trunk sewer, and the following resolution was finally adopted:—"That this meeting of the representatives of the three municipalities hereby agree to adopt as a basis of settlement the figures which have been submitted by the engineers of the municipalities in so far as they relate to the north-west sewer, and undertake to bring the subject before the respective councils." City Engineer Rust reported that the engineers had met in conference to apportion the charge. The total cost would be $365,223. Of that share, Saanich should bear $52,221 and Esquimalt $28,500, the engineers recommended. However, the only fair division was on a percentage basis, they held, under which the Saanich district would pay 14.3 per cent., Esquimalt 7.8 per cent., and Victoria 77.9 per cent. Esquimalt considered it should only pay the percentage to Hereward road, but the city engineer pointed out that if Esquimalt had to build a sewer itself the cost would be $125,000.

Winnipeg, Man.—The works and property committee appointed a sub-committee to go fully into the matter of protecting meters against frost and also of lessening the waste of water in city dwellings, and to furnish a report showing how the situation may be remedied.

LIGHT, HEAT AND POWER.

+—**Calgary, Alta.**—The city council has recommended that the contract be given to the SHEET METAL COMPANY for the heating of the new industrial building, should the present city garage be selected as the site by the new industries committee of the council. The tender of the company was submitted for $2,000. Provision was made that in the event of another site being chosen the recommendation could be withdrawn.

+—**Calgary, Alta.**—The contract has been awarded to ROBERT McCULLOUGH at $990 for the installation of the heating plant in the new pumping station at Calgary.

Dundas, Ont.—The town council has empowered the mayor and clerk to sign a contract between the town and Hydro-Electric system for from 275 to 300 street lights of 100 watts each, at $9 each, to be installed in accordance with the specifications presented by the commission to the council.

Edmonton, Alta.—An important motion which was unanimously adopted by the city council, deals with the extension of the city power plant; and it was also recommended that the commissioners begin at once with the work of having plans and specifications made, tenders called, and contracts awarded.

Guelph, Ont.—The Light and Heat Commission has decided to purchase and install in the new gas and electric light building on Huskisson Street a new gas heating outfit. The object is to give a thorough trial to the use of gas for heating, and if found by the commission and citizens to be a feasible thing to use in private homes, services will be installed in city dwellings.

Guelph, Ont.—Tenders will be received up till October 28th, 1913, for the heating and plumbing of the new dining hall and poultry building at the Ontario Agricultural College, Guelph. Plans and specifications may be obtained from H. F. McNaughten, Esq., Secretary, Department of Public Works for Ontario, Toronto, Ont.

Hamilton, Ont.—Engineer Sifton of the Hydro department has asked the city board of control for a further grant of $335,000 with which to complete the installation of the municipal power plant. Since the original estimate has been made upon the plant, many new streets have been opened, requiring more lamps and far greater sub-station equipment. A by-law will be submitted to the ratepayers in January, 1914.

+—**Montreal, Que.**—A contract for a 450 h.p., 250 r.p.m., 550 volt, 25 cycle, slip-ring type induction motor, with short circuiting and brush lifting device, and pedestal bearings, together with a Siemens type liquid starter, has been placed with the SIEMENS COMPANY OF CANADA by the Dome Mines Company, Limited of South Porcupine. The motor is to be used to drive a compressor made by Belliss and Morcom.

Ottawa, Ont.—Tenders will be received up till November 4th, 1913, for the furnishing and installing of the electric wiring systems required in connection with the equipment of the National Transcontinental Railway car shops at Transcona, Man. Plans and specifications may be obtained from P. E. Ryan, Secretary of the Commissioners of the Transcontinental Railway, Ottawa, Ont.

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Owen Sound, Ont.—The electric light and power committee of Owen Sound has reached a decision whereby the town will take 1,200 horsepower from the Hydro-Electric Commission, the energy to be generated at the commission's proposed station at Eugenia Falls. The current will be supplied at $29 per horsepower. Plans have been prepared, and all that remains to bind the contract is the formal signature on the part of the town, since the ratepayers passed a by-law to secure the power nearly two years ago.

Saskatoon, Sask.—Supplying power to the industries located at Factoria, and to the government elevator, has been considered by the city council. To the elevator, it granted a two-cent per kilowatt-hour rate, provided the government will make an agreement with the city. The question of constructing a power line to Factoria was left in the hands of the finance committee and the commissioners with power to act.

Welland, Ont.—The Canadian Niagara Power Company is planning to more than double the original generating capacity of their plant. The plant consisted originally of five units of 10,000 horsepower capacity each. Two additional units of 12,500 horsepower each were installed, and three more are to be placed in position within the next three years. Already an order has been placed for unit No. 8, and the steel sections of the machine will arrive next spring. When the work of installing No. 8 is begun, an order will be given for unit No. 9.

Winnipeg, Man.—Tenders will be received up till November 4th, 1913, for the manufacture and delivery at the Power House of Point du Bois, of electrically operated switching gear and accessories. Plans and specifications may be obtained from M. Peterson, Esq., Secretary, Board of Control, Winnipeg, Man.

BRIDGES, ROADS AND PAVEMENTS.

Brandon, Man.—Representatives from the men's associations are to be appointed to the committee which has been formed to wait upon Superintendent McHarg, of the C.P.R. in regard to an overhead bridge or a subway from the south to the north side of the track in the vicinity of the round-house. Little hope is entertained that the company will build either construction, unless it is compelled to do so by the board of railway commissioners, though the committee will make every effort to have the company build a "slope way" from the First Street bridge on the north side in an easterly direction.

Calgary, Alta.—The city commissioners have approved a plan prepared by Parks Superintendent Reader which calls for an extensive system of boulevarding streets, and for which a local improvement by-law for $150,000 will be submitted to ratepayers. Before this is done, however, the list of streets for which boulevarding is proposed, is to be revised.

Edmonton, Alta.—Plans have been made for a subway on Athabasca Avenue at one of the most dangerous C.P.R. crossings in the city. These plans have to be approved in Ottawa, and copies forwarded from the Dominion Government to the C.P.R. headquarters at Montreal.

Fort William, Ont.—To make the approach from the city side to the bascule bridge adequate and suitable, it has been suggested that a spiral loop which would form an approach to the public traffic of the bridge, and which would reach the street level on the river side of Syndicate Avenue where traffic could move in either direction without loss of time, would meet with all demands.

Hull, Que.—A special meeting of the city council was held and a decision was made to accept the temporary loan of $11,000 offered by the Quebec Provincial Government for the construction of the new macadamized road between Hull and Gatineau Point. The construction work is to be commenced at once.

+—Montreal, Que.—The contract has been awarded to JOHN S. METCALF COMPANY, LIMITED, constructing engineers, Montreal and Chicago, by the Canadian Pacific Railway Company, for the construction of the Glen Arch at Westmount, Montreal, Que. to provide for a width of four tracks. The estimated cost was $50,000.

Montreal, Que.—Mr. McLeod, railway engineer of the city, has submitted to the board of control his plan for the reconstruction of the Ontario Street subway. Mr. McLeod proposes to widen the subway on the north side only and in such a way as to make the width between abutments 60 feet instead of 40 as at present; the head room to be 14 feet instead of 12; under which scheme the total cost of the subway would be approximately $117,000, instead of $153,000 as by the C.P.R. plan. The sewers and water mains can remain as at present, the present abutment and retaining walls will remain intact saving expense and no cross street will be affected by the new grade, except the north-east corner of Ontario and Beaufort, where the existing roadway will have to be lowered about 18 inches. Only $8,000 extra land will have to be acquired for the widening of the street to 60 feet. No decision will be reached by the controllers until the matter has been fully discussed with the Canadian Pacific authorities; and if the plan is adopted by them, application will be made immediately to the Board of Railway Commissioners for the authorization to rebuild the subway.

Vancouver, B.C.—The proposed extension of Venables Street to Campbell Avenue met with a heated discussion at the Grandview Ratepayers' Association meeting. Decision in the matter was deferred for two weeks in order to allow Alderman Evans and Alderman McSpadden time for the preparation of more data with regard to their respective plans for a continuous thoroughfare to Grandview from the East End.

Vancouver, B.C.—The Department of Public Works at Ottawa has approved the plans for the proposed North Vancouver subway under the C.P.R. Company's tracks at the foot of Columbia Avenue to the ferry wharf. The work is to be proceeded with at once, the estimated cost being $35,000.

Vancouver, B.C.—The matter meeting with most recent consideration by the civic bridges and railway committee was the question of the viaducts on Hastings, Pender, Harris, and Keefer Streets. Work upon these structures, it is hoped, will be started this year.

Vancouver, B.C.—The city engineer has recommended to the board of works at an estimate of $10,140 the opening of Carnaron Street to a width of 66 feet northward from a point 61.9 feet north of Tenth Avenue to Broadway. Before the city council can act, however, financial arrangements must be assured.

Victoria, B.C.—At the recent meeting of the Inner Harbor Association, a resolution was passed urging that the Point Ellice bridge be opened, and that the city consent to the sale of a span entrance on the east side to the C.N.P. in connection with the project to raise the bridge level and in its place to substitute a draw span to permit of the opening of the Upper Harbor to navigation. As an obstruction to navigation, the Rock Bay bridge was also referred to, and the straightening of the structure so as to connect with Rock Bay Avenue was urged. It was proposed to fill in the two ends and to place in the centre a draw span which would give access to the two mills on the waterfront east of the bridge, and it was decided to ask the Dominion Government to dredge the area inside.

Winnipeg, Man.—When the C.P.R. has completed its work of raising the track levels and of extending the main shed, alterations will be made to the C.P.R. subway on Main Street. Plans have been approved by the city engineer, and have been submitted to the works and property committee. These have been made in accordance with the agreement made between the city and company early in the summer, and have been accepted by the committee.

INDUSTRIAL WORKS.

Chippewa, Ont.—The committee which was delegated to wait upon the Hon. Dr. Reid at Ottawa to urge the location of a lock at Chippewa, and of the peace memorial bridge at Niagara Falls, reported upon their return that the contract for that section of the new Welland Canal which lies between Welland and Port Robinson, would not be let until engineers had made a complete survey and estimate of the cost of the proposition.

Cote St. Paul, Que.—The Montreal Light, Heat and Power Company are calling for tenders for extensions to their gas works.

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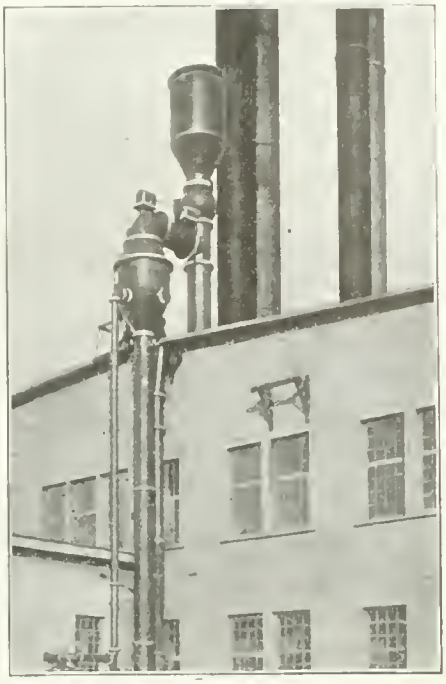

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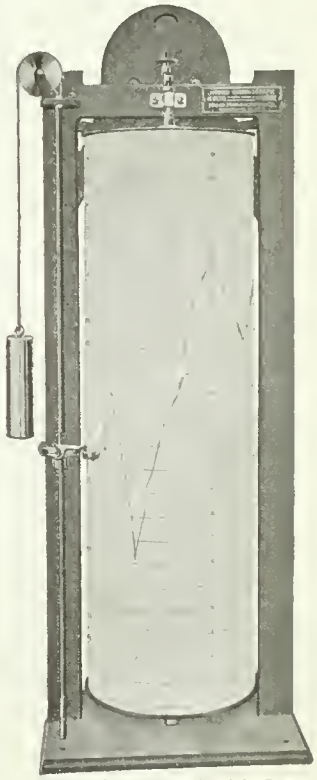

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Fort William, Ont.—Tenders will be received up till October 24th, 1913, for plumbing in several houses. Plans and specifications may be obtained from M. McCulloch, Manager, City Clerk's Office, Fort William, Ont.

Fort William, Ont.—The city council has appointed a committee to act in conjunction with a board of trade committee to consider the improvement of conditions at the city dock and the subway leading to it under the C.P.R. tracks.

▲—**Halifax, N.S.**—Tenders will be received up till October 25th for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging, and filling of reclaimed areas. Plans and specifications may be obtained from L. K. Jones, Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, Ont.

Hamilton, Ont.—The SMART-TURNER MACHINE CO., LIMITED, of Hamilton, is supplying the Otis Fensom Elevator Co., Limited, with one of the Underwriter fire pumps.

+—**Malbaie, Gaspe Co., Que.**—The contract for building the big new Government pier at Malbaie, Gaspe, has been awarded to JOHN BURNS, at a cost of $42,700.

Merlin, Ont.—Tenders will be received up till October 25th for the repair and improvement of Indian Creek Drain in the Township of Raleigh, city of Chatham, and Township of Harwick. Plans and specifications may be obtained from A. E. Robinson, clerk of Raleigh, and Geo. A. McCubbin, C.E. Signed, Jas. Wellwood, Reeve, (Raleigh Tp.), Merlin, Ont.

Montreal, Que.—The SMART-TURNER MACHINE CO., LIMITED, of Hamilton, is supplying the Harbor Commissioners of Montreal with one of their Simplex power pumps.

Ottawa, Ont.—Tenders will be received up till October 31st, 1913, for Nassau Dam, Trent Canal. Plans and specifications may be obtained from L. K. Jones, Esq., Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till November 17th, 1913, for the construction of harbor improvements at Port Hope, Ont. Plans and specifications may be obtained from the District Engineer, J. G. Sing, Esq., Confederation Life Building, Toronto. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—The damming of Chippewa Creek, so as to connect the city of Niagara Falls with the new Welland Canal, is being urged upon the Department of Railways and Canals. The creek enters the Niagara River within a mile of the city, and from the outlet to the new canal is a distance of about seven miles. A dam would make the creek navigable and would furnish Niagara Falls with water transportation.

Ottawa, Ont.—Tenders will be received up till November 17th, 1913, for the construction of a pile protection work at Rainy River, Thunder Bay and Rainy River District, Ont. Plans and specifications may be obtained from F. G. Harcourt, Esq., District Engineer, Port Arthur, Ont. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received up till November 12th for the construction of a wharf at Rocky Point, West River, Queen's County, P.E.I. Plans and specifications may be obtained from W. E. Hyndman, Esq., District Engineer, Charlottetown, P.E.I. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Port Moody, B.C.—The city engineer's department is conducting surveys in the neighborhood of Noon and Scott Creeks, on the north side of Burrard Inlet, with a view to locating a source of water supply for the city. Already the Coquitlam municipal council has an application on file for rights on Scott Creek, but will be asked to withdraw in favor of Port Moody.

+—**Salmon River, N.B.**—The contract has been awarded the ISLAND DREDGING COMPANY for the construction of a pier at Salmon River, N.B. The contract price was $9,989.

South Vancouver, B.C.—The organization of the North Arm Harbor Commission has been completed, and the task of improving the north arm of the river is being set in operation. The first features of the work to be undertaken will be the dredging and the construction of the jetty, both of which will require expenditures of thousands of dollars. It has been proposed to build an abutment along the north bank of the arm and to fill in behind this with the mud and silt dredged from the bed of the channel.

St. John, N.B.—The city has had forcibly brought to its attention the inadequacy of its wharves through the withdrawal of the mail steamers. The Board of Trade and the civic authorities are already considering plans to increase greatly the city's wharfage facilities. Two wharves are now under construction on the west side of the harbor and the city government will urge that such contracts as are necessary will be awarded to provide for three additional wharves comprising four berths for use during the winter of 1914-15. A suggestion is also being made that the property be secured, and suitable buildings constructed, for passenger traffic.

▲—**Toronto, Ont.**—Tenders will be received up till November 18th, 1913, for the supplying and laying of an 84-inch steel conduit from the Pure Water Reservoir on Toronto Island, to the South Tunnel Shaft. Plans and specifications may be obtained from the Department of Public Works, Room 10, City Hall, Toronto. Signed, H. C. Hocken (Mayor), Chairman, Board of Control

▲—**Toronto, Ont.**—Tenders will be received up till November 18th for sundries, including brass work, iron and lead pipe, iron valve, special castings, etc. Plans and specifications may be obtained from the head office of the Department of Works, City Hall, Toronto. H. C. Hocken (Mayor), Chairman, Board of Control.

Vancouver, B.C.—Tenders will be received up till October 24th, 1913, for the construction of a 260 cubic yard dump scow. Plans and specifications may be obtained from J. L. Nelson, Esq., Superintendent of Dredges, Department of Public Works, Vancouver, B.C.

Vancouver, B.C.—The ratepayers are to be called upon for the approval of a by-law to raise a loan of $40,000 for a new wharf.

Vancouver, B.C.—The contract for the dredging of the inlet off Pier A will soon be awarded by the C.P.R. Company. Extensive improvements are to be made around the pier for the better accommodation of the deep draft transpacific liners.

Vancouver, B.C.—Tenders will be received up till October 24th, 1913, for the supply of iron work for dump scow. Plans and specifications may be obtained from J. L. Nelson, Esq., Superintendent of Dredges, Department of Public Works, Vancouver, B.C.

+—**Vancouver, B.C.**—The contract has been awarded to the B. C. MARINE RAILWAYS, Esquimalt, for the equipment of the Dominion dredge "King Edward" with an oil-burner.

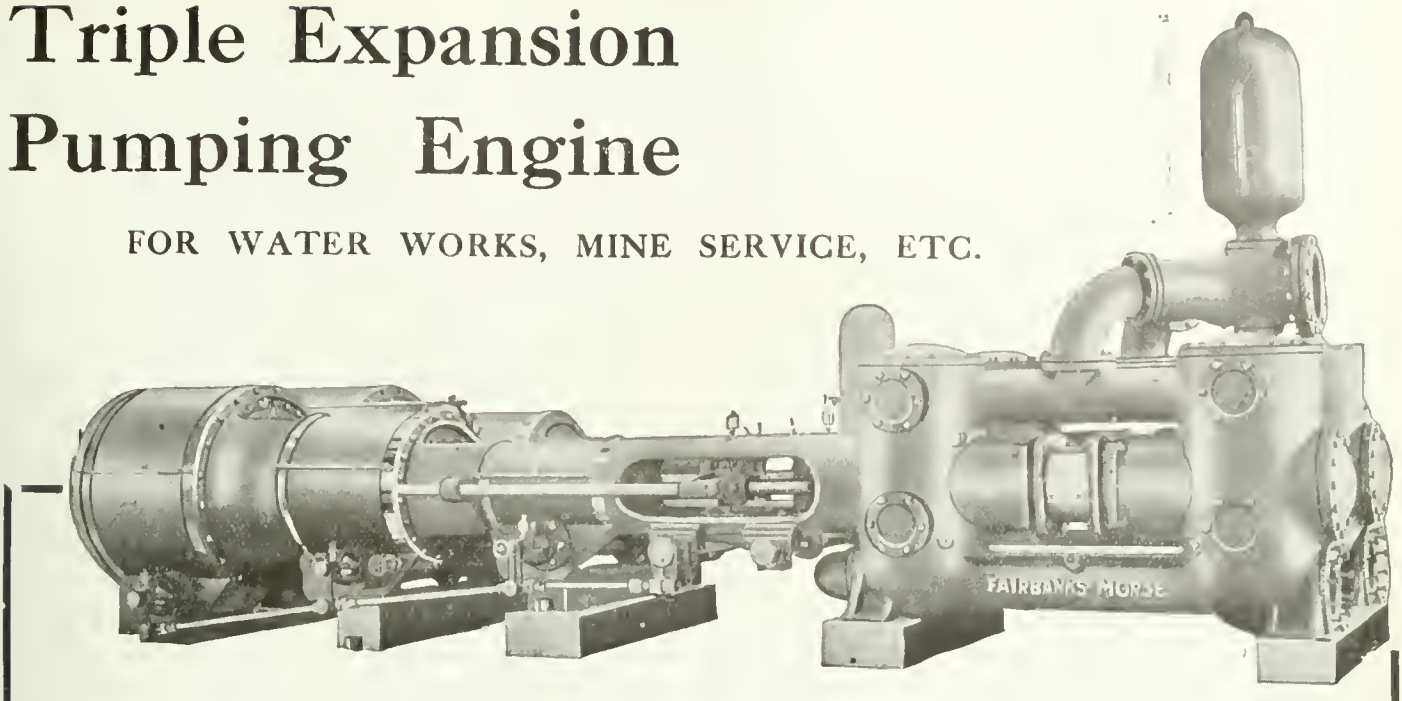
Vancouver, B.C.—The best location and plan for the retaining wall across False Creek, west of Main Street bridge, which is to be built by the Canadian Northern Railway, is being considered by a committee comprised of Mayor Baxter, Ald. Frank E. Woodside, chairman of the bridges and railways committee, Mr. H. H. Stevens, M.P., and members of the harbor commission. The C.N.R. officials are anxious to proceed with the construction as soon as possible.

Victoria, B.C.—The delay in the letting of contracts for the construction of two piers in the vicinity of Ogden's Point, has been explained by a cable from the Hon. R. Rogers. The Minister of Public Works has been recommending piers of stone and cement, instead of piers of crib work with cement covering, as originally planned. The result is that call for tenders for stone and cement piers is expected within a few days.

Winnipeg, Man.—The Harbor Commission have decided upon the construction of a large public dock, 500 feet in length, on the Winnipeg bank of the Red River, between James and Pacific avenues. Plans have been completed at an estimated cost of $35,000, but the construction cannot be begun until a grant is forthcoming from the Dominion Government.

Triple Expansion Pumping Engine

FOR WATER WORKS, MINE SERVICE, ETC.



The Fairbanks-Morse Triple Expansion Duplex Outside Centre Packed Plunger Pumping Engine shown here is very economical in the consumption of steam. The economy of operation makes this Pump preferable to all others in many situations.

The steam end is fitted with semi-rotative valves. The plungers being externally packed are always in sight and any leakage can be at once detected.

All parts are easy of access. The stuffing boxes are large and deep, so that ample allowance of packing may be used.

This type of pump is heavily proportioned throughout in order to meet the demands of heavy service. It is designed to give long and satisfactory service at a minimum cost. It has a 24-inch stroke and a capacity of 2,500,000 gallons per 24 hours.

Departmentalising a Great Business

The marketing of one article is a very simple problem. As the number and variety of the products you sell increase, the complexity of your merchandising problem grows.

Our business has grown in the last dozen years from a comparatively few products into an enormous number of lines. This tremendous growth has necessitated the organizing of our business along departmental lines with able, efficient men at the heads of the various departments.

As organized now we can serve the mechanical field better than any house in Canada. In addition to being manufacturers, we are literally a large "departmental house for machinery and mechanical goods." This bringing together of a vast number of lines and classifying them according to departments is the kind of combination in industry that makes for efficiency, economy and better service.

It is just as great a convenience to Engineers, Contractors and Builders to be able to get their supplies from one House as it is to the general public to shop in a large, modern department store. In dealing with us you can get what you want "under one roof." Write, phone or call.

The Canadian Fairbanks-Morse Co., Limited

"The Departmental House for Mechanical Goods"

ST. JOHN QUEBEC MONTREAL OTTAWA TORONTO
WINNIPEG SASKATOON FORT WILLIAM CALGARY VANCOUVER

TENDERS CALLED FOR

SPECIAL NOTICE TO CONTRACTORS.

RE GREATER WINNIPEG WATER SUPPLY.

(Estimated Cost $13,500,000.)

Notice is hereby given to Contractors that tenders will be invited early in the year 1914 for the construction of works necessary for the delivery of water from Shoal Lake to the Greater Winnipeg Water District. The following is a brief description of the proposed works:—

1. A dyke and channel for the diversion of the Falcon River into Snowshoe Bay.
2. 85 miles concrete aqueduct.
3. 10 miles pipe line (probably 1916 work).
4. 900 lineal feet tunnel under Red River.
5. 85 miles of construction railway.
6. Telephone line.
7. Clearing and ditching.

The fall season of the year affords the best opportunity for inspection of proposed route of the aqueduct, and it is recommended that contractors having a view to tendering on the work should send their inspectors over the line at as early a date as possible.

Particulars as to estimated cost of the work and map of approximate location and profile of aqueduct may be obtained from the undersigned.

M. PETERSON,
Acting Secretary of the
Administration Board,
Greater Winnipeg Water
District.

City Hall,
Winnipeg, Canada,
October 6th, 1913.

Note.—Copy of report of the Consulting Engineers, plan and profile of work and typical details of design may be seen at the office of *The Canadian Engineer*, 62 Church Street, Toronto.

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon, on **Tuesday, November 4th, 1913,** for the construction of the following sewers:—

Division No. 2, West Toronto, Contract No. 3.

Outlet from Keele Street and Uttley Park to Quebec and Annette, via Uttley Park, Hillsview Avenue, Medland Crescent, Humberside Avenue and Quebec Avenue.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen, and forms of tenders obtained at the office of the Commissioner of Works, Toronto.

Tenderers shall submit with their tender, the names of two sureties (approved by the City Treasurer, not members of the City Council, or officers of the Corporation of the City of Toronto) or in lieu of said sureties, the bond of a guarantee company, approved of as aforesaid.

The usual conditions relating to tendering as prescribed by the City By-law must be strictly complied with.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

Toronto, October 15th, 1913.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Addition and Alteration to Public Building, Lindsay, Ont.," will be received at this office until 4 p.m., on Wednesday, November 5, 1913, for the work mentioned.

Plans, specification and form of contract can be seen and forms of tender obtained at the office of Mr. Thos. Hastings, Clerk of Works, Postal Station F, Yonge Street, Toronto, at the Post Office, Lindsay, Ont., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 15, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—47381.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Harbor Improvements at Port Hope, Ont.," will be received at this office until 4 p.m., on Monday, November 17, 1913, for the construction of Harbor Improvements at Port Hope, Durham County, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the office of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Port Hope, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 16, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—47820.

(For further Tenders see page 88.)

Insuring Pumps

against their destruction by fire requires engineering knowledge that is not needed in insuring dwellings, stores, etc.. We used the word "Pumps" only as an illustration. It requires sound engineering and expert insurance knowledge—combined in the one firm—to secure for any industrial or engineering firm the lowest possible insurance rates. Only a firm like ours—employing a staff of engineers—could appreciate your requirements—not only in fire insurance but also in special forms of insurance.

Correspondence solicited.

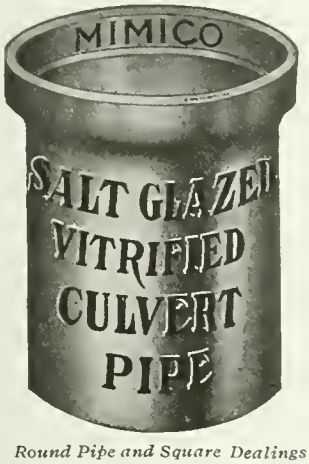
E. M. SELLON & CO.
LIMITED
INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

Ground Water

must be kept out of the sewer. Less money will have to be spent on disposal plant if the amount of sewage to be treated is smaller. Every gallon of ground water that leaks into the sewer adds to the expense and seriousness of the sewage disposal problem.



MIMICO PIPE can be trusted at all times to be watertight.

Round Pipe and Square Dealings *Prices on request.*

The Ontario Sewer Pipe Co.
LIMITED
MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

Renouf Publishing Co.

25 McGill College Ave.
MONTREAL

Structural Details of Hip and Valley Rafters.

By CARLTON THOMAS BISHOP, C.E., Assistant Professor of Civil Engineering, Yale University. Oblong 4to, fully illustrated by general drawings and typical problems, vi+72 pages. Cloth, $1.75 net.

This book has been written to meet the requirements of structural draftsmen when solving problems in hip and valley construction. Complete directions are given for making shop drawings for the steel work of intersecting roofs and similar structures. The notes for the various cases are arranged for convenient reference and are illustrated by general drawings and typical problems.

Graphics and Structural Design.

By H. D. HESS, M.E., Professor of Machine Design, Sibley College, Cornell University. Formerly Designer and Computer for the Mechanical Department of the Pencoyd Iron Works and the American Bridge Company. Member, American Society of Mechanical Engineers. 8vo, viii+426 pages, 429 figures. Cloth, $3.00 net.

To the general designer knowledge of this subject is indispensable while acquaintance with the methods used in determining the stresses in, and the subsequent designing of, structures is of the greatest benefit to others in all designing for strength, whether of machines or structures.

A Treatise on the Design and Construction of Roofs.

By N. CLIFFORD RICKER, B.S., M. Arch., D. Arch., Professor of Architecture, University of Illinois. 8vo, xii+432 pages, 644 figures. Cloth, $5.00 net.

Supplies the data, methods, formulas, and tables required in the design of a roof, arranged in the simplest manner and so as to require the least time and labor in their application.

Applied Methods of Scientific Management.

By FREDERICK A. PARKHURST, M.E., Associate, American Society of Mechanical Engineers. 8vo, xii+325 pages, 48 figures, and 9 plates. Cloth, $2.00 net.

This book will appeal strongly to the manager or superintendent of a plant, as it contains valuable suggestions and outlines the routine which should be assigned to almost every employee.

Elements of Heating and Ventilation.

By ARTHUR M. GREENE, Jr., Professor of Mechanical Engineering, Rensselaer Polytechnic Institute. 8vo, vi+324 pages, 223 figures. Cloth, $2.50 net.

Brings together in logical order and in a small volume the necessary data from which to design the heating and ventilating systems of buildings.

TENDERS CALLED FOR

TENDERS FOR 84-IN. STEEL CONDUIT.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on

Tuesday, November 18th, 1913,

for the supplying and laying of an 84-inch steel conduit from the Pure Water Reservoir on Toronto Island to the South Tunnel Shaft.

Specifications and tender forms may be obtained upon application at the Department of Works, Room 10, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering, as prescribed by city by-law, must be strictly complied with, or the tenders may be declared informal. Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company, approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, October 17, 1913.

TENDERS FOR ANNUAL SUPPLIES.

DEPARTMENT OF WORKS.

TENDERS will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, November 18th, 1913, for: —

BRASS AND BRONZE CASTINGS.
BRASS WORK FOR HOUSE SERVICES.
CAST IRON PIPES.
HYDRANTS.
IRON VALVE AND STOP COCK BOXES.
LEAD PIPE.
SPECIAL CASTINGS.
STOP VALVES.

Specifications and tender form for any of the foregoing may be obtained upon application at the Head Office of the Department of Works, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering as prescribed by City By-law, must be strictly complied with, or the tenders may be declared informal. Tenderers shall submit with their tenders the names of two personal sureties, approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto,
October 21st, 1913.

MAIL CONTRACT.

Sealed tenders addressed to the Postmaster-General, will be received at Ottawa until noon on Friday, the 14th November, 1913, for the conveyance of his Majesty's mails, on a proposed contract for four years, six times per week each way, over Mono Road and Rural Mail Route, from the Postmaster-General's pleasure.

Printed notices containing further information as to conditions of proposed contract may be seen and blank forms of tender may be obtained at the Post Office of Mono Road, and at the office of the Post Office Inspector, Toronto.

A. SUTHERLAND,
Post Office Inspector.

Post Office Inspector's Office, Toronto, October 7th, 1913.

52 A.—2,500-26 9-12.

FURTHER EXTENSION OF TIME.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

CANADIAN GOVERNMENT RAILWAYS.

Halifax Ocean Terminals Railway, Halifax, N.S.

Sealed tenders addressed to the undersigned and endorsed "Tender for docks, First Unit, Contract No. 3, Halifax Ocean Terminal," will be received at this office until twelve o'clock noon, Saturday, the twenty-fifth day ot October, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor to a depth of 45 feet at low water, and filling reclaimed areas.

Plans and specifications and form of tender may be seen and full information obtained at the office of the General Manager, Moncton, N.B., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Halifax, N.S.

The right is reserved to reject any or all tenders.

By order, L. K. JONES,
Assistant Deputy-Minister and Secretary,

Department of Railways and Canals,
Ottawa, September 2nd, 1913.

(For further Tenders see page 84.)

CURRENT NEWS.

Ottawa, Ont.—The Minister of the Interior purposes making an investigation into the small water powers in the West, and he has sent out an engineer with this end in view. The development of these powers is to be encouraged, and recently the regulations regarding the leasing of such powers were amended.

Ottawa, Ont.—The drill in Dundonald Park has failed to strike water after reaching a depth of 1,130 feet; but permission has been granted the firm in charge of boring operations to proceed to a depth of 2,000 feet. After this depth has been reached, if the operations are still unsuccessful, further attempts to locate a subterranean stream for well purposes will be abandoned.

MEXICAN EAGLE ASPHALT

TRADE MARK

The highest quality of any asphaltum imported into Canada

Warner-Quinlan Co. paving St. Audre St., Montreal, with Mexican Eagle Asphalt

Most adhesive, toughest and most ductile of all pure asphalts

Write for prices and particulars to

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

SECOND-HAND MACHINERY

New and Second-hand

Contractors' Machinery For Sale

IMMEDIATE DELIVERY.

1—8"x12", double cylinder, double drum hoist with boiler (new).
1—7"x12", double cylinder, double drum hoist with boiler (new).
1—6"x12", double cylinder, double drum hoist with boiler (new).
1—6½"x8", double cylinder, double drum hoist with boiler (used).
1—6½"x8", double cylinder, double drum hoist without boiler (new).
1—6½"x8", double cylinder, single drum hoist without boiler (new).
1—5"x7", double cylinder, single drum hoist without boiler (new).
1—5"x6", double cylinder, single drum hoist with boiler (new).
1—No. 3, Ransome Concrete Mixer on skids (used).
1—8"x10"x8", Steam Driven Air Compressor (used).
4", 5" and 6" Centrifugal Pumps, d.-c. to Vertical Engines (new).
1½", 3" and 4" Centrifugal Pumps, d.-c. to Gasoline Engines (new).
5" and 6", Belt Driven Centrifugal Pumps (used).

H. W. PETRIE, Limited

Front Street West TORONTO, ONT.

PANAMA CANAL EQUIPMENT FOR SALE.—The Isthmian Canal Commission will offer for sale in the near future the equipment used in building the Panama Canal, such as rolling stock, excavating machinery, floating equipment, miscellaneous plants, and miscellaneous equipment, including locomotives, cars, steam shovels, cranes, unloaders, earth spreaders, track shifters, rock drills, well drills, dredges, barges, tugs, launches, pile drivers, concrete handling plants, pumps, rock crushers, etc. Inquiries from users of such equipment are invited for its purchase. Catalogues listing the equipment offered for sale and other information may be obtained upon application to the General Purchasing Officer, Isthmian Canal Commission, Washington, D.C. F. C. Boggs, Major, Corps of Engineers, U.S.A., General Purchasing Officer.

FOR SALE.—One model 41 Marion steam shovel, less than a year old; one Porter locomotive; ten 4-yard Western cars; one 40 H.P. boiler. Please address Box 154, *The Canadian Engineer*, Toronto.

MISCELLANEOUS.

Calgary, Alta.—Great expectations are entertained with regard to the oil fields near Okotoks, Alta. Private messages have been received to the effect that the oil strikes made give promise of very great supply.

Edmonton, Alta.—The city commissioners recommended to the council that an expenditure be authorized for the construction of gates to protect pedestrians and traffic at railway crossings on four of the city's streets. The recommendation was accepted unanimously, and the gates, including proper signs and lights, will be established at the earliest possible date.

+—Fredericton, N.B.—The contract for the new I.C.R. freight sheds in Fredericton has been awarded to MESSRS. McLAGGAN, McBEAN AND BELL of this city. The contract price is said to be between $13,500 and $15,000.

Goderich, Ont.—The American Road Machinery Company proposes to erect very shortly an addition to their factory at Goderich, which will be a building 70 x 100 feet.

+—Montreal, Que.—Wright and Sons, architects of Montreal, have awarded the general contract for the new G. R. Prowse Range Company's building, on University Street, to ROBERT NELVILLE of Montreal. The contract for the steel work has been awarded to the DOMINION BRIDGE COMPANY, and the excavation, concrete and brickwork to A. E. WAND.

▲—Ottawa, Ont.—Tenders will be received up till November 5th, 1913, for addition and alteration to a public building, Kingston, Ont. Plans and specifications may be obtained from R. C. Desrochers, Secretary of Public Works, Ottawa, Ont.

+—Ottawa, Ont.—The Government of Canada has let contracts necessary for the installation of a $90,000 telescope; and this is to be completed in less than two years. Canada will possess then the largest reflecting telescope in the world. WARNE AND SWASEY of Cleveland, will supply the mechanical equipment; and the JOHN A. BRASHEAU COMPANY of Pittsburg, the lenses. These latter will include a 6-foot silvered mirror, which will take almost a year to manufacture. The probable location of the telescope will be at the Dominion Observatory at the Experimental Farm.

Ottawa, Ont.—Application for incorporation has been made to the Secretary of State's Department by the Confederation Contracting Company, Limited. The new firm is to be capitalized at $2,000,000; and it is understood that it will act this winter as sub-contractor on the Welland Canal.

Ottawa, Ont.—The Canadian Government has retained in its service the firm of Vitale and Rothery, forest engineers of New York City, to advise with the Canadian Conservation Commission in planning the survey of the Crown lands in the Province of New Brunswick.

Petitcodiac, N.B.—A movement is on foot for the rebuilding of the burnt district at Petitcodiac with concrete. In consideration of that a delegation has visited Moncton to ascertain the cost of cement blocks and to investigate all necessary matters connected with rebuilding.

Quebec, Que.—The C.P.R. Company has announced its decision to re-erect a large modern passenger station in the city of Quebec. The new structure will be commenced in the spring. A further project is to use the old Champlain Market as a freight station, complementary to the new construction.

Regina, Sask.—Mr. E. A. Brown, Regina, has invented a tube bender for conduit work. This is the third appliance which Mr. Brown has invented for conduit work.

Rideau Junction, Ont.—The construction of the C,N,R, shops at Rideau Junction has commenced, and an endeavour will be made to have them completed by the coming spring. It is expected that these shops will be eventually the largest and most important on the C.N.R. system.

CURRENT NEWS.

Edmonton, Alta.—The special committee appointed by the council to investigate the reduction of power charges, have reported to the council, but have reached as yet no definite conclusions. The committee reports thus:—"Having gone very carefully into the question of the rates at present being charged the street railway department and electric light department, by the power house department, we believe that a better arrangement ought to be entered into with these two departments, and we would recommend that a committee consisting of Messrs. Ormsby, Parsons and Woodroofe be appointed to go into the whole question of rates, and report to the council at its next session."

Hamilton, Ont.—Engineer Geoffrey of the Hydro-Electric Commission has inspected the township for the purpose of furnishing to the commission and to the Reeve of the township an estimate of the cost of lighting this area with hydro light.

Howick, Que.—The village of Howick is spending over $10,000 this year in the construction of macadamized roadways for its central streets, and all the work is to be completed before winter sets in.

Montreal, Que.—A report has been given the city legislation committee by Dr. Louis Laberge, in which he urges that power be secured from the Legislature permitting the city not to take over a new street until sewers, water-pipes, gas-pipes, and wire conduits are underground, and sidewalks and macadam or pavements are laid. This reform, he claims, is greatly in the interests of public health.

PERMANENCE—

an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

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CANADA CEMENT COMPANY

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MONTREAL

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MONTREAL TORONTO WINNIPEG CALGARY

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Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.—Assistant Engineers, Transitmen, Levellers, Rodmen, Chainmen, Inspectors and Draftsmen for all branches of engineering work. We make no charge to enroll you on our books. Send for application form. Civil Engineer's Employment Bureau, P.O. Box 391, Montreal.

WANTED.—Assistant and chainman for D.L.S. work (Manitoba). Apply Box 166, *The Canadian Engineer*, Toronto.

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Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

MECHANICAL ENGINEER resident in Toronto desires position; wide experience in manufacture and installation; would accept temporary post; references. Box 116, *The Canadian Engineer*, Toronto.

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AN ELECTRICAL ENGINEER; ten years' experience in Western Canada, head office, Winnipeg, is desirous of getting in touch with firms wishing Western Representative. Have managed sales office of one of the largest manufacturing concerns in Canada for the past five years, so am in close touch with conditions. 482½ Main Street, Winnipeg, Man.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

FOUNDRY AND SHOP WANTED.—United States manufacturer desires to lease Canadian foundry and machine shop. Please give full particulars of equipment and state terms desired. All letters confidential. Address Box 156, *The Canadian Engineer*, Toronto.

FOR SALE.—Old-established and well-known Canadian engineering company, doing large business from coast to coast—an excellent opportunity for investors or for anyone wishing to extend operations in Canada by taking over a going concern, with complete plant staff and extensive connection. All communications strictly confidential. Address Box 164, *The Canadian Engineer*, Toronto.

CURRENT NEWS.

Ottawa, Ont.—A conference is to be held in Ottawa on October 30th, which will deal with the pollution of navigable waterways and joint action by the Dominion and the provinces with a view to its prevention. Representatives from the Dominion and the provinces are to attend, and the report of the special committee of the House of Commons, which investigated the question during the last session, will be presented.

St. Catharines, Ont.—The second shovel has been put to work near lock twenty-five on the railroad cut of No. 3 section of the Welland Ship Canal. This is but a start on labor that will ultimately employ 50 shovels or more before its completion.

St. Catharines, Ont.—It is stated that the big trunk sewer, which is to supply Vine Street and the intervening territory between that point and Carleton Street, will be completed within a week. Considerable delay has been experienced in the work due to the discovery of quicksand.

Toronto, Ont.—Work has recommenced on the new G.T.R. bridge at Sunnyside. There has been a delay in the supply of steel, but the difficulty seems to have been circumvented and the large steel spans are now in process of erection.

Vancouver, B.C.—The effort made by the city council to secure a Government loan from the province for continuing the construction of the Marine Drive through to Horseshoe Bay has been unsuccessful. The Minister of Public Works has stated that no further Government appropriations can be made this year, and work on the road must be discontinued for the present.

Victoria, B.C.—Delay is being experienced on the Johnson Street bridge, due to questions of location and grade which cannot be settled until Mr. Gamble, Chief Engineer of Railways, returns, and the matter is again taken up with Government officials.

Welland, Ont.—The first dredge has started work on Contract No. 1 of the Welland Ship Canal at Port Weller. The intention of the contractors is to carry on dredging operations night and day, and to use the material dislodged for the construction of a temporary haven for the protection of the company's fleet of scows, tugs and coal barges during the coming winter.

NEW INCORPORATIONS.

Moose Jaw, Sask.—The Canadian Faced Brick Process and Machinery Co., Limited, $100,000.

Fort Qu'Appelle, Sask.—The Fort Qu'Appelle Boatbuilders and Manufacturers, Limited, $25,000.

Windsor, Ont.—Peninsular Chemical Co., Limited, $40,000. W. Lucking, H. W. Hanlon, H. Van Auken.

Niagara Falls, Ont.—Niagara Brick and Tile Co., Limited, $100,000. F. W. Griffiths, H. F. Upper, W. B. Masters.

Redcliff, Alta.—Quick Removable Bar Cylinder Co., Limited, $500,000. W. D. Hale, J. M. Tinnall, V. L. Harvey.

Windsor, Ont.—The Parsons Motor Car Co., of Canada, Limited, $500,000 A. J. Denomy, T. G. Ellis, R. Ll. Sanscrainte.

Salaberry de Valleyfield, Que.—The Valleyfield Water Power Co., Limited, $1,000,000. N. A. Ostiguy, J. Lowe, A. Cossette.

Vancouver, B.C.—Number Three Oil Well Development Co., Limited, $20,000. Baynes Sound Collieries, Limited, $100,000.

Winnipeg, Man.—Manitoba Contractors, Limited, $250,000. C. I. Jameson, W. F. Guild, W. J. Crawford. Sidney Greenwood Building Co., Limited, $100,000. S. Ward, S. Greenwood, W. W. Barry.

Montreal, Que.—Quebec Development Co., Limited, $2,500,000. A. Wainwright, M. Alexander, C. Sinclair. Simplex Construction Co., Limited, $150,000. A. Wainwright, M. Alexander, C. Sinclair.

Toronto, Ont.—Canadian Rand Goldfields, Limited, $1,000,000. T. R. Hollingworth, F. G. Dyke, F. E. Earl. Canadian Bitumastic Enamels Co., Limited, $40,000. A. W. Holmsted, E. M. Carruthers, A. Ritchie.

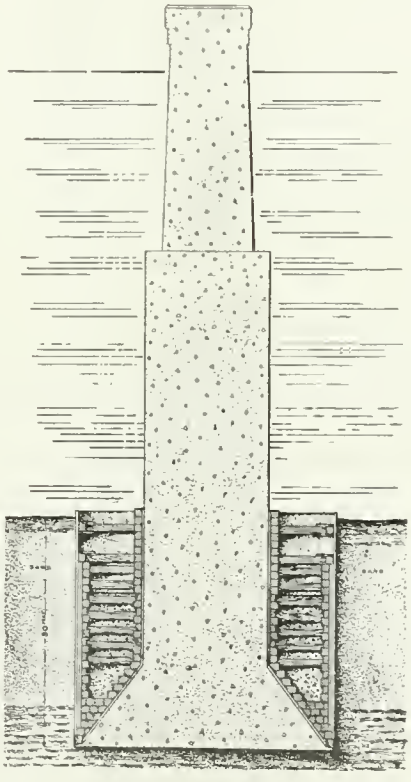
PITT RIVER BRIDGE, BRITISH COLUMBIA—FOR THE CANADIAN PACIFIC RAILWAY.

This bridge is now being replaced by a double track structure on the same site.

The above shows our forces engaged upon this work.

Transcontinental Traffic is being maintained during construction.

Below is section of one of the dredging caissons, which are being sunk in 60 feet of water to a depth of 90 feet.



As Engineers

We investigate
conditions
and
make designs.

As Contractors

We estimate
the cost
and
do the work.

THE FOUNDATION COMPANY, LIMITED

MONTREAL VANCOUVER

MARKET CONDITIONS

Montreal, October 18th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.10 per 100 pounds; best refined horseshoe, $2.35; forged iron $2.25; mild steel, $2.20; sleigh shoe steel, $2.20 for 1 x ⅜ base; tire steel, $2.30 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1 40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in , $3.45; 9/16-in., $3 45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1 in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots. Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4 30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $22.50 per ton; selected Summerlee, $22; soft Summerlee, $21.50 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19.25 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch $1.08.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40 60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3,40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c " H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Toronto, October 22nd, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c per ton of 2,000 lbs., either 1-inch, 10c., 2-inch or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Winnipeg, October 21st, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to 2.50 per barrel.

Chain—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7-16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3-35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe caulk, $4.50 base tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Oct. 30, 1913

Contents of this issue on page 651

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

PRESENT METHODS OF TESTING MATERIALS

WITH SPECIAL REFERENCE TO THE WORK OF THE INTERNATIONAL TESTING ASSOCIATION—A PAPER READ BEFORE THE IRON AND STEEL INSTITUTE, BRUSSELS

By Professor H. HUBERT,

Department of Engineering, Liége University.

THE increasing importance of the use of metals in every description of construction, both of the stationary type, such as bridges and roofs, and of mobile type, such as the parts of machinery; the ever-increasing intensity of the stresses they are expected to withstand and of the energy they are required to transmit, have during recent years necessitated a more and more intimate knowledge of the properties of the materials employed and of the laws which determine the distribution of the stresses in the elements of the structure themselves.

Before dealing with the actual subject it might, perhaps, be advisable to make the following generalization: The most conclusive test, from the point of view of the strength of a structure, is obviously that which consists in subjecting the structure to the maximum it is required to undergo, or even to still greater stresses, so as to ensure complete security against all possible accidents. That is what is done, for example, in the case of ropes, in bridges, in boilers, and in pipes. Such tests are obviously of extreme interest from the point of view of the confirmation of the accuracy of the formulas employed in the calculations of dimensions, and of the hypotheses that it is often necessary to introduce into these calculations. They may also often be made to yield valuable data for the building of similar structures. An attempt has been made to introduce such tests into current practice. In this connection reference should be made to the methods and apparatus of Mr. Rabut, which have been applied to begin with in France, and to those of Mr. James Howard, which have been adopted by the Bureau of Standards in Washington, and were made the subject of a memoir presented to the Congress of the International Testing Association in New York in September, last year.

The first-named allows of the determination, with very close approximation to the truth, of the deformation l which a given length of piece L, forming part of a structure, undergoes, and of the stress being deducted from the formula $t = E \frac{l}{L}$, t being in this instance the tensile stress; or of plotting a diagram having as abscissæ the time, and as ordinates the deflections a metallic bridge undergoes under the influence of moving loads; or, finally, of measuring the angular deviation required in investigating the separate influences of overload and of wind pressure.

Howard's apparatus consists of telescopic callipers, furnished with points bevelled to an angle of 55 deg., which can fit into cavities tapering at an angle of 65 deg. in the pieces undergoing test. Mr. Howard has used this apparatus to investigate the deformation and stresses in the elements of bridges, flood-gates, "sky-scrapers," steam boilers, etc.

In the same connection may be mentioned the tests which have to be applied to the plates intended for the armouring of warships, or for the outsides of gun turrets in forts. These plates have to resist the violent impacts of projectiles. This property is one which can only be made manifest by tests carried out on plates placed in conditions identical with those they have to undergo in practice. In a paper, likewise presented to the New York Congress, Mr. Leonardo Fea shows, from numerous experiments carried out on chromium-nickel and on chromium-nickel-vanadium plates, that none of the tests to which metals are ordinarily submitted, such as tensile tests, compression tests, hardness tests, or fatigue tests, can afford an adequate conception of their behavior under fire. Fortunately such considerations do not obtain in every case, and it often happens that the determination of one or more of the elastic properties of a substance affords an engineer sufficient insight into its behavior in some other respect. For instance, tensile tests are carried out on cement intended for masonry buildings, where it will have to undergo compressive stresses. Experiment, as a matter of fact, has established a certain relationship between the two modes of resistance in cement, provided that the tests are carried out under special conditions, that is to say, on test-pieces always prepared in the same way and always stressed in the same manner. It is in this way, likewise, that a tendency has arisen to substitute hardness tests for tensile tests in iron and steel.

Great modern industries no longer confine themselves to the supply of their own national markets. The works of all civilized countries compete amongst themselves for the markets of the whole world. It has therefore become necessary that the conditions specified as to materials and the estimates of the cost of construction should be, as far as possible, uniform, and that indeed a single nomenclature should be everywhere adopted with the object of controlling the manufacture, of facilitating industrial relations, and of avoiding useless and often ruinous disputes. This standardization has been one of the leading objects which the founders of the International Association have had in view.

Before dwelling in greater detail on the work of the Association, it is necessary to enumerate the different kinds of test to which metals, and in particular iron and steel, are subjected, or to which it has been proposed to subject them. We can adopt the plan of the French Committee on methods of testing, and divide them into three groups:—

(1) *Chemical Tests.*—These are more especially carried out during the progress of manufacture, in order to ascertain the composition and degree of purity of the products. They are, however, also carried out by the purchaser as a check on the specifications controlling the sale.

(2) *Physical Tests.*—These consist of the examination of the exterior of the products and noting their fracture. The superficial examination may yield, to an expert, a general idea. The examination of the fracture, however, particularly when the surface can be projected, under strong illumination, on a screen and suitably enlarged, can yield more definite indications as to the qualities of steel and of cast iron, and as to the defects they may possess. Of late this method has been improved by polishing the surface of fractures and etching it with a dilute solution of acid, or of iodine, potassium iodide, alcoholic solution of hydrochloric acid, chloride of iron solution, or, finally and preferably, with a 10 per cent. ammoniacal copper solution which allows of a micrographic examination being made forthwith.

(3) *Mechanical Tests*, which were for long the only ones to which recourse was to be had in studying metals, still remain some of the most important and practical of tests. The rules or recommendations published by the International Association classify these tests, so far as metals are concerned, into resistance tests on subjection to various forms of stress (tensile, compressive, shearing, bending, and torsional) either applied gradually or suddenly, and workshop tests (bending double, bending single, hammering down, up-setting, punching, and drift tests). They differentiate besides the tests undertaken with a definite object in the case of (1) rolled and forged iron and steel rails, axles, tires, bridge sections, boiler material, shipbuilding material, wire, and wire ropes; (2) for cast iron; (3) for copper; and (4) for other metals and alloys.

The necessity of using, for tests of this nature, accurate and very costly machines, of taking rather large test-pieces from the materials to be tested, of subjecting these test-pieces to most careful and therefore somewhat expensive preliminary treatment, and of entrusting the tests themselves to an expert staff, renders the expense and the time required for such tests relatively large. Many inventors have sought to supersede them by more rapid and cheaper methods, even at the expense of sacrificing some degree of accuracy. Amongst such methods may be instanced the Frémont punch test, with automatic recorder, and the hardness test. The latter in particular has been for many years the object of numerous researches, and has given rise to lively discussions in the technical papers at Congresses of the International Association and at meetings of the National Testing Associations.

As Professor Martens points out in his important work on the testing of materials, "hardness" has been made the subject of many definitions amongst which it is not easy to make a satisfactory selection, and which have led to a number of methods for measuring it. He classifies these methods into two groups:—

(1) In the first group the hardness is ascertained by the penetration of a given body by another at a fixed point, the penetration being effected either by pressure or by impact.

(2) In the second group the penetrating body makes space for itself at the surface of the other body, which it scratches.

When penetration is effected by pressure, penetrants of various shapes are employed. In 1900 Brinell suggested the employment of a very hard spherical steel ball applied by the instrumentality of a hydraulic press, or by a weight, to the surface of the metal to be tested. It produces a depression of semi-spherical shape. If S be the area of this depression in square millimetres and P the pressure in kilogrammes applied to the ball, the ratio $\frac{P}{S}$, called the coefficient or hardness number, may be taken as a measure of the resistance of the metal to the ball, as it increases in proportion as the metal is harder. The ratio $\frac{P}{S}$ increases in any given metal when S is increased, or when the diameter of the ball is diminished. It also depends, within certain limits, on the time taken in making the test. To obtain comparable results it is necessary, therefore, to employ a ball of constant diameter, generally 10 millimetres, and a constant pressure, generally, in the case of iron and steel, 3,000 kilogrammes. On the other hand, from experiments made by Captain Grard, of Paris, it would appear that five minutes is sufficient for S to attain its maximum.

By carrying out numerous tensile tests on steel and comparing the results with those of the ball test, Brinell believed himself able to show that a definite relation exists between the breaking strain and the hardness number. If this be so, the ball hardness test would furnish an easy, rapid and cheap means of ascertaining the strength of a steel. It would also have the advantage of being capable of being applied to finished parts without injuring them, or to ascertaining the homogeneity of metal by making depressions at various situations. It would also furnish the manufacturer or user with an easy means of controlling the influences of thermal or of mechanical treatment, such, for example, as hardening or planishing. The interest which this process aroused may therefore be readily understood. Numerous investigators have sought to verify the relationship. In some instances it may be made to yield results very closely approximating to the truth by adopting the process of multiplying the hardness number by various coefficients in the case of hard or mild steels, and according as the impression is made in the direction of rolling or across the grain. Other observers, such as Mr. Breuil, have found that this method may result in very erroneous results, and the Brussels Congress would not consent to the substitution of the ball hardness test for the tensile test in specifications. The Congress, nevertheless, recognized the value of the process by recommending the determination of the hardness number in testing supplies. Since that time numerous other researches have been made and have given rise to another process of ascertaining the hardness by a method suggested by Martens and Heyn, which consists of taking the depth of the depression as indication of the hardness instead of its diameter.

At the Copenhagen Congress Mr. Ludwik, of Vienna, who had been deputed to report on hardness tests, con-

cluded, on the evidence of all the previously published data, that no simple relation existed between the elastic limit, the breaking strain, and the hardness, but that this did not exclude the possibility of deducing the elastic limit and the breaking strain from hardness tests by means of certain empirical coefficients. By determining the coefficient for each group of sufficiently similar materials, a fairly satisfactory approximation can be arrived at. Mr. Ludwik further notes that for metals that display contraction, the breaking strain does not yield an exact idea of the specific strength. The Copenhagen Congress came to no decision as to ball or cone hardness tests.

The last Congress, at New York, again had occasion to examine the question of hardness from the point of view of resistance to wear. From an important memoir by Mr. Saniter it appears that the relation between these two qualities is too uncertain for either to be deduced from the other. Nevertheless, Mr. Hibbard found that, of two steels of equal hardness, the one with the highest tensile strength had a higher resistance to wear, and that of two steels of equal tensile strength the hardest displayed the greater resistance to wear.

Side by side with ball and cone tests are other methods less frequently employed, but by no means devoid of interest. We may specially refer to the scleroscope method, described by Shore and Breuil, which consists in measuring the height to which a steel ball falling, through a given distance, on to the surface of the metal under test, rebounds, and Colonel Martel's method, which consists in measuring the volume of the impression produced by a pyramidal point falling from a certain height, and, finally, the sclerometers, which measure the depth of scratch produced by a steel point loaded with a predetermined weight.

Up to a certain point some degree of reliance may also be had on the method of photographing the sparks produced by steel when acted on by an emery wheel. Bermann, of Budapest, proposed at the New York Congress that this test should be adopted in the programme of the Association, pointing out that the results obtained show that the percentages of carbon silicon, and manganese in alloy steels can be accurately ascertained by comparing the sparks they produce with those produced by steels of normal composition.

Amongst circumstances exercising considerable influence on the strength of materials there is one which has been the object of numerous researches, and which has forced itself in the most urgent manner on the attention of designers ever since the speed of machines has risen considerably; it is the alteration and rapid succession of stresses which induces what is at present known as "fatigue" in metals. The earliest investigations of this subject were those of Wöhler (1857-1870). Later Spangenberg and Bauschinger (1870) devoted themselves to the question. Some earlier experiments are, however, attributed to Fairbairn.

Without recapitulating here the laws enunciated by Bauschinger, it may be said that both fatigue and hardness tests have as their object the ascertainment of the resistance of metals during use, that is to say, the stresses they can withstand indefinitely without breaking, applied in various ways and undergoing rapid variations and, in particular, changes in direction. Many methods have been thought out for applying such stresses by tension, by bending in one or more planes, and by reiterated shocks. The Brussels Congress did not deal with the matter. The Copenhagen Congress received a communication from Mr. Howard on tests carried out on two kinds of steel containing respectively 0.55 and 0.82 per cent. of carbon, and one by Messrs. Schule and Brunner on the endurance of copper wire under repeated tensile and bending tests. The subject was treated more fully at the New York Congress, where it gave rise to six important papers. That by Mr. Roos, of Stockholm, may be specially mentioned. He carried out experiments by subjecting test-pieces to static stress, by rotary coiling, and by repeated shocks of definite amount. He found that the limit of endurance increases in the same ratio as the limit of proportionality, of which it is on an average 0.65. Mr. Roos believed it possible to conclude from his own personal experience that 80 per cent. of the fractures in pieces that he had examined were due to fatigue and that much importance is to be attached to hardness tests. This conclusion was also arrived at in another paper contributed by Mr. Kommers on tests carried out on the Landgraf Turner machine. He attempted to deduce therefrom a "factor of quality" that might serve for commercial use. It may also be pointed out that the National Arms factory of Herstal, near Liége, which is one of the most important producers of automobiles, motor bicycles, and bicycles, tests the metals it employs by means of a machine which produces shocks of low intensity, rapidly repeated, on test-pieces of a given size.

This leads us, by a natural transition, to deal with a question which has been most strongly ventilated during the last few years, but upon which no agreement has as yet been reached. I refer to the determination of the resistance of metals to shocks of given intensity by means of a determination of their resilience.

The regulations published by the International Association as a result of the Brussels Congress contain a chapter relative to impact tests but dealing exclusively with tests made with a heavy weight (500 to 1,000 kilogrammes falling vertically), and the question of tests made on notched bars is not discussed. The Budapest Congress of 1901 had, however, already recommended this form of test. At the Brussels Congress Mr. Sauvage presented a detailed report on this subject, on behalf of the sub-committee of which he was a member. He gives a history of the publications relative to this type of test, and describes the different apparatus that had been suggested for carrying them out, particularly the Barba and Leblant spring tup, Frémont's spring pressure tup, the pendulum weight employed by Messrs. Bent, Russel, Charpy, and Unwin, and Guillery's rotating weight.

This test is made on a rectangular-sectioned test-piece notched on one side and resting on two supports. It is struck in the middle opposite to the notched side, so that fracture takes place with one blow. The work in kilogrammetres expended in delivering the shock divided by the cross section in square centimetres of the metal left at the bottom of the notch gives the resilience of the metal. The object is to reveal the brittleness of the metal. These tests are easily made, require but small test-pieces, and are inexpensive. Those who have investigated them claim in their favor that they are practical tests, as the parts of a structure during use often display reductions in section, and that they serve to bring out differences in metals that no other type of test reveals. It has, nevertheless, to be admitted that the results of these tests vary with the shape and dimensions of the test-pieces and of the notches, and it has not been proved that the brittleness such tests reveal is of the same nature as that which

operates during the actual use of such pieces. This was shown by Mr. Le Chatelier at the Budapest Congress of 1901. Mr. Sauvage's conclusion was likewise that they had failed to establish their claims. At the Brussels Congress Mr. Ast sought to establish a relation between impact tests on notched bars and tensile and bending tests. Comparison does not establish this relation. On the other hand, numerous facts observed by two officers of the Dutch artillery similarly led to a negative conclusion. The Brussels Congress also negatived the suggestion of inserting notched bar tests in specifications, while at the same time recognizing that the method was capable of yielding highly interesting results.

In a lengthy and important memoir which Mr. Breuil published in the "Revue de Mécanique" (1908-1909) he criticizes the different methods of testing notched bars and investigates the influence of different factors on the results, a subject he had previously dealt with in 1904 in his Carnegie Scholarship report to the Iron and Steel Institute. He concludes that this class of test exaggerates the differences between metals, without, however, conforming to any fixed law, and that it is better to make tensile tests on thin bars to ascertain brittleness. The notched bar test should only be employed to reveal the homogeneity of the metal.

The general meeting of the German Association on Methods of testing, however, held in Berlin on April 5, 1907, in adopting the conclusions of a report by a committee under the chairmanship of Mr. Martens, recommended impact tests on notched bars and recorded a preference for the Charpy swing weight. The delegates defended this resolution at the Copenhagen Congress in 1909, at which Mr. Charpy presented, on his own account, an important memoir on bending tests on notched bars. His conclusions were to the effect that these tests served to bring out the differences which failed to reveal themselves in tensile tests, and that it was not wise, therefore, to ignore them, although it was advisable to adopt a standard method in order to render comparable the results obtained by different investigators. The Congress discussed the question—which was, indeed, the subject of eight memoirs—at length, and adopted the following resolutions:—

The test bars should measure 30 x 30 x 160 millimetres, and should be notched to a depth of 15 millimetres. The bottom of the notch should have a curvature to a radius of 2 millimetres.

In the case of plates the bars may have the thickness of the plate itself and a width of 30 millimetres. The notch should be perpendicular to the rolled surfaces and have a depth of 15 millimetres, and a curvature at the bottom of 2 millimetres radius.

For pieces not admitting of the employment of bars of 30 x 30 millimetres, the bars should be 10 x 10 millimetres, and be notched to 5 millimetres with a curvature at the bottom of the notch to a radius of ⅔ millimetre.

The bars subjected to a bending test by receiving in the middle, and on the surface opposite to the notch, the impact of a falling weight rounded off to a radius of 2 millimetres. The bars rest on knife-edges 120 millimetres apart in the case of large test-pieces and 60 millimetres apart in the case of small test-pieces. As far as possible the temperature during testing should be between 15 degs. to 25 degs. C.

The bars should be fractured by a single blow by means of an apparatus which allows of the energy absorbed in breaking the bars being ascertained.

Finally, the Congress authorized a committee, under the chairmanship of Mr. Charpy, to study the relation existing on the one hand between the results given by notch bars tested under different conditions, and on the other, between the results of tests and the behavior displayed by metals under service conditions. The question was bound, therefore, to come up again at the New York Congress. It gave rise to nine memoirs. Mr. Charpy presented the report of the special committee, from which the following chief findings may be extracted:—

(1) The tests carried out by Messrs. Bartel, Ehrensberger, and Charpy appear to have proved that the resilience shown by small test-pieces is always lower than that shown by large test-pieces geometrically similar. The difference is greater in proportion as the resilience is greater.

(2) Tests by Messrs. Mercier and Mimey have proved that energy required to deform to a similar degree two similar test-pieces of similar metal is proportional to their volumes, and that if the height of fall, the masses of the falling weights, and the distances between supports satisfy the following ratios:—

$$\frac{\sqrt{H_1}}{\sqrt{H_2}} = \frac{M_1}{M_2} = \frac{D_1}{D_2}$$

the energy expended in producing deformation is proportional to the cube of their dimensions and not to the square.

Mr. Charpy recognizes that the employment of two types of test-pieces has not yielded the anticipated results, and that it would be advisable to increase the diameter of the notch in the case of the smaller test-pieces. It does not as yet appear possible to definitely impose any special type of testing appliance, but it is necessary to call attention to the importance of reducing losses of energy due to friction and vibration, and to the necessity of introducing a method of calibrating the apparatus.

The attention of the members of the Congress was pointedly directed to the declaration of Mr. Derihon, whose die-stamping works at Ans, near Liége, produce a large amount of automobile parts, exported to almost all parts of the world. Mr. Derihon used the Frémont weight and test-pieces, measuring 10 x 8 x 60 millimetres, with a notch of 1 millimetre in depth. From 80 to 100 tons of steel are used in his works, and 10,000 to 12,000 impact tests made per month. From 18 to 30 kilogrammetres of resilience is required according to the properties of the steels. To begin with, the specimens rejected amounted to 40 per cent. This result led to improvements in the method of treatment, until at the present time the number of failures has fallen to 3 per 1,000. On the conclusion of the discussion the special committee proposed to ratify the decisions of the Copenhagen Congress, and to collect together for the next Congress descriptions of the machines employed and of numerous comparative tests. The Congress confirmed this decision, and commissioned the committee to present at the next Congress definite suggestions as to the height of fall, the weight of the tup, the process of calibration, the form to be given to the supports of the test-piece, and a definition of the notch for small test-pieces.

According to Capt. Bernier, the Canadian Arctic explorer, who returned on Sept. 25th from Baffin's Land, there is no gold in that region, and previous statements attributed to him that gold had been discovered are pronounced incorrect.

THE BRITISH COLUMBIA ENGINEER.

ON October 13th, the Vancouver Branch of the Canadian Society of Civil Engineers held its first meeting for the winter session. It was largely attended, and was quite representative of both the Vancouver and Victoria Branches, as a large delegation from the latter was present to hear the address of Mr. G. R. G. Conway. Mr. Conway, who is Chief Engineer of the British Columbia Electric Railway Company, is Chairman of the Branch, and is an enthusiastic advocate for a more thorough organization of the engineering profession in Western Canada, and particularly in British Columbia.

In his address, the speaker referred to the benefits accruing to the Branch from its association with the Chamber of Mines, thus affording permanent headquarters, and the prediction was set forth of an Engineering Societies' building before a great lapse of time, this building to be the permanent home for the professional organizations of the province.

Reference was made to the many great and serious problems confronting the British Columbia engineer during recent years, occasioned by the enormous development of the national resources of the province, the building of railroads, the utilization of water powers, the construction of irrigation works, and the advancement of manufacturing industries, and a tribute was paid to the manner in which this engineering work was being directed and carried out. The Canadian Society of Civil Engineers came in for no small measure of credit, as, with few exceptions, the men who are responsible for these great engineering works, as well as their indispensable and important associates, are members of the Society.

Speaking of the members of the Society resident in British Columbia, Mr. Conway makes the following remarks:

"It is because of our real as well as our numerical strength, that the British Columbia members feel that a closer union between themselves is vital and necessary. It is true that we have important branches in Vancouver and Victoria, but we feel that our parent Society with its headquarters at Montreal is somewhat out of touch, both geographically and in spirit, with our Western ambitions. The local branch in Vancouver has been in existence now for about four years—but that is a long time as we measure our growth here. The Victoria Branch is even more youthful. We feel that we must rouse ourselves into vigorous activity so that our honored and venerable Parent will appreciate that her lusty western branches have arrived at years of discretion and are able to judge what is good for their own progress, and how that progress can assist the national Society. In anything we suggest, we wish to be quite emphatic that nothing shall be done that will divorce us from, or alienate the sympathies of, the parent Society; but that the wish of all of us is to broaden and increase the influence of the Canadian Society of Civil Engineers so as to make it a truly representative national Society, weilding a more powerful and beneficient influence over the whole Dominion than it does at present. We do not want it to become—as Western members are sometimes inclined to think it may—a purely local Society for members in the neighborhood of Montreal and Ottawa, living under the influence and fostering care of McGill University, but rather a Society that shall adequately represent the engineering activities in all the great provinces.

"At the present time we have about 240 members in British Columbia, who gain practically nothing from the parent Society, and who feel that any benefit that comes to them from membership is entirely dependent upon local efforts. We have been discussing for some time past, the formation of a British Columbia section of the members, so that our influence in the province will be more fully recognized, and to obtain for ourselves a greater share in the government of the Society so far as our Provincial interests are affected, than is possible under present conditions. We have taken these matters up with the Council of the Society, and are now proposing to forward for consideration at the Annual Meeting in January, at Montreal, a definite proposal which I hope will be cordially endorsed by all the members in British Columbia. Briefly, the proposal is that we shall form a Provincial Division of the Society and still retain the local branches, who will co-operate in all matters that are vitally important to the members in British Columbia. This co-operation, we believe, is of great importance when approaching the Provincial Government on public matters, so that in any petitions it will be felt that we are a united body of trained specialists, who in an advisory capacity might be of great assistance to the Government in the many problems that arise where engineering counsel is necessary. Furthermore, we wish it to be recognized that in the ranks of the Canadian Society of Civil Engineers the best engineering talent in the Dominion of Canada can be found. It is our ambition to place the Canadian Society upon the same influential plane as that occupied by the Institution of Civil Engineers of Great Britain and the American Society of Civil Engineers, whose recommendations to their Governments are not only welcomed but eagerly sought."

Another matter upon which Mr. Conway dwelt to some extent, emphasizing the interest it held for members of the engineering profession in British Columbia, was the provincial university, and its proposed facilities for the training of men in the engineering. He urged the establishment, in addition to the essential departments of civil, electrical, mechanical and mining engineering, of course in economic geology and mineralogy, and a department for the special study of irrigation and the conservation of water, stating the future of the central portion of British Columbia was dependent upon a scientific understanding of the proper storage and proper disposal of water for irrigation. Courses in forestry and in naval architecture were also urged.

In speaking of the engineering works of the province reference was made to the many problems involved in the construction at the present time of 3,000 miles of railway at the cost of $175,000,000; of the magnitude of municipal work; of the development of the vast water power resources, which are conservatively placed at 3,000,000 h.p., and of the difficulties to be surmounted in mining engineering and the lumbering industry. Considering what remains to be accomplished, and considering also the field for harbor engineering, there are unlimited opportunities for the engineer on the Pacific Coast.

Industries are being crippled by lack of proper dock accommodations in Vancouver, and it is difficult to predict how prepared Vancouver will be in 1915 when

the Panama Canal begins to make its influence felt. It was emphasized that more attention should be directed to accommodation for water traffic.

"In Burrard Inlet we have, with the exception of San Francisco, the finest harbor on the Pacific Coast, one that needs no great expenditure to protect it from storms, as many famous harbors have done, but one where the requirements are chiefly wharves and docks that will be absolutely necessary, if we are to maintain a great trade with Europe and with the awakening Orient. The engineer can transform Burrard Inlet into one of the finest harbors in the world, and although some activity has already been shown by our parliamentary representatives in rousing interest in these enterprises, we are delaying too long in starting the project."

Following a discussion of the status and needs of the engineer in British Columbia and of the part which the Vancouver Branch of the Canadian Society of Civil Engineers, was destined to play a resolution was put, and unanimously adopted, to submit to the parent Society in Montreal, the following proposal.

Proposed Change in the By-Laws of the Canadian Society of Civil Engineers.

A new By-law to be numbered 56, and to read as follows:—

A Provincial Division of the Society may be established under the authority of the Council at the request of the majority of the corporate members residing in the Province.

All members residing within such Province shall be members of the Provincial Division so formed.

The officers of a Provincial Division shall be a Chairman, a Secretary-Treasurer, or a Secretary and a Treasurer, and a Committee of four or more members. The Committee shall be elected by a letter ballot of the corporate members residing in the Province. The Chairman and the Secretary-Treasurer, or the Secretary and the Treasurer, shall be elected by the Committee.

The Constitution and By-laws of all Provincial Divisions shall be subject to the approval of the Council of the Society. The Secretary of the Provincial Division shall transmit to the Council, copies of all minutes of meetings, and reports of all proceedings of the Division. The Secretary and the Treasurer shall present a yearly report to the Annual Meeting of the Society.

The Parent Society shall, in addition to the rebate to the branches, grant a further rebate to the Provincial Division of One ($1.00) Dollar per head for every corporate member in the Province, other than those connected with the local branches.

The proposal was forwarded to the Secretary of the Society, formally signed by the most prominent and representative engineers in the West, some of whom are among the oldest members of the Society. The names of those signing were: H. J. Cambie, Thos. H. Tracey, T. H. White, A. E. Hill, F. L. Fellowes, F. C. Gamble, G. R. G. Conway, J. H. Kennedy, R. F. Leslie, G. H. Webster, H. M. Burwell, J. F. Garden, H. B. Smith, H. Carry, and J. R. Grant.

Great interest has been taken in the proposal of the British Columbia members, their object being to strengthen the hands of the Provincial members, and in so doing it is their belief that the parent Society's influence will be strengthened.

INDUSTRIAL DEVELOPMENT IN FORT WILLIAM.

The tremendous growth of Fort William's transhipping trade within the past few years has given great impetus to the development of the city, but Fort William was not contented to remain merely a transhipping point, her citizens realizing the importance of what nature had already done for the city in the way of harbor facilities, etc., and, seeing that the geographical situation destined the city for a strategical manufacturing point of importance, they have through various channels aided and encouraged manufacturing industries to establish at the head of the lakes, and as a result Fort William is to-day rated as one of the important manufacturing centres of the Dominion.

During 1912 Fort William secured some ten manufacturing industries which are erecting plants valued at nearly $4,000,000 and giving employment to close on to 3,000 men.

Among the leading manufacturing industries of the city it is important to note the following:—

The Canadian Car and Foundry Company, Limited, whose plant is now under construction and will cost in the neighborhood of $2,000,000 and give employment to 1,600 men.

The Canada Iron Corporation, Limited, with a million-dollar plant employing nearly 500 men.

The Canadian Steel Foundries plant, to be erected within the next twelve months at a cost of $250,000 and to employ 250 men.

The National Tube Company, Limited, with a plant and equipment valued at $400,000 and practically now ready to begin operations with a staff of 150 employees.

One of nature's valuable gifts to Fort William is the water power available. Within a radius of 50 miles of the city there is water power to the extent of probably 1,000,000 horsepower available. Some 35,000 horsepower has been developed at Kakabeka Falls, on the Kaministiquia River, 17 miles above Fort William. This power has been developed by the Kaministiquia Power Company.

Fort William's harbor and rail facilities are well known. In connection with western Canada's grain crop, it is of some interest to note that Fort William has 23 elevators, with a combined capacity of close on to 30,000,000 bushels. The largest elevator at present in Fort William is the Grand Trunk Pacific, which has a capacity of some 6,500,000 bushels. Additional annexes are being added from year to year that will ultimately bring the total capacity of this elevator to 40,000,000 bushels. This city has been chosen as home of the board of grain commissioners and is to be the headquarters of the grain sample markets.

Iron and other mineral deposits exist in the immediate vicinity. Quite recently considerable development work has been undertaken and samples of iron ore, assaying from 43 to 65 per cent., have been procured.

Lumbering forms a very important industry at and near Fort William and gives steady employment to a great many men and within a fifty mile radius of the city is much arable land.

ELECTRIFICATION OF THE LÖTSCHBERG RAILWAY.

The recent opening of the Lötschberg Railway affords a rapid connection between Italy and the western countries of Europe. The enterprise included a tunnel nine and one-fourth miles in length through the Alps. Reference was made to the construction of this tunnel, which is the third longest on the continent, in July 24th issue of *The Canadian Engineer*, where it was also stated that electric traction would be used.

The locomotives which have been put into service upon this line are claimed to be not only the largest locomotives so far constructed, but, generally speaking, the most powerful locomotives in the world. They are described in detail in a recent issue of *The Electrical Review*, (Eng.,) from which the accompanying illustrations and much of the data are reproduced. Experimental operation on the Spiez-Frutigen section showed the suitability of the single-phase system for the operation of trunk railways, and electrical operation was definitely introduced in 1910 on this portion of the Lötschberg Railway, the trolley line pressure being 15,000 volts, and the periodicity, 15 cycles. The Oerlikon Company supplied the first locomotive with an output of 2,000 h.p. during an hour's working at a speed 42 km, (20.1 mi.) per hour, and this was equipped with two motors each of 1,000 h.p. The satisfactory results obtained with this locomotive during the last two years induced the railway company to entrust the same company with the design of 13 locomotives equipped with motors of even greater power, for the through service on the Thun-Spiez-Brigue Line.

These new locomotives, are designed to develop 2,500 h.p. during 1½ hours' uninterrupted service, at a speed of 50 km. (31.07 mi.) per hour, and have five coupled axles and two free axles. The pull on the drawbar at normal speed is 10,000 kg. (11.02 tons), which suffices for hauling a train of 310 tons over a gradient of 27 per cent., or a train of 530 tons over a gradient of 17 per cent., at a speed of 50 km. (31.07 mi.) per hour, the pull at the wheel circumference being 13,500 kg. (14.88 tons). The maximum speed has been fixed at 75 km. (40.6 mi.) per hour. The locomotives are able in starting to develop a pull 30 per cent. above the normal figure, that is, of about 18,000 kg. (19.82 tons).

As regards the mechanical part, the longitudinal frame carries the body of the locomotive, which comprises three compartments, viz., the engine room and the drivers' cabins, which are separated from the former by partition walls and doors. In order to ensure the greatest possible freedom on curves, the central (driving) axle has been given a side-play of 25 mm. (0.984 in.), the two inner coupled axles are located rigidly in the frame, and each of the two outer ones, having a side-play of 40 mm. (1.5748 in.) is connected with the corresponding fee axle, thus forming what is called a Krauss-Winterthur bogie. In the case of the free axle an even greater side-play has been provided, thus allowing curves of only 120 m. (393.7 ft.) radius to be negotiated in spite of the considerable length of the locomotive. The central axle has spiral springs and the coupled and free axles plate springs.

The hand brake in each driver's cab acts on the free and coupled axles situated near by and on a brake block on the driving axle. In view of the considerable gradients on the line, the locomotives have been equipped with the Westinghouse automatic brake and a regulating brake. From the driver's platform are also controlled the whistle and sanding device which, like the collector bow, and part of the safety devices, door-locks and ladders are operated by compressed air.

All the electrical equipment has been duplicated, thus allowing the locomotive to be operated with half of its equipment, that is, with one transformer and one motor and accessories. Provision has also been made for the two halves of the equipment to work either in series or in parallel, the two motors being fed from either transformer, so that the locomotive will, for instance, develop its full tractive effort with a single transformer and controller, and both motors arranged in series, and be able permanently to keep up its full speed with one motor.

The current goes from the 15,000-volt line through the two bow collectors over two choking coils, to the two halves of the electrical equipment, viz., through two high-tension oil switches to the two transformers and two earthing slip-rings fixed on the rigid axles, to the rails.

The high-tension oil switches allow the whole of the machinery to be switched off. For the sake of safety there have been fitted on both sides of the oil switches, earthing switches which are closed while the doors of the high-tension compartments are kept open.

Fig. 1.—Locomotive and Train, Lotschberg Railway.

The transformers are air-cooled, the low-tension coils having 12 tappings for controlling the speed. A special fan fitted to each transformer ensures thorough cooling.

In operating the controller, perfectly smooth starting with a practically constant pull is obtained, on account of the low pressure difference (45 volts) between the various steps, the power factor being about .95 with all loads at normal speed. These favorable starting conditions are, or course, of the utmost importance to the power station supplying the line, especially during the simultaneous starting and shunting of several trains.

Fitted on the transformer, and combined with it, is the controller, the contacts of which are connected directly with the low-tension windings of the transformer. All parts of the switch subject to wear are readily exchangeable. Current interruption proper takes place on a secondary drum with magnetic spark damping, whereas any alterations in the connections of the main-switch drum occur under no-voltage conditions. The switching is effected mechanically by a small auxiliary motor fed with direct current, which, through the

intermediary of a wormgear, actuates a pawl mechanism. The pawls are controlled by electro-magnets energized from the driver's platforms. According as one or other of the pawls is actuated, the switch drum will rotate in either direction, thus making or undoing the connection.

These controller switches, as well as the low-tension oil switches, are designed for a maximum current of 3,600 amperes.

The two motors, each designed to give 1,250 h.p. on the rails during 1½ hours' uninterrupted operation, are of the Oerlikon compensated series type, rigidly fitted into resilient frames. They drive through tooth-wheeled gearing with a ratio of 1:2:23, fitted into the motor housing, on to the motor shaft, which is a loose axle connected by the driving gear to the coupled driving axle. The cranks of the two main shafts of the motors are connected by a triangular rigging to the cranks of the driving axles. This arrangement avoids practically any non-resilient part, the spring action in the triangular rigging with the central driving axle being accommodated by a vertical rubbing plate.

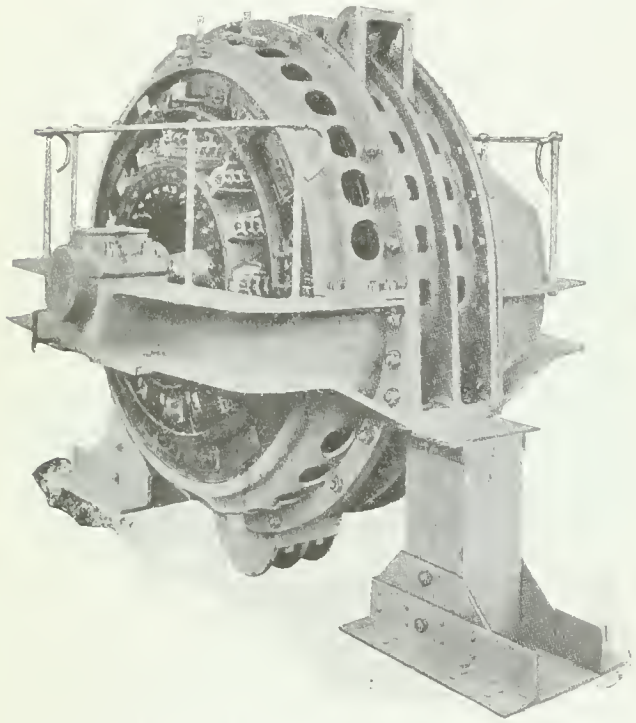


Fig. 2.—Oerlikon Motor for 2,500-H.P. Lotschberg Locomotive.

The motors are of the 16-pole open type, the air being allowed free access everywhere. They are fed at a maximum pressure of about 430 volts, and are designed to absorb about 3,000 amperes, at their maximum output. A ceiling fan fitted above the motors ventilates the whole of the motor compartment. This motor system which has also been used in connection with the 2,000 h.p. experimental locomotives previously referred to, shows most favorable starting conditions, thus greatly facilitating the shunting of the locomotives. In starting at full power, the locomotive only requires about a third of the normal overhead line current. Another advantage of this system is its practical independence of the number of cycles and of any speed limitation by synchronous number of turns. The normal speed of the locomotive is reached with four times the synchronous number of turns of the motors. The power and speed of the motor are also independent within wide limits of the overhead line voltage, any considerable drop in the line voltage being compensated by suitable transformer winding, while the motor with only one-third of its normal voltage, is able permanently to develop its full power. This provides for great overload capacity of the motors at normal pressure.

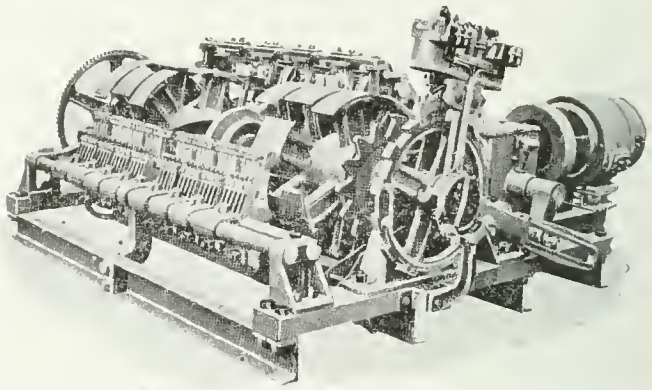


Fig. 4.—Motor-Operated Controller, 2,500 H.P., Lötschberg Locomotive.

Fitted direct on to each motor and electrically connected with it, is the controller for reversing the direction of travelling. This alters the current direction in the exciter coil, and is controlled through electro-magnets from the driver's cabin. In case of emergency these controllers, as well as the remaining apparatus, can be operated by hand.

Current for the auxiliary motors and for heating, can be derived from either transformer by means of switch fuses, the heating current being switched in from the drivers' platforms.

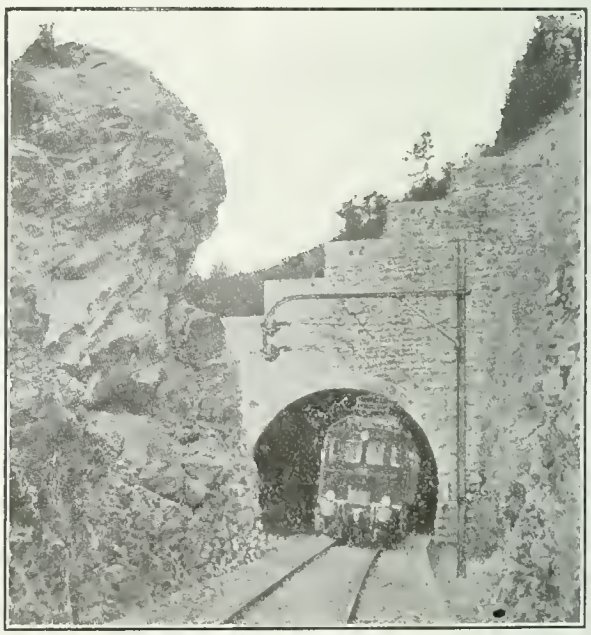


Fig. 3.—Entrance to the Lotschberg Tunnel.

A converter set supplies continuous current to the remote control and the lighting, in parallel with four ordinary train lighting batteries, and is also controlled from the driver's cabin. All the requisite switches and instruments are installed in the drivers' cabins.

The two high-tension compartments in the motor room of the locomotive are closed by lattice-work doors, which are so locked that the high-tension circuit in front of and behind the high-tension oil switch has to be earthed before opening them. The key used in undoing this lock is arranged on a tap connected to the bow air conduit and cannot be removed unless the tap is opened, thus causing any air in the bow conduit to be discharged. This key cannot be withdrawn from the lock before closing all the doors, thus preventing the high-tension compartment from being opened while "alive." Means have also been provided for the oil switches to be operated by hand only while under no-voltage. In order to keep the operator informed of the actual position of the apparatus in the case of hand operation, signal lamps have been provided for the controller and direction of travelling. The folding ladders for climbing to the roof are mechanically connected with alarm whistles, which are actuated in the event of there being any compressed air left in the bow air conduit on lowering a ladder.

The following is a summary of the principal data:—

General data: Single-phase alternating current system, 15,000 volts and 15 cycles per second.

Gauge, 48 ft. 8 in.; maximum gradient, 27 per mile.

The principal data of the locomotives themselves are as follows: Maximum length between buffers, 52.5 feet; total wheelbase, 36.86 feet; rigid wheelbase, 14.76 feet; diameter of driving wheels, 4.43 feet; diameter of free wheels, 2.79 feet; maximum axle weight, 16.6 tons; friction weight, 78.2 tons; total weight, 104 tons; output during 1.5 hours, 2,500 h.p.; pull on wheel during 1.5 hours, 1,488 tons; speed for 1.5 hours, 31.07 miles per hour.

COPPER-ZINC ALLOYS.

Considerable discussion has taken place lately regarding the several advantages for engineering work of the copper-tin alloys, or true bronzes, and the copper-zinc alloys, which are usually generically termed brasses. It will be remembered that quite recently a firm of continental engineers introduced a new alloy of the latter type, which is expected to prove of special value. It would not appear possible yet to give any details as to the behaviour and durability of this alloy in actual service, owing to the fact that it has only recently been obtainable. An interesting paper was recently read by Dr. C. H. Desch and Mr. S. Whyte, both of Glasgow University, on the "Corrosion of Copper-Zinc Alloys," from which much valuable information can be obtained, and which throws considerable light on the subject. It appears that the results of certain tests carried out emphasized the importance of distinguishing between material which was actually dissolved and that which merely lay in strata in the mass. It was found that the effect of quenching from above, the transformation temperature increased the tendency to corrode. It was demonstrated that there was no evidence that the alloy containing tin had any less tendency initially to corrode than any of the high-grade brasses. It was proved, however, that the presence of iron, as had long been suspected to be the case, did increase the tendency of the alloy to corrode.

MICA DEPOSITS IN CANADA.

Concerning the importance of Canada as a mica-producing country, very interesting information is given in a report issued by the Department of Mines in a pamphlet by Mr. J. McLeish, called *Economic Minerals and Mining Industries*. The following paragraphs have been taken from the same:—

"With the exception, perhaps, of Ceylon, Canada is the only country, as far as is yet known, in which the variety phlogopite—or 'amber mica,' as it is termed in the trade—is known to occur in economic quantities. The mica of commerce is of two kinds—muscovite, or 'white mica,' and phlogopite, or 'amber mica.' The former is obtained from both India and the United States, while the latter is secured almost wholly from Canada. Of the two varieties, phlogopite commands rather the higher price, being softer and more flexible and altogether more suitable for use as an insulator—this being the principal use to which mica is put at the present day.

"The amber mica deposits of Canada are comprised within an area of approximately 1,200 square miles in the province of Quebec, and 900 square miles in the province of Ontario. The two districts are separated geographically by the Ottawa River, and geologically by a belt of sedimentary rocks about 40 miles wide. The city of Ottawa lies between the two productive areas and is the seat of the mica industry—all the important works engaged in trimming and in otherwise preparing the mineral for the markets being located in that place.

"Deposits of white mica, also, occur in Canada, and occurrences of this variety (some few of which have been worked at various times), are known from Labrador in the east to the Rocky Mountains in the west, while several Arctic expeditions have returned with good specimens from the far north.

"Though the average dimensions of mica sheets do not much exceed 3 x 5 inches, plates of enormous size are sometimes obtained. Crystals have been found which measured over 4 feet across and weighed nearly two tons.

"About 300 mines have been worked for mica at various times in Canada, but at the present day no more than 25 are in active operation. Among the large operators may be named:—The General Electric Company of Schenectady, N.Y.; Webster and Company, Ottawa; Blackburn Brothers, Ottawa; Wallingford and Company, Ottawa; O'Brien and Fowler, Ottawa; Kent Brothers, Kingston."

NATIONAL MUNICIPAL LEAGUE.

The National Municipal League convenes in Toronto on November 12th, 13th, 14th and 15th.

USES OF COAL TAR.

Tar, a bye-product from the coking of coal, is used largely for two purposes, namely, distillation for production of creosote and light oils and pitch, and for use in road-making, giving a smooth and dustless surface to macadamized pavement. Both of these uses of tar have increased very greatly in the last few years, and the tendency for still further increase indicates a very large proportion of the future production will be similarly used. Tar is further being used successfully in open-hearth furnaces, replacing producer gas; also in heavy oil engines, providing it does not contain too much free carbon.

SANITARY SURVEY OF RIVERS.

By R. O. Wynne-Roberts,
Consulting Engineer, Regina.

(Continued from last week's issue.)

THE authors then state that in Sept., 1911, the Des Plaines at Lockport was much more offensive than the canal, its organic contents being evidently in far more advanced stage of decomposition. Stones and pebbles were completely covered over with septic growth of sphœrotilus and algæ, mainly blue-green species. The water had a grayish look and a filthy smell, evidently much too foul for even the most indifferent species of fish. The content of dissolved oxygen was, however, higher in the Des Plaines than in the canal, being 44 per cent. of saturation.

At Dresden Heights, the dissolved oxygen content averaged 13.1 per cent. at 68 deg. Fahr., but in the Kankakee River, close by, it averaged 126.8 per cent. at a temperature of 71.6 deg. Fahr. In other words, the Kankakee River water was supersaturated with oxygen. Kankakee River water held in solution 2.1 parts per million of carbon dioxide as compared with 12.8 parts in the Des Plaines.

Slime worms (*Tuberficidæ*) were rare in the soft, black sludge in the Des Plaines.

Decomposition of its sewage material had not reached its climax, which came at Morris and Marseilles, at low water in the hottest weather.

"Conditions in the Kankakee at its mouth are particularly interesting and important, since they give us a close approximation to those of the natural water of the Illinois River, derived, as they are, from a territory similar in character to the valley of the Illinois below, and contaminated but slightly, if at all at this place, by way of contributions from comparatively small towns at some distance above."

The average of nine determinations of oxygen in this river was 103.8 per cent. of saturation. In the forenoon it averaged 101.7 per cent. and in the afternoon 121.2 per cent. The afternoon increase was doubtless due to the liberation of oxygen by submerged plants under the influence of sunlight. This phenomena is corroborated by Messrs. Clark and Adams, who found green growths (Chlorophyll) to give off free oxygen when growing in light, and that water containing chlorophyll-bearing organisms take a greater part in overcoming sewage pollution in surface waters than is at present generally realized.

Messrs. Forbes and Richardson found no blue-green algæ, no fixed form of protozoa, no oligochæte worms, no sewage fungus in the Kankakee River water.

At Morris, the Des Plaines River water flowed more or less along the north bank and the Kankakee River water along the south, and it was plain by the dissolved oxygen tests that the waters had not mixed.

An extensive deposit of sludge, 5 to 6 feet deep in places, was formed at the lower end on an island. Some gases from this sludge were collected and analyzed, with the following results: Carbon dioxide, 18.96 per cent.; oxygen, 0.03 per cent.; carbon monoxide, 0.56 per cent.; methane, 79.25 per cent.; nitrogen, 1.19 per cent. The abundance of carbon dioxide and the almost complete absence of oxygen are, of course, to be understood as due to organic decomposition in the presence of oxygen, and the methane is evidence of the continuance of the decomposition after the available oxygen was exhausted.

"**Sludge Worms.**—It is clear that neither plants nor animals requiring oxygen could live in these sediments at the bottom of the stream. The abundance of Tuberficidæ imbedded in this is explained by the extraordinary respiratory capacity of these worms, and by the fact that their respiratory structures are situated at the anal end of the body, which projects above the bottom and is kept continually waving back and forth. Their circulatory system likewise specially adapts them to live in water with a minimum of oxygen, the blood containing sufficient hemoglobin in solution to give it a red color, and being kept in active circulation through a closed system of blood-vessels."

"**Marseilles Dam.**—The situation of quarter of a mile above the dam may best be described by a comparison with that at Morris, these points being but seventeen miles apart, with no important tributary of the river or other modifying factor coming in to interfere with the spontaneous development of conditions within the stream itself. Another important and interesting comparison is that of chemical and biological data from above and below this dam, since this comparison will show us what and how great are the effects of the fall upon the polluted water."

"The analyses for August, 1911, show oxygen ratios of 20.4 per cent. at Morris on the 11th, and 11 per cent. at Marseilles on the 12th, 16.35 per cent. at Morris on 22nd and 23rd, and 7.4 per cent. at Marseilles on 24th and 25th. The carbon dioxide ratios, on the other hand, were much larger at Marseilles than at Morris on these dates. Active decomposition of organic matter was thus clearly evident in this midsummer weather, at low stage of water then prevailing. With higher water and cooler weather the difference between Morris and Marseilles were greatly diminished, the percentage of saturation, February 16th to 20th, standing at 48.76 for Morris and at 43.70 for Marseilles. In the fall of the following year these ratios were, in fact, reversed, the Marseilles determinations being 5 per cent. higher than at Morris, Sept. 27th and 9 per cent. higher, Nov. 14th."

"**Below the Dam.**—Turning now to the situation below the dam at Marseilles, in July and August, 1911, the ratios of dissolved oxygen three-fourths of a mile below were more than three times as great as those above; that under winter conditions in February and March they were 13 and 14 per cent. greater; and that in August and September, 1912, with cooler weather and higher water levels than in the previous year, they varied from one and a half to two times as great. The necessity of taking samples for analysis at some distance below the dam was shown by the fact that the oxygen content of the water, September, 1911, an eighth of a mile below was more than ten times that above—a discrepancy to be accounted for only on the supposition that the air mechanically caught in the water at the fall had not yet had time to escape."

At Starved Rock, which is 95 miles from the mouth of Chicago River, the odor of the water in August, 1911, was still disagreeable, and sewage fungus still found floating in the current.

At Chillicothe, 145 miles down stream, in July and August, 1911, the water had a distinct greenish cast, without odor and mud taken from the bottom had a good, fresh smell. In March, 1913, however, the sludge from a deposit 2 feet deep had a distinct sewage odor. The cooler temperature of the water—41 deg. Fahr.—delayed decomposition. The river was, however, still far below a normal unpolluted stream in oxygen ratios, and contained much more carbon dioxide. The average of dis-

solved oxygen tests in August, 1911, gave 3.70 parts per million, but in Nov., 1911, it was 10.15 parts per million, equal to 84 per cent. of saturation.

"**Summary by Stations.**—The Sanitary Canal at Lockport.—Although the water of the canal at Lockport was comparatively clear, with an inoffensive odor, even in August and September, 1911, it was not only heavily loaded with putrescible materials from the Chicago sewage, mainly as yet undecomposed, but it was lower in oxygen content at most times than the river water either of the Des Plaines or the Illinois at any point where our tests and collections were made. In the winter, however, the amount of oxygen in solution approximated the ratios of an unpolluted stream, being actually higher in February, 1912, than at any point between Lockport and Peoria. This is to be understood, of course, as due to the gradual start and slow decomposition of the self-purification process in cold weather."

"**The Des Plaines River at Dresden Heights.**—The Des Plaines at its mouth was heavily loaded with putrescible sewage materials so far advanced in decomposition that oxygen ratios were always very low. They differed, however, according to seasons, in comparison with those of the next lower stations, being higher than these in the hottest weather and lower at lower temperatures. In July, 1911, for example, when the water of the Des Plaines contained 1.21 parts per million, that of the Illinois stood at 1.07 at Morris, and at 0.83 above the Marseilles dam. In November, 1912, on the other hand, the corresponding figures were 4.90 for the Des Plaines, 6.80 for the Illinois at Morris, and 7.90 at the Marseilles dam. This seasonal difference is again to be accounted for by the different effect of low and high temperatures upon the beginning and rapidity of decomposition process in a polluted stream."

"**Morris to Marseilles.**—In the seventeen-mile section of the Illinois from Morris to the upper dam the river reaches its lowest point of pollutional distress, becoming, when very hot weather coincides with a low stage of water, a thoroughly sick stream. Its oxygen is nearly gone; its carbon dioxide rises to the maximum; its sediments become substantially like the sludge of a septic tank; its surface bubbles with the gases of decomposition escaping from sludge banks on its bottom; its odor is offensive; and its color is gray with suspended specks and larger clusters of sewage organisms carried down from the stony floor of the polluted Des Plaines, or swept from their attachments along the banks of the Illinois. On its surface are also floating masses of decaying debris borne up by the gases developing within them, and covered and fringed with the sewage fungus (*Spheorotilus natans*) and the bell animalcule (*Carchesium lachmanni*), usually associated in these waters. The vegetation and drift at the edge of the stream are also everywhere slimy with these foul-water plants and minute filth-loving animals."

The authors, in bringing their report to a close, express a few results of their investigations, and the following extracts are, perhaps, sufficient to indicate what they are:—

General Summary of Chemical Features.—"The lowest ratios of dissolved oxygen in the upper Illinois were found in July and August, 1911. When determinations at the mouth of the Kankakee varied but little from 10 parts per million, those from the mid-stream at Morris, nine miles below, ranged from 0.24 to 1.78; at Marseilles, above the dam, 2.18; and at Starved Rock, 3.18. At Chillicothe the ratios varied on different days from 2.10 to 4.21 parts per million, with an average of 3.47. Single determinations at the lowest of our river stations yielded as little as 19.5 per cent. of saturation, and the average of all our midsummer determinations here for 1911 was but 40.8. As the Kankakee River average at this time was 112.2, it appears that during the upper ninety-three miles of its course the Illinois did not regain much more than a third of the oxygen lost to the Chicago sewage."

"A trip was made for chemical determinations, February 1st to 8th, 1912, from Lockport to Chillicothe, and another, March 18th to 28th, from Lockport to the mouth of the Illinois at Grafton. The water temperatures averaged 34 deg. Fahr. on the first trip and 35 deg. Fahr. on the second trip, the upper river being quite frozen over much of the time.

"The oxygen determinations of these trips differ widely from those of the preceding midsummer in the much higher ratios found in the winter, and in the fact that the lowest point for oxygen was very much farther down the stream. In all our midsummer trips this lowest point was reached at the Marseilles dam, but in February there was less oxygen at Chillicothe than at Marseilles, and in March, when the whole of the river was traversed, the oxygen ratios declined down stream from Marseilles to Havana, rising then gradually to the mouth of the Illinois. At Morris the ratio of oxygen was more than six times as great in February as in midsummer; above the dam at Marseilles it was more than eight times as great; below the dam more than three times; and at Chillicothe it was 30 per cent. greater. The March ratios from Morris down were much higher still, reaching a maximum of 10 parts per million below the Marseilles dam, falling thence rapidly to Peoria (0.8), dropping a trifle only at Peoria below the outlets of the sewer system (6.5), declining slightly to Havana (0.2), and rising steadily to the mouth of the Illinois (9.4), the water of the Mississippi standing at the same time at 10.5. In the entire distance from Lockport to Grafton the percentage of oxygen saturation on this March trip did not fall below 44 (Peru), nor rise above 75 (south shore, Morris)."

The Effect of a Dam on Dissolved Gases.—"The fall over the Marseilles dam in the hot weather and low water period of July and August, 1911, had the effect to increase the dissolved oxygen more than 4½ times, raising it from an average of 0.64 parts per million to 2.94 parts. On the other hand, with the cold weather, high oxygen ratios, and higher water levels of February and March, 1912, and the consequent reduced fall of a large volume of water at Marseilles, the oxygen increase was only 18 per cent.—from 7.35 parts per million above the dam to 8.65 parts below; and in August and September, 1912, the weather being still cooler, and the water lower than in the midsummer of the previous year, the increase was only 77 per cent.—from 2.05 parts per million above the dam to 3.62 parts below. It should be noted, however, that this beneficial effect is greatest when it is most needed—when the pollution is most concentrated and decomposition processes are most active. In the absence of a dam at this point the recovery of oxygen used up in decomposition would be greatly retarded in midsummer, and heavily polluted water would be carried much farther down the stream."

Seasonal Phases of Chemical Condition.—"The midsummer and the winter phases represent, of course, the extremes between which the fall and spring conditions come as intermediate or transition stages. The midsummer phase, with its high temperatures and low stage of water, is characterized by a concentrated pollution and an early and rapid decomposition and deoxygenating

process, with lowest oxygen readings at Morris and above the dam at Marseilles, followed by a sudden increase of oxygen below the dam and a gradual rise in ratios thence down the stream to its mouth. The winter phase contrasts with this by a delay of decomposition such that the oxygen ratio is highest at Marseilles, declines slowly to the middle of the river's course (about Havana), and then rises gradually to its mouth. In the autumnal transition phase the oxygen ratio is at its lowest point in the Dresden Heights-Marseilles section, although much higher there than in midsummer, rises thence slowly to Peoria, and continues on an approximately level line to the mouth of the Illinois. In the spring phase a transition in the opposite direction probably gives somewhat similar results, modified, however, by the spring floods, which are usually much larger than those resulting from the fall rains, and by differences in the antecedent seasonal conditions from which this spring transition makes its start."

"These periodical changes in the distribution of oxygen and carbon dioxide within the stream are, of course, consequent upon seasonal differences in temperature and stage of water, influenced considerably by the upper dam, at Marseilles, and the above descriptions may perhaps need modification to make them applicable to notably unusual years."

The writer has endeavored to give the essential features of this valuable report, but there are other interesting points dealt with which cannot be referred to in the space of a review such as this. The comprehensive character of the investigations made under a variety of conditions and over lengthy periods and on the same river, afford a useful index into what may be expected in Canadian rivers, where dilution is contended to sufficiently purify large volumes of sewage. It would seem from Messrs. Forbes and Richardson's report that in the case of Chicago sewage dilution is either insufficient or it is not effective enough. Without the necessary data it is, of course, not possible to express opinions on this score. Hoping the foregoing will be of some service to your readers, who, if they require further information, should obtain a copy of the bulletin in question, by writing to the Director of the State Laboratory, Urbana, Illinois.

ITALY'S WATER POWER DEVELOPMENT.

The *Scientific American* gives an interesting account of the enormous power plants planned, involving irrigation works, for Southern Italy. It is expected that water storage reservoirs sufficient to produce 50,000 horsepower, can be laid out in the Calabria region; while, in the Sila mountain country, where there is an abundant rainfall, though irregular, throughout the year, four great reservoirs will be used, the largest to contain 5,000 million cubic feet of water. It is planned to erect at the outset a 50,000 horsepower turbine electric plant, from which part of the current generated will be utilized by the nitrate of calcium fertilizer works, and the remainder will be transmitted over long power lines throughout Calabria and surrounding regions. Additional profit is to be gained for agriculture by this new enterprise; for the regular water supply will provide a very satisfactory irrigation system. For the island of Sardinia a somewhat similar scheme is contemplated; and for the Cagliari plain the water of the River Tirso, which is to supply a reservoir of 10,000 million cubic feet for use with a 15,000 horsepower hydraulic plant, will provide irrigation, as well as power in the place of coal for the use of the numerous mines of the country.

THE REJECTED McGREGOR LAKE SCHEME FOR OTTAWA WATER SUPPLY.

As announced on page 78 of last week's issue, the city of Ottawa has decided to adopt the scheme advanced by Sir Alex. Binnie, for the supply of water from Thirty-One Mile and Pemichangaw Lakes. *The Canadian Engineer*, in its October 16th issue, outlined the water situation in Ottawa and published the important features of the report upon the recommendation of which the City Council decided, on October 17th, to act.

This report also included the results of an investigation of the McGregor Lake series as a source of supply. By the term "McGregor Lakes" are known a large number of lakes which are situated at distances varying from about 15 to 30 miles to the north of Ottawa and lying about mid-way between the Gatineau and the Lievre Rivers. They are small when compared with Thirty-One Mile Lake, the largest being McGregor, which has an area of 2.13 square miles, or about one-ninth of the area of Thirty-One Mile Lake. Mr. Hazen in his report, dated the 10th of May, 1910, gave a table setting out the various lakes, 37 in number, and their areas, which either discharge into the Blanche River by way of McGregor, or the waters of which can easily be diverted into that lake:

McGregor, with an area of 2.13 square miles,
Wakefield, with an area of 1.47 square miles,
Grand, with an area of 1.37 square miles, and
St. Germains, with an area of 1.12 square miles, are the only lakes of any size; the others enumerated varying from about a square mile to a few acres in extent. The drainage area which contributes, or which can economically be made to contribute, to the water flowing from McGregor Lake into the Blanche River amounts to about 94 square miles. Taking the same figure for average rainfall, as in the previously described Pemichangaw Lake scheme, viz., 37 inches, and assuming the same figure for evaporation from which the figure of 13.6 inches is arrived at as representing the run-off during the three driest consecutive years as being applicable to both Thirty-One Mile and McGregor areas, the report estimates, a figure of 51,000,000 gallons per diem as the yield of the drainage area.

As in the previous case, the ground surrounding the lakes is for the most part rocky and covered with trees, but the hills surrounding Thirty-One Mile Lake rise to greater altitude, and far more clearing has been done around McGregor Lake and Wakefield Lake, the resident population being given as between 7 and 8 persons per square mile. The effective storage in improving the purity of the surface water and in bleaching and removing the color is now very generally recognized, and it is important in this respect to bear in mind that whereas the total water area of Thirty-One Mile and Pemichangaw Lakes amounts to 24 square miles, the total area of the four principal McGregor Lakes amounts to only 6 square miles. Thirty-One Mile and Pemichangaw are also lakes of great depth, whereas there is a considerable area of comparatively shallow water in the McGregor and Wakefield lakes. Taking these circumstances into consideration, the report suggests that the water stored in Thirty-One Mile and Pemichangaw Lakes would be superior in quality to the McGregor Lake water, and such is unquestionably the case.

Whereas, the water of the former lake was bright and clear in the early part of September, the water of McGregor contained a considerable amount of amorphous matter in suspension. The McGregor Lake water

is, of course, very much superior to the Ottawa River water, but in order to render it as bright and clear at all times of the year as the Thirty-One Mile Lake water filtration would be necessary. If the McGregor Lakes are adopted as a source of supply, that the farms and residence surrounding the lakes should be purchased, as there are far too many possibilities of infection of the water taking place. In fact, the population in the drainage area is considerably higher than that of the basin of the Ottawa River.

Filtration.—The best way of treating the McGregor Lake water would be by means of mechanical filters. The cost of such filters works out at about $20,000 per million gallons treated per diem, when the filter house and various pipe work is included. It is very difficult to say what amount of coagulant would be required, but a very small quantity would be sufficient, seeing the character of the water, and it has been assumed that one half grain of sulphate of alumina per gallon would be sufficient as a yearly average. The working expenses of the filtration plant would exceed $19,000 per annum for an output of 25,000,000 gallons per diem. The loss of head through such filters is considerable; twenty feet was allowed in the estimate for that purpose. This had an important bearing on the lay-out of the scheme.

Method of Collecting and Storing the Water.—As in the previous case, a service reservoir was included in the scheme, and the most suitable site for the service reservoir for the McGregor Lakes scheme would be the same as for the Thirty-One Mile Lake scheme, as there is no other area of ground at a suitable elevation near the city. The present water level of McGregor Lake is about 466 feet above datum, and if the water were filtered 20 feet would be lost, which would reduce the pressure to 446 feet above datum, or to about the same level as the top water level of the service reservoir, namely, 445 feet above datum. It was, therefore, proposed to construct a dam at the outlet of McGregor Lake, where an excellent site exists, so as to raise the water in that lake to give the necessary head. The distance between McGregor Lake and the service reservoir is 78,500 feet, and if the same hydraulic gradient is taken as for the Thirty-One Mile Lake project (1 in 1960), a pipe 54 inches in diameter would be sufficient, the loss of head in the pipe when discharging 25,000,000 gallons a day amounting to about 40 feet. Adding to this the loss of head in the filters, namely, 20 feet, the total loss between the storage and the service reservoirs would amount to 60 feet, and the minimum draw-off level at McGregor Lake would be 445 + 60 = 505 feet, which would mean raising the level of the present lake 39 feet. Assuming McGregor Lake can be raised 50 feet, the top 11 feet could be used for storage.

Here, however, arose a difficulty. At some future date it would be necessary to increase the supply, and this storage would no longer be sufficient. Another excellent site for a dam exists at the outlet of Double Dam Lake, which would store water in Grand Lake. This site would be under water if McGregor Lake was raised 50 feet, and, therefore, it would be necessary to construct, at all events, that portion of the dam which is below water as part of the first instalment. It would, however, be necessary to complete the dam right away for several reasons:—

1. So as to avoid the possible chance of pollution of the water supply of the city by the large body of workmen who would have to be employed in its contruction.

2. It would assist in the storing of flood water, which would otherwise have to run to waste, and would delay bringing the scheme into operation.

3. The water which now flows from Grand Lake into McGregor by way of Double Dam Lake is utilized to develop electric energy to work the air-compressing plant for the Blackburn Mines.

It would either be necessary to compensate the owners for depriving them of this power or to provide an alternative. By constructing the dam this power could readily be given by means of the water held up at the higher level in Grand Lake discharging into McGregor. For these reasons the estimate provided for the supply of 25,000,000 gallons per diem, a second dam at the outlet of Grand Lake which will raise the water in that lake to 550 feet above datum, and would flood back into Wakefield Lake, raising the level of this lake 11 feet. The effect of the works outlined above would be to flood a very large area of land now under cultivation. In making comparison with the Thirty-One Mile Lake project it must be borne in mind that storage is there provided for the full yield of the drainage area for 81,000,000 gallons a day.

Pipe Line.—After leaving the McGregor Lake the pipe line would follow the same route as that proposed by Mr. Hazen for about 5 miles; it would then turn to the west, crossing the Gatineau River about a mile north of Wright's Bridge, and would then proceed in a south-westerly direction to the service reservoir, the total length of the pipe line being 78,500 feet. The estimate assumed that the Gatineau would be crossed by means of suspension bridges having a total length of about 1,000 feet divided up into three spans, the pipes being protected from frost as already described. The first four or five miles would involve a good deal of rock-cutting but the effect of raising the level of the outlet gives an easier route just after leaving the lake, and enables pipes to be carried the whole way up to the dam. The remainder of the route is through fairly easy country as far as the service reservoir. This reservoir and the pipe line forward to the city would be the same as for the Thirty-One Mile Lake project, and, therefore, calls for no further description.

Provided the work were put in hand at once it might have been possible to bring in the water from this source by about the year 1917. The sites for the proposed dams to impound the water of this watershed were not so favorable as that of Mitchel's Dam, where the waters of Thirty-One Mile Lake would be impounded. For this reason they would take longer to construct, although the pipe line itself would be shorter.

Annual Working Expenses.—The working expenses of this scheme would be higher than for the Thirty-One Mile Lake scheme on account of the filtration expenses, which are given as being $19,000 per annum. The aqueduct being shorter would mean a saving of about $5,000, and the total working expenses would amount to approximately $29,000.

The following estimate was based upon the proposals as above:—

Head Works.

Dam to raise McGregor Lake to 515 ft. level with valve tower, etc.....	$ 327,500
Dam to raise Grand Lake to 550 ft. level with outlet works	260,000
Clearing and burning area to be submerged	38,400
Road diversions, with bridges and culverts	80,000
Diversion of water from St. Germain, Battle and Rheaume Lakes	25,000
Plant for Blackburn Mine	25,000

Aqueduct.

54-in. steel main 7-16-in. thick, from McGregor to service reservoir—78,500 lin. ft.	1,448,325
Small stream crossings	9,500
Bridge on Gatineau River	130,000

Service Reservoir and Mains.

Service reservoir (as in Thirty-One Mile Lake scheme)	260,210
51-in. steel mains to city (as in Thirty-One Lake scheme)	1,101,120
Small stream crossings (as in Thirty-One Mile Lake scheme)	20,000
Bridge on Ottawa River (as in Thirty-One Mile Lake scheme)	180,000

Filters.

Filtering plant	500,000
Total for works	$4,395,055
Add 15 per cent. for engineering and contingencies	659,258
	$5,054,313
Land and lakes, compensation, etc.	2,000,000
Total estimate	$7,054,313

The entire report concluded with a comparison of the two schemes, as to their relative merits, as follows:—

	Thirty-one Mile Lake and Pemichangaw Lake	McGregor Lakes
(1.) Total quantity of water available.	81 millions gallons per diem.	51 million gallons per diem
(2) Quality of the water.	Bright and clear.	Somewhat turbid contains amorphous matter in suspension
(3.) Filtration.	Not required.	Required.
(4.) Aqueduct	235,000 ft. 54" pipe; 64,000 ft. 51" pipe;	78,500 ft. 54" pipe; 64,000 ft. 51" pipe.
(5.) Service reservoir.	To hold 295 million gallons.	To hold 295 million gallons.
(6.) Pressure (static)	118 lbs. at Pumping station.	118 lbs. at Pumping station.
(7) Estimated cost.	$7,985,200.	$7,054,313.
(8) Working expenses.	$15,000 per annum.	$29,000 per annum.

Referring again to the intention of the city to go ahead with the former scheme, which has been approved by the Dominion Government and by the Ontario Board of Health, preliminary arrangements for the early commencement of work are being made.

ALASKA RAILWAY DEVELOPMENT.

The British, Canadian, and United States Governments are considering a proposal, it is stated, to construct a railroad through Canadian territory to join Alaska to the United States. The proposed railway would be of obvious commercial value. Sir Richard McBride strongly favors the scheme, and is shortly to visit Washington to discuss the question with the Administration. It is proposed that branch lines should be built to connect the main line with the harbors of Alaska. It is believed also that the projected line will stimulate railway building throughout Alaska, which is required to connect Cordovia and Seward, the two leading ports of Southern Alaska, with the interior and with the Dawson line.

BUSINESS METHODS IN CONSTRUCTION WORK.*

By James L. Stuart,
Constructing Engineer, Pittsburgh, Pa.

PERHAPS there is no business which responds more quickly to what is termed "modern methods" than does the average piece of construction work. Certainly, there is no business with more diversified interests and trades connected with it than the modern structure, be it railroad terminal, factory, office building, hospital or hotel.

It has not been more than twenty years, at most, since the construction of buildings was left entirely to practical men who had themselves worked up from positions as artisans or laborers to positions of leadership in constructional lines. Some of these leaders in the past were most talented and even brilliant, but they did not bring with them into the business, excepting in rare instances, the methods of the trained engineer or the progressive business man, their principal assets being nervous force, executive ability and practical knowledge of the building trades. However, as building construction became more complex and of greater magnitude, the necessity of trained men who understood the engineering problems and who appreciated the application of business methods necessary to bring "order out of chaos" became more apparent, and now both engineering knowledge and modern business methods are most necessary to get proper results as to economy and quality in all of the larger undertakings.

In order to successfully construct a building, it is necessary that one should anticipate each step in the progress of its developments and outline a complete system for its erection, including the various steps from the time the drawings are received from the engineer or architect until the building is turned over completed to its owner. The first step in such a process is to make a complete estimate of the cost of the structure from the drawings and specifications, including every item mentioned in the specifications or shown on the drawings. In addition to this there are other small items which are not mentioned in the specifications, but which are necessarily a part of the cost of the building and should be included as such. Under the latter are such items as the cost of administration, liability insurance, temporary buildings, expediting, tools and machinery and numerous smaller items. These estimates of cost were originally made up by the contractors themselves and were but approximations as compared with the present method of compiling them. In the later method every advantage is taken of the prevailing market prices when the estimate is made, of the conditions of the labor market, the physical condition under which the work is to be done, and the season of the year. In a properly prepared estimate the unit prices should vary on each individual piece of work, whether figured at the same time or not.

After the estimate has been made of the total cost of the building—and I think an estimate should be made of every building whether the work is to be let on a lump sum contract, cost plus a fixed sum, or on a time and material basis—the next step is to make up a time schedule allowing fixed periods of time for the completion

*From a paper presented Jan. 14th, 1913, to the Cleveland Engineering Society.

of each part of the building. This must be done most carefully, as on this schedule is based the dates of completion of the different contracts for material and the contracts with sub-contractors for furnishing such portions of the work as are not to be executed by the general contractor's force in the field. This time schedule is made after a thorough study of the drawings, the site of the new project and a familiarity with the estimate which, as I have said before, gives the quantities of the different kinds of material and assists in estimating the length of time required to complete the various stages of the work.

After the estimate and the time schedule are completed and the contracts for material and labor have been entered into, the real work begins.

A dozen or more sets of drawings are procured from the architect or engineer, a copy of same placed on file in the main office of the builder, one copy sent to the job office and the others distributed among various sub-contractors who have to make up their shop drawings and prepare certain materials to be later installed in the building. A careful record must be kept of these drawings and to whom they are addressed and the date on which they are sent. While the various departments of the main office keep thoroughly in touch with the work in the field and the material in preparation, at this point, if the work is of sufficient magnitude, it is turned over to one particular member of the contractor's force, preferably a trained engineer, whose duty it is to keep in thorough and constant touch with all the drawings and all of the correspondence. He also has access to the files of the sub-contractors, contracts, contracts for materials, the original estimate and all other information pertaining to that particular piece of work. It is then his duty to follow up the sub-contractors in the preparation of their shop drawings, the submitting of same to the architect for approval, the ordering of materials by the sub-contractors, and the progress being made through the fabricating shops and mills. This following-up process is part of his daily routine and from time to time reports are made to the superintendent in charge of the actual field work to enable him to know when the material is going to be received, when the sub-contractors will have their men and material on the job, all of which enables him to shape up the field work so that certain portions of the building will be ready for certain sub-contractors at a fixed time. It is also his duty to keep track of the change orders and the changes made in the construction of the building, whether it be addition or subtraction. You can readily understand how necessary it is that all sub-contractors should be advised of changes, for often when they are conceived in the mind of the owner, their interference will be more far-reaching than he or anybody else anticipated.

A proper executive organization to do the field work is most important. It is far better to have too much assistance in the field than too little. First, there must be a superintendent who possesses rare abilities as an executive, who understands drawings and specifications thoroughly, who has had wide experience in building work and who has a knowledge of the different trades so as to be able to anticipate far in advance of his requirements. Above all, he should be able to create in those working under him, including the workmen employed by his department, and foremen and workmen of the different sub-contractors, an enthusiasm in their work, a desire to see it grow steadily, and to do it in the most substantial manner possible. If the work is of sufficient magnitude he should have an assistant superintendent, or possibly two or three of them, a large enough clerical force to do the timekeeping, and to keep an accurate cost record, and he should segregate the cost of the additional work which was not originally provided for. All of this work, if permitted to lag for even a day, becomes most complicated, and if not accurate, its value is entirely destroyed. In addition to this it is the duty of one of the clerks to send to the main office each day an accurate and concise report of what has been done during the day, the state of the weather, temperature, etc. As the building nears completion, work in the main office lessens and it is usually an excellent idea to have the man in charge of the particular job in the main office to get in actual touch with the building and assist the superintendent in picking up the loose ends and getting each trade completed as rapidly as the progress at the building will permit. This man (from the main office) is thoroughly familiar with each trade, knows just what changes have been made in the work, has a splendid knowledge as to how long it will take each trade to complete its work, knows the difficulties under which each has been laboring and can finish his "following-up process" from the field more intelligently than if he were to remain at the main office.

The cost of a piece of work is always of interest. The estimating department has access to the daily and weekly cost reports which are compiled in the accounting department, and from these they can compare and report to the proper person whether or not the work is being done each day or each week within the amount allowed for same in the original estimate. If the work is not being done within this cost and if the unit prices vary considerably from day to day investigation is at once made at the building to ascertain the reason for such fluctuations, to advise the superintendent of the discrepancy and to see if ways and means cannot be found to bring the cost within its proper allowance—the estimate having been based on the cost of similar work under the same conditions, the proper average should not vary greatly from the amount allowed in the estimate.

Some time during the latter part of May, 1910, a large manufacturing plant in Pittsburgh, covering approximately fifteen acres, was almost totally destroyed by fire. All of the buildings were brick, some with wood trusses and slate roofs, but the greater number were constructed with steel frames and cement tile roofs. The fire in and around these steel structures was so intense, however, that most of them collapsed of their own weight and were but a mass of twisted steel, broken cement tile, brick and mortar, all of which it became necessary to remove in order to reconstruct the plant. We first received orders to clear the site and subsequently were instructed to proceed with the reconstruction of the buildings. Fortunately, the power plant had not been greatly damaged and, as a large portion of the plant had been driven electrically, we were able to get sufficient current of high voltage to use in cutting up, or burning apart, the collapsed steel frames, all of which was so badly damaged that it was loaded on cars and sold as junk.

After the site was cleared we began excavating for the new foundations, starting on the buildings that would be required first and those in which the greatest amount of machinery was to be installed. This scheme was followed so as to enable the entire plant to be completed at about the same time. It was the desire of the manufacturing company to commence manufacturing about the

first of October, or earlier if possible. The key to this particular situation was to get the steel, of which there was about 4,800 tons. After consultation with the operating and executive departments of the manufacturing company, the order in which the different buildings were to be completed was decided on and the dates were fixed for the delivery of the steel for each building and were included in the schedule for the completed buildings. The structures were quite simple, similar to most of the modern factory buildings, but in order to live up to our schedule we knew we must keep continually in touch with the Bridge Company and see that nothing was permitted to lag or be left undone in order to make the deliveries as they promised. Our expediter was put in charge of the job at once and during the first month spent most of his time between the order department of the Bridge Company and the steel mills at which the plain material was being rolled. After the last of the orders for the plain material had been sent to the rolling mills he devoted his time more particularly to the drawing room of the Bridge Company and reported daily just what progress was being made in designing, detailing and checking, the number of draftsmen employed and the progress made on each building. At times it was found that the checking department was overbalanced by the detailing department and that the designing department was not turning out sufficient work to keep the draftsmen doing the detailing and the checkers busy. This was adjusted by numerous meetings between the Bridge Company, the executive department, the manufacturing company and ourselves. It might be said here, that the principal requisites of an expediter are, a thorough knowledge of the work to be performed, a pleasant personality and the ability to interest the people who are actually doing the work—in this case, the men who made out the mill orders, the draftsmen, different foremen in charge of the rolling mill and the foremen in the fabricating shop. All should be made to feel that their interests are parallel and that what is good for one is good for all. As soon as the drawings for one of the buildings were completed, we saw that this work was put in the shop at once where someone had already seen that the plain material was delivered, and that no time was lost in fabricating and shipping same.

At times during the preparation of the drawings it was found necessary to urge the Bridge Company to employ additional men in all departments. This required considerable tact and force as, naturally, the heads of the different departments do not care to have their routine changed or, as they express it, "meddled with." This phase of the difficulty can be overcome only when it is possible to get sufficient interest aroused in that particular piece of work. When the work was started our expediter received from the rolling mills from which he knew the steel was to be furnished, a list of their daily rollings and we saw to it that certain materials were gotten in on the dates at which the first rolling of that particular material was made. This saved not a little time and we were able to get all of the plain material delivered before the shop drawings were entirely completed on the first building. The meetings between the heads of our department and the heads of the Bridge Company were most useful. Our expediter was usually on hand and we were able to discuss the progress made since the last meeting, the condition of the work in the drafting room and shop, and to devise ways and means for overcoming any obstacles that had arisen either due to lack of men or want of materials.

The steel was erected as fast as the work was gotten out of the mill, fabricated and delivered. We insisted on its being fabricated in sequence so that any materials delivered at the building could be immediately put in place. It had been previously decided at which end of the building the work would commence and our superintendent in the field was advised of this fact and was also kept in thorough touch with the progress of the different stages of the steel. As the cars of steel were loaded and shipped out, they were put in the hands of the tracing department of the manufacturing company and our own tracing department as well, and shipments were followed up until they were finally landed at the site. Our tracing department had, prior to this time, made the acquaintance of the different employees of the railroad through whom the records of the movement of the cars was to pass, as well as those who had direct charge at the transfer points. After the steel had been delivered the rest of the work was a mere question of brick, mortar, sand, gravel, cement, window frames, sash, roofing material and sufficient workmen. Of course, there were large quantities of all these materials required and in order not to delay the work it was imperative that certain amounts of same be delivered and put in place prior to the delivery of the steel.

This same method was applied to the construction of the Statler Hotel, Cleveland, except that the work was much more complicated and required many more details. There were approximately ninety sub-contractors and material men in and around the building from almost the day it was started until its completion, and it required a great deal of patience, perseverence and hard work to get the different trades to dovetail into each other throughout so that those who did the preparatory work would be completed and away in time to permit the finished material to be erected in a proper and substantial manner. On the Statler Hotel we found it necessary from about the first of June until a few days before the building was turned over to Mr. Statler, to insist on daily meetings of all of the sub-contractors on the work, together with the architect's representative and others interested in the building. At these daily meetings each trade was taken up separately with the principal representative of that particular trade and the representatives of all the other trades present. He was asked regarding the progress of his work and was told to state whether or not he was being retarded by any of the other trades. If it was found that he was being hampered he was made to state explicitly and in detail to what extent and how.

The advantage of having all of the sub-contractors together at one time can readily be seen, as it eliminated innumerable quarrels between the foremen of the different trades and many misunderstandings which invariably arise due to the fact that the workmen and foremen are not always capable of expressing their troubles in an intelligent manner and, when they are busy, many times do not take the trouble to express themselves at all. It was rather hard to get them to continually attend these daily meetings, as they were held in the evening after they were supposed to be through with their work. We always tried to make the meetings as pleasant and as short as possible and never permitted ill-feeling to exist between the several trades arising from the discussions at the meetings. A typewritten report of each meeting was posted up on the general bulletin board so that each of the sub-contractors would have access to same during the following day.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Agitation for Provincial Branch of the Canadian Society 651
The Paving Determinator 651

Leading Articles:

Present Methods of Testing Materials 636
The British Columbia Engineer 639
Industrial Development in Fort William 640
Electrification of the Lötschberg Railway 641
Mica Deposits in Canada 643
Sanitary Survey of Rivers 644
The Rejected McGregor Lake Scheme for Ottawa Water Supply 646
Business Methods in Construction Work 648
The Effect Upon Design in Reinforced Concrete and Alterations in the Modular Ratio 652

Engineers' Library 658
Coast to Coast 663
Personals 663
Coming Meetings 664
Railway Orders 73
Construction News 76
Technical and Municipal Societies 94

AGITATION FOR PROVINCIAL DIVISIONS OF THE CANADIAN SOCIETY.

British Columbia members of the Canadian Society of Civil Engineers are strongly advocating a change in the by-laws of the Society to enable them to establish a provincial division, whose jurisdiction shall extend over the entire province, its membership comprising all members, whether connected with existing branches of the Society or not. The movement has become prominent during the past year, and a strong effort will be made at the annual meeting of the Society in January to present convincing arguments for its adoption. On page 639 of this issue appears an account of a joint meeting recently held by the Vancouver and Victoria branches. A full discussion of the question was indulged in and a resolution adopted, which has been included in the article. Briefly, the necessity for such an organization was emphatically urged, and it is understood that other branches of the Society concur pretty generally with the contention prevailing on the Pacific Coast.

This expression of a keen desire for more activity and influence on the part of the Canadian Society of Civil Engineers, coming as it does from within, is one that should be supported, as upon it hinges several vital factors. One, for example, is the necessity for the establishment of a better relation between the Society, as a representative body, and the grounds for, and extent of, the responsibilities of the engineering profession in its position in the van of the forces that are furthering the development of the country. The engineer has been rightly termed the advance agent of civilization, and with his work is associated a vast personal responsibility which, in case of failure, is all his own—wherein exists a noticeable difference between professions. If his work is a success, the engineer may receive a little credit; if it is not, he is held accountable. Disparagement is inevitable, praise is probable.

Be that as it may, the profession is being moulded by the Society and, with the illimitable outlook for engineering activity in Canada, it is timely that measures should be advanced to substantiate the grounds for the responsibility which falls to the Canadian Society of Civil Engineers in the country's development. An unsuccessful piece of engineering construction stands in the eye of the public a glaring monument to incompetency. Nor can it be denied that the profession falls for a goodly share of derision as well as the unfortunate individual. There is work for the Society in the prevention of incompetency in engineering. The formation of provincial divisions, with a grant of sufficient leeway to foster the interests of engineering in their own provinces, is a plan worthy of consideration.

THE PAVING "DETERMINATOR."

Webster defines the word "determinator" as one who fixes, settles or decides. In that sense the word certainly cannot be properly applied to the machine that was labeled "Paving Determinator" at the recent American Road Congress. Two large, heavy wheels were driven around a two-foot circular path, constructed for three-quarters of the way of concrete, the remaining quarter of the circle being of vitrified brick. The machine was driven at high speed night and day for a week.

Both materials stood the "test" remarkably well. Like all abrasion tests, however, it differed so much from practical, working conditions that little importance can be attached to the results. It is doubtful whether any entirely successful abrasion test has ever been made with any material. They have been frequently tried by the large laboratories such as Capt. Hunt's and others, but have always been disappointing. Chilled cast iron vs. forged steel, enamelled tile vs. other floorings, brick vs. concrete—in all of these tests conditions have been created by the test itself that are not met with in actual practice. Heat is created and a grinding action induced instead of a rubbing action; or a kneading effect is produced that in practice is eliminated by frequent scrubbings and cleanings; or the expansion and contraction, due to gradual differences in temperature throughout the seasons, cannot be similated: or any one of a dozen of other discrepancies between the test conditions and actual working conditions make the test of little value. Moreover, no two brick roads are the same, nor are any two concrete roads. It would, therefore, be the sheerest folly to condemn either brick or concrete as the result of an abrasion test on a few feet of each pavement. Local conditions, prevailing prices and some explicit suitability to the particular work in hand, will govern the choice of the engineer far more than the results of the "paving determinator."

EDITORIAL COMMENT.

The proposal of the Hydro-Electric Power Commission to furnish electrical power to Owen Sound from Eugenia Falls, was accepted by the town council on Monday last. The commission's investigation into the stream flow has been of a convincing nature as far as supply is concerned, which point has been a bone of contention for two years. As stated in these columns early in September, the commission found 1,400 h.p. available at little cost, or with the use of a storage basin 4,000 h.p. Thus assured, Owen Sound has expressed its willingness, and the work of power development will proceed. Construction will commence at Eugenia Falls early in the spring, and power will likely be turned on before 1915.

* * * *

The Ontario Highway Commission has arranged a series of meetings throughout older Ontario at which representatives from surrounding municipalities will gather, voice their needs, and acquire from the Commissioners a clear understanding of the good roads movement. The sessions are educational in motive and are to be strongly commended. No doubt the Commission will be the recipient of many potent and valuable suggestions, as the individaul demands of the different localities accumulate. Likewise the representatives will receive an insight into the magnitude of the undertaking and the advisability of bringing strong argument before the Legislature next spring for the furtherance of the needful improvement. Meetings are scheduled for: Ottawa, Oct. 28th; Belleville, Nov. 4th; Hamilton, Nov. 11th; London, Dec. 16th; Toronto, Jan. 13th, 1914, and Guelph, Jan. 20th, 1914. The older part of the province has been divided into sections with these cities as centres, and all counties are to be represented.

THE EFFECT UPON DESIGN IN REINFORCED CONCRETE OF ALTERATIONS IN THE MODULAR RATIO.

THE London (Eng.) City Council has recently drawn up a revised code of regulations for reinforced concrete buildings, supplanting those which were adopted in 1911, and which were subjected to much criticism from structural men, the chief claim being that of inadequate and incorrect assumptions in the matter of designs. The subject has received wide attention during the past season, largely owing to the belief that the new regulations, as were then in the stages of preparation, were again being based upon wrong assumptions, viz., that the concrete takes no tensile stress, and that the stress-strains line of concrete and steel, acting in conjunction, is straight. The subject received a thorough treatment by Mr. Percy J. Waldram, F.S.I., M.C.I., in *Engineering*, (issues of June 13, 20, and 27), to which the reader may very profitably refer. The articles discuss the previous regulations, point by point, and show the value of drawing up regulations that will assist in, rather than retard, the application of sound engineering principles by providing for periodical revisions or for the alternative use of future modifications of a theory which may at present be used largely, but tentatively.

The same writer again takes up the subject in *Engineering*, for September 26th (since the revised code was drawn up), and calls attention to the lack of elasticity in the obligatory use of the purely theoretical formulæ specified in the new regulations, many of which are well known to be based upon inadequate data and upon hypotheses which are patently incorrect, even though the errors may be negligible.

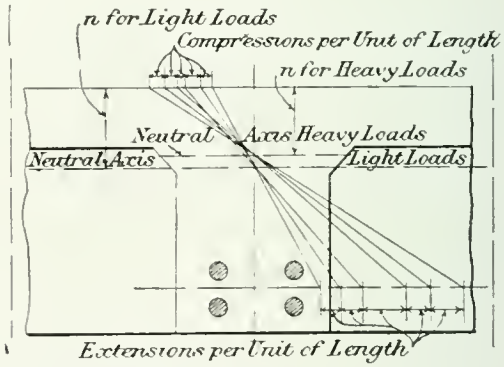


Fig. 1.—Determination of Position of Neutral Axis by Extensometer Measurements.

There are many phases of the discussion that will be found to apply with almost equal force to regulations in America respecting reinforced concrete construction, and the following extracts from Mr. Waldram's paper should prove of value.

It is unfortunate that no machinery is provided (in these new regulations of the London City Council) for the automatic revision of the code at stated periods, in order that advantage may be taken of our rapidly increasing knowledge of a new and intricate subject. These matters will doubtless be fully considered by the institutions to whom is entrusted the statutory duty of criticizing the code. With regard, however, to the extensive alterations which are made in the permissible stresses and the modular ratio, there is no small danger

of full consideration being hampered by lack of data upon which calculations showing their effect can be worked out readily.

In the following article an attempt is therefore made to supply such necessary machinery without in any way attempting to anticipate any conclusions which the institutions may arrive at with regard to the desirability or otherwise of the alterations of stresses and modular ratios now suggested by the Council. These alterations appear at first sight to be merely prudent, even if somewhat excessive, concessions to a not unnatural distrust of a method of construction based upon intricate theory and comparatively new to many designers. But when carefully examined it will be found that their cumulative effect upon the design of actual

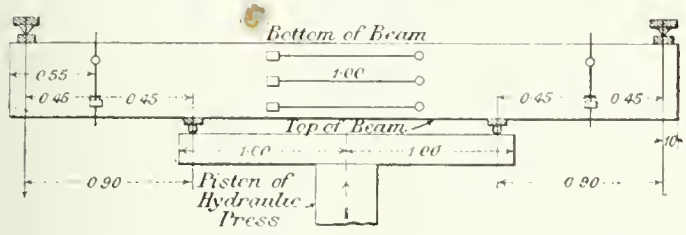


Fig. 2.—Typical Arrangements for Test of Beams, Adopted by French Government Commission, 1900 to 1906.

members would be very severe, and, in fact, almost revolutionary. The new material would by them almost certainly be barred physically by excessive weight, as well as economically by excessive cost, from undertaking many tasks which are well within its ordinary field of employment; and it would appear to be no exaggeration to say that very few of the large buildings now being erected or completed for Government or public authorities would come even within a reasonable distance of complying with the proposed code.

It will be found that mixtures richer than the stereotyped 1:2:4 are so severely discredited that in all work carried out under the code they will of necessity be penalized out of existence. The risk of making concretes too rich in cement would scarcely explain such drastic treatment, and one can only conclude that the Council feared the contingency of district surveyors being imposed upon by approving calculations for rich, strong concretes in situations where ordinary 1:2:4: mixtures would subsequently be substituted in the district surveyor's enforced absence. There may be more cogent objections to stronger mixtures; but considering the great economies in weight and cost which can often be effected by their use, and the importance of eliminating unnecessary dead weight, it is at least open to question whether they should be prohibited for no better reason than that district surveyors have not been given adequate discretion to insist upon the necessary supervision of mixing.

Not only are the permissible stresses on rich concretes severely cut down, but the modular ratio is also lowered in respect of them; the net result being, as will be seen later, a virtual permissible stress actually lower than that of the poorer 1:2:4 mixture, thus preventing a designer even from calculating for 1:2:4 concrete, and subsequently carrying out the work in a stronger and more expensive material. The tasks which are imposed upon the concrete of a reinforced member, in addition to that of resisting the bending moments, are so numerous, so complex, and so important, that many prudent designers might still desire to enrich their mixtures, in spite of the increase of dead weight and cost which would be incurred by doing so under the proposed code. Any such desire to strengthen a constituent whose relative weakness is universally admitted would in the vast majority of cases be promptly checked by the stipulation that new values of the fundamental modular ratios must be used whenever rich concretes are employed. To comply with this regulation the user of rich concretes must either calculate at interminable length, or else recompile, at least twice, the whole of the tables, data, or diagrams which he ordinarily uses; and the district surveyor who checks his calculations must do the same. No one who has attempted, even in part, the enormous labor involved by such a task would care to undertake it unless he were assured that something like reasonable finality had been reached with regard to the values specified. But we have no means of knowing whether these are based upon reliable data, compiled by scientists of standing, upon observations of the behavior of actual beams under load, or are merely deduced from the results obtained by subjecting plain specimens of rich concretes to evenly-distributed compression. Such specimens would certainly act quite differently under flexural stress in a beam, and probably still more so if the beam were reinforced.

Members under Flexural Stress.—In any member of reinforced concrete the proportion of the total work done which is borne by the concrete and by the steel reinforcement respectively is determined not by the relative ultimate strength, but by the relative stiffness of the two materials. In other words, it is governed by the ratio existing between the modulus of elasticity of the steel E_s, and that of the concrete E_c, and known as the modular ratio $\frac{E_s}{E_c}$, or m.

The calculations of the designer in reinforced concrete depend absolutely upon the accuracy of his forecast of the relative stiffness of his materials at working loads. Such a forecast can only be obtained by noting the behavior of his materials when in double harness in a beam. The observer must be prepared to find that it will vary at different stresses, and that direct compression and tension tests on different specimens are no criterion of what will happen when the materials are subjected to the varying intensity of stress which is imposed upon the fibres of a beam section under flexure.

The modular ratio at different stresses can be obtained by measuring the relative extension and compression of the concrete fibres and the steel, and thus locating the neutral axis, as in Fig. 1. Then for any given position of the neutral axis in any beam of given proportions there must be one modular ratio consistent with that position, and also with the formulæ used. Thus in a rectangular section reinforced with a proportion r of tensile rods, if the distance n of the neutral axis from the top of the beam were determined by the ordinary formula in which $n_1 = \frac{n}{d}$

$$n_1 = \sqrt{m^2 r^2 + 2\,m\,r} - m\,r$$

then the value of m would be

$$m = \frac{n_1^2}{2\,r\,(1 - n_1)}.$$

If the beam experimented upon were a T-section of which the proportion of depth of slab to depth of beam were s_1, then the value of m, which would have to be inserted in the ordinary formula

$$n_1 = \frac{s_1^2 + 2\,m\,r}{2\,(s_1 + m\,r)}$$

would be

$$m = \frac{s_1\,(2\,n_1 - s_1)}{2\,r\,(1 - n_1)}.$$

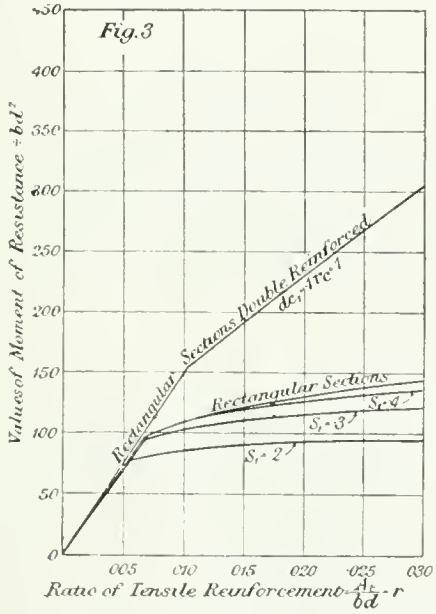
If the section were rectangular and reinforced in tension and compression, the ratio of compression to tensile reinforcement $\frac{A_c}{A_t}$ being r_c, and the depth of the former below the top of the beam were d_o / d, or d_{o_1}, then the value of m would be

$$m = \frac{n_1^2}{2\,r\,(1 - n_1) - 2\,r\,r_c\,(n_1 - d\,c_1)}$$

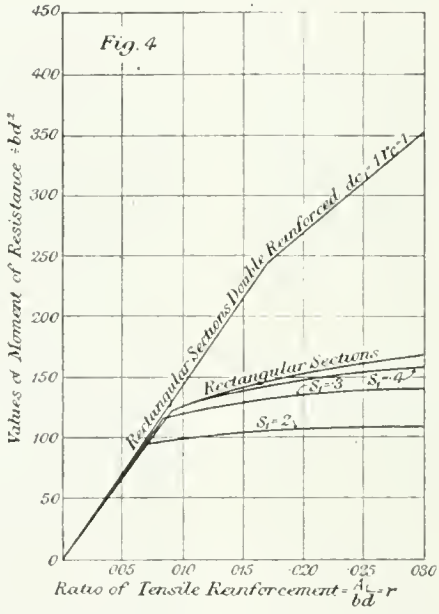
In view of the importance of fixing a correct modular ratio for different classes of concrete, and of the fact that expenditure upon experimental research was specifically authorized under the London County Council General Powers Act of 1909, it is certainly a matter for regret that the Council have not taken advantage of the facilities which thus lay ready to their hand, before attempting to fix new modular ratios in their proposed code of 1913. The ratios specified (11 for 1 :1½ :3 and 8 for 1 :1 :2 concrete) may prove eventually to be correct at working stresses, but engineers will need to be authoritatively assured of this before undertaking the huge task of recompiling their data to agree with them. In fact, to permanently fix them by any means other than carefully digested research ought to be out of the question.

The value attributed to m enters into every one of the calculations required for reinforced concrete. So numerous and intricate are these that practical designers are forced to condense the essential factors into tables and diagrams, the compilation of which represents thousands of tedious calculations. The slightest alteration in the value of m renders the whole of that

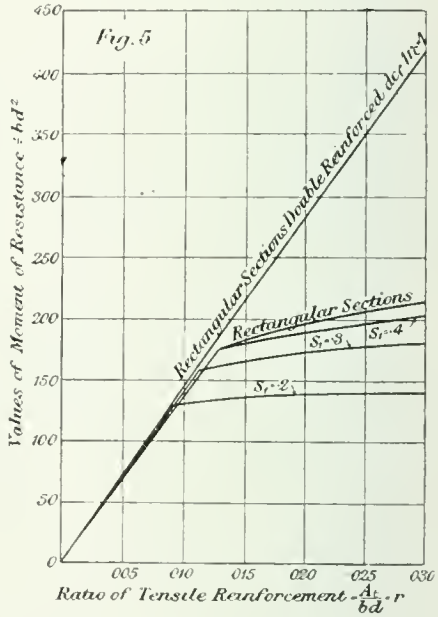
1 :2 :4 Concrete, $c = 600$, $m = 15$



1 :1½ :3 Concrete, $c = 700$, $m = 15$



1 :1 :2 Concrete, $c = 900$, $m = 15$.



The modular ratio for different classes of concrete can therefore be determined without much difficulty by testing a number of beams under different loads and noting the position of the neutral axis shown by extensometer readings of the extended and compressed fibres.

The French Government Commission, which sat from 1900 to 1906, tested a large number of beams and recorded the extensometer readings. Fig. 2 reproduced from M. Nivet's *Cacul de Beton Armé*, show the arrangements adopted for a typical beam. The details of these tests are available, but, unfortunately, they did not include beams of richer concretes.

Until sufficient exact data have been collated of extensometer tests upon beams of rich concretes, T-sections, and of sections reinforced in compression, any value attributed to m for such sections must be at least only conjectural.

labor useless for any purpose for which the altered value of m is to be used. Such alterations can materially affect the calculated strength of beam sections, as is shown by comparing Figs. 3 to 9, in which are plotted the moments of resistance of some typical single reinforced rectangular and T-beams, and of rectangular sections reinforced both in compression and tension.

No examples of double-reinforced T-sections are included, on the ground that under the heavy stresses which demand double reinforcement, it is unwise to consider the material of a relatively thin slab to be a fully efficient working partner in the compression flange; and only such part of it should be taken into account as is consistent with the assumption of a vertically rectangular section. The value of d_o, or depth of centre of compressive reinforcement from top of beam

selected, is $\frac{d}{10}$. Other values could, of course, be added, but allowing for ½ in. of cover in slabs and 1 in. in beams, this value will be found to be a fair average for double reinforced sections. All the types shown are calculated for a permissible tensile stress of 16,000 lb. per sq. in. on the steel, and for a compressive stress of m times the stress on the concrete immediately surrounding the steel.

Figs. 3, 4, and 5 show the unit safe working moment of resistance of beam-sections, calculated with a modular ratio of 15 at the concrete stresses recommended in the Reports of the Joint Committee on Reinforced Concrete of the Royal Institute of British Architects, which stresses are also one-fourth of the ultimate test loads at 90 days, stipulated in the new London County Council code for concretes of the proportions stated.

Figs. 6 and 7 show the same sections calculated with modular ratios reduced to 11 and 8 respectively for the richer mixtures. It will be seen that the effect is a reduction in the theoretical strength, which is more severe on beams with double reinforcement than on those reinforced in tension only. The reason of this is that any reduction of the modular ratio postulates that the stiffness of concrete more nearly approaches that of steel. It, therefore, picks up more readily that proportion of the load which taxes its strength to the full permissible limit, and the capacity of the combination is thus more quickly reached; in double reinforced beams the same excessive zeal of the concrete to overwork itself not only causes it to reach more rapidly the limit of its strength, and calls for more assistance from the compressive reinforcement which is harnessed tandem with it, but also reduces the efficiency of that compressive reinforcement by causing it to work in conformity with a more easily exhausted partner.

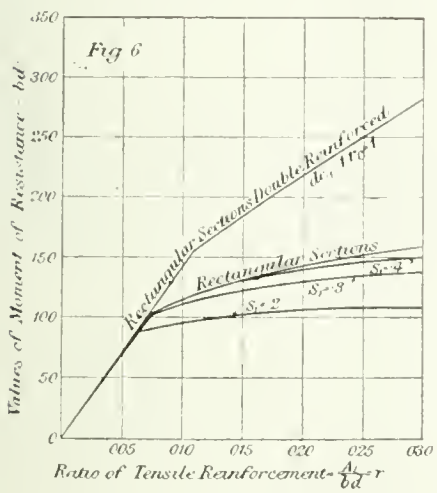
Figs. 8 and 9 show the joint effect of applying to the same sections the reduced modular ratios and also the reduced concrete stresses stipulated in the proposed London County Council code.

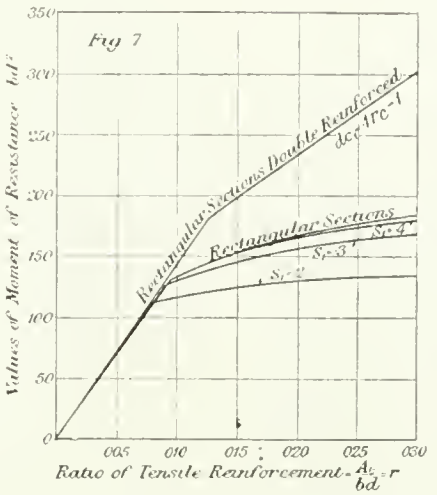
It will be seen from these figures that, in order to comply with the code, the designer must consider his beams to be much weaker if he uses rich concretes than if he uses poorer mixtures. This result is so extraordinary that it would appear to be doubtful whether the compilers of the code really intended to bring it about. The high shearing stresses still permitted by the code make any unnecessary dead-weight more than usually undesirable; and unless very excellent reasons can be shown for the extremely low stresses, and, therefore, very bulky sections involved, it would appear to be reasonable to consider a revision of the present proposals so as to conform with the results shown in Figs. 6 and 7, giving designers the option of either working to reduced modular ratios, or of suitably reducing their working stresses to give the same result.

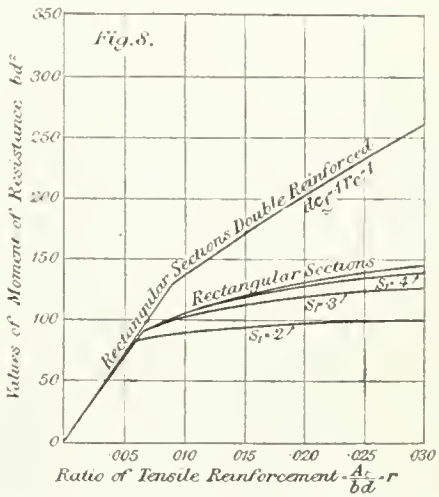
The effect of altering the modular ratio only, leaving the Royal Institute of British Architects' stresses unchanged, is shown in Figs. 10 and 11 in the shape of a percentage reduction in the strength as calculated by the Royal Institute of British Architects' rules, upon which the tables and diagrams generally found in text-books and drawing-offices are based.

At proportions of reinforcement below the economic ratio the stress on the concrete becomes of no importance, and the effect of any alteration of the modular ratio is practically negligible, the slight reduction of tensile stress (or the corresponding increase of nominal tensile strength) obtained by it being too small to take into account. It is necessary, however, to carefully note that the reduction in compressive strength commences at the economic ratio fixed by the lower modular value, and not that fixed by the higher value. The former is indicated by the point on the base line of the diagram from which each graph starts, and the latter by the point at which the graph abruptly changes direction. Fortunately it is possible to fix with but little labor the economic ratios of any class of beam section for any given values attributed to t, c, and m. If, therefore, Figs. 10 and 11 could be expressed in tabular form, the labor involved by altering m could be very sensibly reduced for the great majority of cases arising in actual design. The object of the designer is, or should be, to select the section which will do the work required of it without unnecessary cost in reinforcement. If one type—say, a T-beam in which $s_1 = 0.3$—would require a proportion of reinforcement greater than the economic ratio, then it is cheaper to make the rib wider until it will contain the full triangular area forming the virtual compression

1 :1 ½ :3 Concrete, $c=700$, $m=11$. 1 :1 :2 Concrete, $c=900$, $m=8$. 1 :1 ½ :3 Concrete, $c=650$, $m=11$.







flange of a rectangular section. If this is still insufficient, the designer can most economically increase the deficient compressive strength by going to a still more efficient class, and selecting some suitable double reinforced section. It pays better to use the section properly adapted to any task rather than to over-reinforce an unsuitable one; and the most important result of reducing the modular ratio is therefore the effect which it has upon the position of the economic ratio, which, as the limit of the economical capacity of any type of section is also the practical limit of its employment.

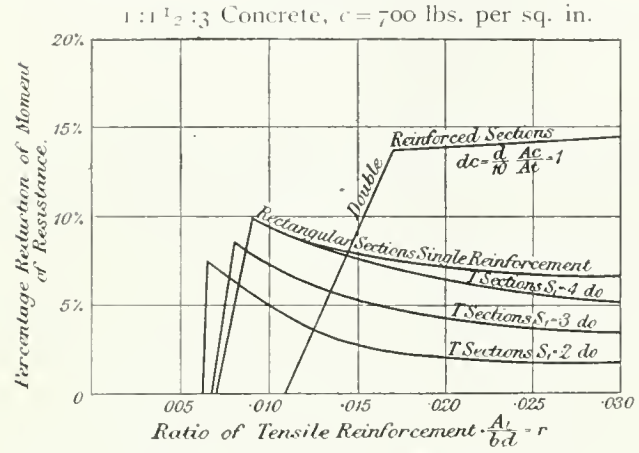


Fig. 10.—Effect of Reducing the Modular Ratio from $m = 15$ to $m = 11$.

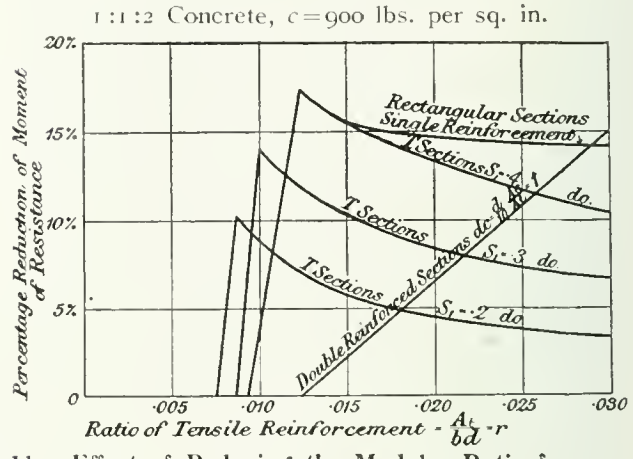


Fig. 11.—Effect of Reducing the Modular Ratio from $m = 15$ to $m = 8$.

Reinforced Concrete Beam Sections.

Strictly speaking, any formula or tabular statement purporting to express Figs. 10 and 11 should allow for the fact that the reduction of the permissible strength necessitated by reducing the modular ratio grows less severe on sections reinforced in tension above the economic ratio, as shown by the dipping curves. But when it is considered how seldom this obtains in good design, probably no great injustice would be done by stipulating, at least as an alternative method of calculation, that the effect of the reduced modular ratios upon the Royal Institute of British Architects' permissible stresses on beams may be taken by calculating as for $m = 15$ and deducting the percentages shown in Table I. The somewhat rare cases of beams reinforced considerably beyond the economic ratio can be calculated specially. The economic ratio could be easily defined as that proportion of tensile reinforcement at which $R_c = R_t$.

The table, like the diagrams, is intended to be illustrative only. Additional percentages would be required for intermediate values of s, in single reinforced T-beams, and, in double reinforced rectangular sections, for values of $\frac{A_c}{A_t}$ greater or less than 1, and possibly for values of d_c greater or less than $\frac{d}{10}$.

Table I.—Showing the reduction, caused by reducing modular ratio below $m = 15$, of permissible moment of resistance of beam sections calculated at the Royal Institute of British Architects' stresses.

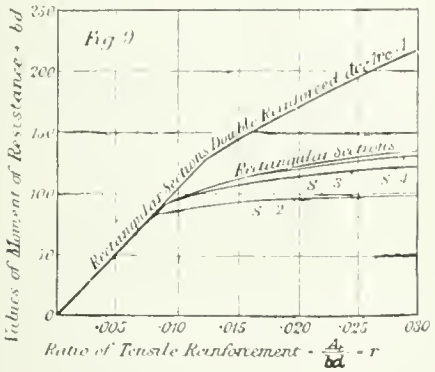
Type of Section.	1 : 1½ : 3 Concrete $c = 700$, $t = 16\,000$. $m = 11$.	1 : 1 : 2 Concrete. $c = 900$. $t = 16{,}000$. $m = 8$.
Sections with Tensile Reinforcements Only.		0
Rectangular sections or their equivalents at E.R. when $m = 15$	0	—
At or above E.R. when $m = 11$	10 per cent.	17½ per cent.
At or above E.R. when $m = 8$	—	0
T-sections $s = 0.3$ or over at E.R. when $m = 15$..	0	—
At or above E.R. when $m = 11$	8 per cent.	14 per cent.
At or above E.R. when $m = 8$	—	0
T-sections $s = 0.2$ at E.R. when $m = 15$	0	—
At or above E.R. when $m = 11$	7½ per cent.	10 per cent.
At or above E.R. when $m = 8$	—	
Sections with Compressive and Tensile Reinforcement.		
Rectangular sections $d_c = \frac{d}{10}$, $A_c = A_t$, at E.R. when $m = 15$....	0	0
At or above E.R. when $m = 11$	14 per cent.	—
At or above E.R. when $m = 8$	—	23 per cent.

Proportionate reductions to be made at ratios of tensile reinforcements between the economic ratios stated.

Columns Under Axial Load.—The methods of calculating columns under axial loads lend themselves very readily to standardization in straight-line graphs easily calculated and easily drawn for any given modular ratio and stresses. An alternative method of calculation, whereby a percentage reduction may be made from the Royal Institute of British Architects' diagrams, is therefore not so much needed as is the case with sections designed to meet flexural stresses under bending moments. It is, however, very important to note that the effect upon column stresses of reducing the modular ratios does not necessarily tend towards increased safety. In a section subjected to bending moment, the limiting stress on the concrete is almost invariably the vital criterion. In columns, however, it is much more frequently the stress on the steel. The large extent to which the use in columns of hard, stiff steels with high yield-points is advocated serves to show how frequently the designer finds that a given column can only be adequately reinforced by steel which is harder or more willing than the British standard mild structural steel. The effect of reducing the modular ratio is in effect to assume that the

concrete will take a greater proportion of the joint load, so that the steel must necessarily take a smaller share. For any given loading, less stress will be debited to the steel than would be the case if the concrete were credited with a relatively lesser degree of eagerness to pick up work. If the modular ratio be fixed without due care, or upon considerations which do not apply to the actual behavior of fibres under joint stress, there is obvious danger of giving it too low a value. Whether such unduly low value would be liable to overtax the steel depends upon the limiting stress on the concrete. In the proposed London County Council regulations this is reduced so drastically that even if a modular ratio of 15 actually obtained in place of 11 or 8, as stipulated, the permissible stress on the steel would still be greater than m times the greatest permissible stress on the concrete. But the London County Council concrete stresses on columns are only one-half to one-third of those recommended in the Royal Institute of British Architects' report, which was drawn up by well-known men selected to represent great institutions. As the Committee's report attached to the London County Council's code carefully throws upon the Local Government Board the responsibility of these reductions, it is scarcely probable that in any case outside the small legal scope of the new code engineers and designers will discard the considered recommendations of the Royal Institute of British Architects' Committee until they know how the new stresses were arrived at. The suggestion that the modular ratio should be reduced for richer, stronger concretes is not a new one and will probably find many adherents. But if this be done, it must be recollected that it is equivalent to relieving the steel of part of its responsibility. For instance, if a prudent designer, using the Royal Institute of British Architects' stresses on 1:1½:3 concrete for a

1:1:2 Concrete, $c = 650$, $m = 8$.



column 100 sq. in. area, with 3 per cent. of vertical reinforcement, adopted a ratio of 11 instead of 15, he could load his concrete up to 1,456 lb. per sq. in. (or 0.52 U) under which conditions his speed would be stressed to $m\ c$, or 16,016 lb., if $m = 11$. The equivalent section would be $100 + \{3 \times (m - 1)\} = 130$ sq. in., and the permissible load would be $130 \times 1{,}456 = 189{,}280$ lb., or, say, 84 tons. But if at working stresses the proper value of m were really 15, then the equivalent area would be $100 + \{3 \times (m - 1)\} = 142$ sq. in., and the stress on the steel would be $\frac{189{,}280}{142} \times 15$, or 20,000 lb. per sq. in., instead of 16,000.

The correct practical value to be attributed to the modular ratio is therefore at least worthy of exact and authoritative determination, not only in justice to the capabilities of the material, but also on the score of safety.

PROPOSED CANADIAN INSTITUTION OF MUNICIPAL ENGINEERS.

The following gentlemen have consented to act on the provisional committee appointed to draft out the constitution and arrange the preliminaries of the proposed Canadian Institution of Municipal Engineers: Mr. J. Antonisen, street railway superintendent, Brandon, Man.; Mr. M. H. Baker, city engineer, Prince Albert; Mr. Willis Chipman, consulting engineer, Toronto; Mr. G. T. Clark, city engineer, Saskatoon; Mr. G. W. Craig, city engineer, Calgary; Mr. Arch. Currie, city engineer, Ottawa; Mr. F. L. Fellowes, supervising city engineer, Vancouver; Mr. G. D. Mackie, town engineer, Swift Current; Mr. T. Aird Murray, consulting engineer, Toronto; Mr. F. McArthur, city engineer, Regina; Mr. H. H. Phillips, city hall, Toronto; Mr. R. Potter, town engineer, Battleford; Mr. J. B. Sterling, city engineer, North Battleford; Mr. L. A. Thornton, city works commissioner, Regina; Mr. R. O. Wynne-Roberts (convenor), consulting engineer, Regina.

A NEW RAILWAY DITCHING MACHINE.

An excavating machine adapted to railway ditching has been patented by Naylor Johnson, Montreal. The machine consists of a framework mounted on skids, having at one end a mast and at the other end a steam winch. The excavator is arranged to draw itself and a train of flat cars.

The point of greatest interest is the arrangement of the single hoisting rope which is rove through blocks on the boom and buckets bail to make a tackle, and then passes over the mast to the winch. When the rope is wound up, the bucket is first drawn up to the boom, and the boom and bucket are then drawn up together to dumping position. In order to return the bucket to cutting position before the boom drops, a check rope is provided for the boom passing over a brake-controlled drum. By tightening the brake as the hoisting rope is slackened off, the check rope holds the elevator boom while the bucket drops to cutting position. The brake is then released to let the check rope slacken with the hoisting rope, so that the boom lowers the bucket into the cut. The boom is arranged to swing through a considerable angle to the line of excavation, and the swing of the bucket is radially adjustable with respect to the boom, so that it will always swing parallel with the car carrying the machine. An adjustable, inclined rail controls the lateral movement of the boom.

There is also an independent boom with a plough attached to it. The plough is arranged to give batter to the ground outside the ditch, this batter being formed to the angle of forty-five degrees. The plough is provided with a rooter point and is also intended for use in levelling rough ground before ditching. The bucket can be detached in a few minutes by withdrawing one pin and cotter. There are many other uses to which it can be put when not in use as a ditcher. Mr. Johnson claims for this machine great simplicity and large capacity combined with great ease and flexibility of operation.

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CONTENTS.

Book Reviews:
Toothed Gearing 659
Diagrams for the Solution of the Kutter and Basin Formula 659
Steam Power Plant Engineering 658
Hydraulic Turbines With a Chapter on Centrifugal Pumps 659
The Laboratory Manual of Testing Materials.. 660
Reinforced Construction Concrete 660
Locomotive Boiler Construction 660
Publications Received 660
Catalogues Received 662

BOOK REVIEWS.

Steam Power Plant Engineering.—By G. F. Gebhardt, Professor of Mechanical Engineering, Armour Institute of Technology, Chicago. Published by John Wiley & Sons, New York. Agents for Canada, Renouf Publishing Company, Montreal. 990 pages; 606 illustrations, besides charts and tables; cloth; 6 x 9 inches. Price, $4.00.

Reviewed by George Service, Wh.Sc.

In his preface to the fourth edition Mr. Gebhardt says: "Although primarily intended as a text-book for engineering students, it is hoped that the new edition will be of interest to practising engineers," and a study of the book convinces one that both the claim made, and the hope expressed, are justifiable.

The author has gathered together from many sources, and arranged in logical order, a large amount of up-to-date practice and discussion covering the subject, and, while the text is sufficiently full for ordinary purposes, the value of the book, especially to practising engineers, is greatly augmented by the extensive bibliography incorporated with the text, forming a splendid reference index for anyone wishing to make independent investigations. The book is remarkably free from "faddishness," such as some novel (and unusual) system of notation, or of nomenclature; and, indeed, the author has taken special pains, by the use of italics, to bring the generally accepted terms to the notice of the student.

In addition to dealing very fully with successful practice, attention is called to various parts of the subject, which, so far, have not been developed to be commercially successful, probably with the object of stimulating investigation along these lines; as, for example, the use of powdered coal. The advantages of such material are very clearly stated, as well as the practical difficulties which have been met with in the attempts to use it.

It has obviously been the intention of the author to deal chiefly with the various details constituting a steam power plant, and very little space has been devoted to the discussion of complete plants, only two central station plants, and one isolated power plant, in Chicago, being described. But one cannot help feeling that the volume would have been more complete had it included, even if only in table form, particulars of a number of typical power stations, which data would probably show that certain fixed proportions existed between the various departments of the plant, and would be of use for practising engineers in making preliminary lay-outs, as well as for advanced students.

The chapter on fuels and combustion contains data drawn largely from United States Government reports, and, unfortunately no reference is made to Canadian coals. The desirability of classifying coals according to the carbon-hydrogen ratio, as adopted by the United States Geological Survey, is pointed out, as it appears to apply satisfactorily to all grades of coal. The subject of combustion in general is treated fully and well, and considerable attention is paid to the use of oil fuel, a number of tests of an oil-burning boiler showing an efficiency of 75.8 per cent. to 83.3 per cent. being given.

Subject matter on the Reciprocating Steam Engine covers over 80 pages, dealing with theory, description of types, and the latest performances obtained, the lowest steam consumption recorded to date being given as 6.95 pounds per indicated horse-power hour. The author points out the advisability of giving the performance in heat units instead of pounds of steam, now that superheated steam is being used.

Steam turbines have become important competitors of the reciprocating engine, and are given very full treatment, taking up about 80 pages. The principal types are illustrated, and the mathematical theory worked out. The advantages of a steam turbine plant are stated thus: "(1) Simplicity; (2) Economy of space and foundation; (3) Absence of oil in condensed steam; (4) Freedom from vibration; (5) Uniform angular velocity; and (6) High efficiencies for large variations in load;" and may be taken as an example of the clear and concise style the author uses throughout the whole book. Each item is afterwards discussed at considerable length. A number of recent performances are given, the B.T.U. per electrical horse-power being as low as 204 for a 2,000 K.W. machine. Comparative costs of the installation and operation of steam turbine and engine plants are given, the balance being in favor of the steam turbine plants.

The high vacuum necessary for recent turbine practice has necessitated considerable modification in the design of the condensing plant, and this part of the subject is treated very fully in the excellent chapters on Condensers and Cooling Towers, and Pumps; and in line with the plan adopted throughout the book, recent data as to the power required, and costs, are given.

One of the most interesting chapters, and one not usually inserted in a technical work of this kind, deals with finance and economics, and the cost of power. At the outset the author points out the necessity for a clear understanding of such much-used (often loosely) terms as "load factor," "curve load factor," "rated capacity," and so on; and gives

definitions of their generally accepted meanings. The cost of each section of the plant is taken up in detail, and a large amount of data given from actual practice, which should be of use to the practising engineer in particular.

All the other chapters, including a very good one on Superheated Steam and Superheaters, are well written and illustrated, but do not call for any special remarks.

In printing the tables an occasional decimal point has been misplaced, and in one place the author states that turbine plants of over 60,000 K.W. capacity can be installed for $65.00 per K.W., while in another he gives the cost as $75.00. Occasionally he touches on debatable ground, as, for instance, when discussing the use of kerosene in boilers he says: "Kerosene oil and other refined petroleum oils are sometimes used with good effect in boilers to prevent scale from adhering;" while later on he adds: "Evidently oil does not have the same effect or give the desired result in all cases." But as a rule his conclusions are extremely definite.

Throughout the book are many diagrams plotted from actual results, which are useful in themselves, and also as illustrating the graphical method of making records and compiling data. The author recommends the use of the "Mollier Total Heat Entropy Diagram" in place of the usual steam tables, and a copy of this diagram is given in the appendix.

Although the volume consists of nearly 1,000 pages, it is extremely concise in its treatment throughout, excessive elaboration being entirely absent; and after a careful study one is satisfied that it is well worthy of a place in any technical library, be it that of a student or practising engineer.

Hydraulic Turbines, with a Chapter on Centrifugal Pumps. —By R. L. Daugherty, Assistant Professor in Sibley College, Cornell University. Published by McGraw-Hill Book Company, New York. Cloth; 6 x 9¼ inches; 156 pages; 96 illustrations. Price, $2.00.

Reviewed by T. H. Hogg,
Assistant Hydraulic Engineer, Hydro-Electric Power Commission of Ontario.

This little volume is a most timely addition to the literature on hydraulic turbines. While a number of treatises have appeared at different times dealing with the design of turbines, these have dealt with the subject in such a manner that they have been of little use to the busy engineer who desires to make a proper choice of wheel under given conditions. Comparatively few men are interested in the design of hydraulic turbines, for a relatively small number are called upon to design machines. The design of water turbines is a highly specialized industry, requiring considerable empirical knowledge, which can be learned only through experience. On the other hand, with the great increase in the number of power developments, a vastly increasing number of engineers are finding it necessary to familiarize themselves with the construction of turbines and to understand their characteristics, in order that they may be able to make an intelligent selection of a type and size of machine for any given set of conditions. This book will appeal to this latter class, for it presents in short, concise form the conditions that bear on the choice of turbines. The general question of the development of water-power is dealt with only in so far as it bears on the choice of turbines.

The author states that his purpose in proposing the text was to give a general idea of water-power development and conditions affecting the turbine operation, a knowledge of the principal features of construction of modern turbines, an outline of the theory and the characteristics of the principal types, commercial constants, means of selection of type and size of turbine, cost of turbines and water-power, and comparison with cost of steam power. A chapter is also included on centrifugal pumps, covering the essential points an engineer desires to know to aid him in the selection of a proper type of pump.

The book should appeal to all engineers interested in the subject of hydraulic turbine selection.

Toothed Gearing.—By Geo. T. White, B.Sc. (London). Published by Scott, Greenwood & Son. 210 pages; 4½ x 7 inches; 136 illustrations and diagrams, also tables. Price, $1.00 net.

Reviewed by Chester B. Hamilton, Jun., B.A.Sc.,
Manager, Hamilton Gear and Machine Company, Toronto.

This is a treatise on Toothed Gearing, as distinguished from Gear Cutting, or practical applications of gears. These latter subjects are excluded and reserved for separate treatment. In this there is no doubt that the author is wise, as the subject in hand is amply large for the size of the book.

The work is modern, being dated July, 1912. Some of the data is new, having been previously published only in the Proceedings of technical societies. Most of the material is old and standard, but is compiled and presented in an effective and clean-cut manner.

The work leans toward the theoretical, rather than the practical, but this cannot be avoided. It is a suitable presentment of the theory for the use of the practical gear-man, as well as for one interested in the theory for itself. That is far more than can be said of most books handling such subjects.

Below is the list of chapter headings: I.—Kinematics. II.—The Spur Wheel, Cycloidal Teeth. III.—Annular Wheels, Cycloidal Teeth. IV.—The Spur Wheel, Involute Teeth. V.—Obliquity of Action. VI.—Pin Gearing. VII.—Non-Circular Wheels. VIII.—Lobed Wheels. IX.—Helical Wheels. X.—Bevel Wheels. XI.—Skew Bevel Wheels. XII.—Worm Bearing. XIII.—Oblique Worm and Wheel. XIV.—Screw Wheels or Spiral Wheels. XV.—Strength of Teeth. XVI.—Durability. XVII.—Trains of Wheels. XVIII.—The Odontograph.

The whole field is quite well covered, and, taken all around, it is a book to be recommended for anyone having a serious interest in gears.

Diagrams for the Solution of the Kutter and Bazin Formulæ. —Prepared by Karl R. Kennison, M. Me. Soc. C.E., Providence, R.I. Published by the author. Two diagrams and explanatory notes. 4 pages; size, 9 x 11 inches. Price, $1.00, postpaid.

Reviewed by J. J. Traill, B.A.Sc.,
Lecturer in Hydraulics, University of Toronto.

These diagrams are so arranged that when any three of the four variables, Slope, Hydraulic Radius, Roughness Factor, and Velocity, are known, the fourth may be scaled. There are two very decided advantages over most graphical representations of the Kutter and Bazin Formulæ, namely, the facts that the desired quantity may be scaled without a straightedge, and that the fourth variable plotted is the velocity and not the Chezy Coefficient. The author makes the claim that the results obtained are as accurate as the uncertainties in the application of the formulæ warrant. A careful examination indicates that this is true for the great majority of cases, the exceptions being for materials so uniform in surface that the value of the roughness factor is well fixed. A weak point in the diagram of Kutter's Formula is the omission of a number of the lines of roughness that might readily have been plotted, and, if inserted, would add greatly to the ease with which the diagram could be used. The diagrams are, however, extremely simple to use, both on account of convenient size and good arrangement.

Laboratory Manual of Testing Materials.—By William Kendrick, Hatt, C.E., Ph.D., Professor of Civil Engineering, Purdue University; and H. H. Scofield, M.E., Assistant Professor in Laboratory for Testing Materials, Purdue University. Published by McGraw-Hill Book Company, Inc., 239 West 39th Street, New York. Cloth; 5 x 7½ inches; 125 pages. Price, $1.25 net.

Reviewed by Robert J. Marshall, B.A.Sc.,
Department of Applied Mechanics, University of Toronto

In the mass of engineering literature published on all sorts of technical subjects, this book by Professors Hatt and Scofield is the first work of its kind which has come to my notice on this particular subject. There is a real field for a student's text in Testing Materials, and this book is the first of its kind which deals in detail with experiments and methods of performing the tests, and seems to fulfil the above need.

The book, which is of convenient size, is well edited and nicely bound. It is divided into two sections. The first forty pages contain: a chapter on general instructions to the student, such as the necessary precautions for successful experimenting; a chapter of definitions which serves to refresh the instruction of the earlier years and a chapter descriptive of the ordinary machines and instruments used in an average experimental laboratory. Chapters VI. and VII., which comprise the second section, outline the experiments and give detail methods of performiug each experiment. The instruction is precise and to the point. The references are well chosen, and in all the book appears to be the result of long experience in this kind of work.

Reinforced Concrete Construction.—By M. T. Cantell, Head of the Technical Department of the Kelvin Technical High School, Winnipeg, Man. Published by E. F. & N. Spon, London, Eng., and Spon & Chamberlain, 123 Liberty Street, New York. 240 pages; 250 illustrations; 7 plates; 7 x 10 inches. Price, $5.00 net.

Reviewed by Prof. P. Gillespie
Department of Applied Mechanics, University of Toronto.

This well-printed volume, comprising some 240 pages, is the second and more advanced of two works by Mr. Cantell on reinforced concrete design. A knowledge of the elements of design in this material is really necessary to an understanding of the text, and it is assumed by the author that the reader possesses such a knowledge. The book favors the British in its notation, in its illustrative typical designs, and in the authorities which it follows. This is apparent, for example, in those somewhat arbitrary rules of design which all regulations contain, and which are necessary in cases where theoretical treatment is impossible or unduly involved. Such matters as the limiting ratio of width of slab to thickness of web in tee-beams, and the minimum spacing of rings in columns reinforced by hoops are decided according to R.I.B.A. practice rather than American. This circumstance, however, should not spoil the text for American readers nor deprive them of its benefits. Indeed, it is the reviewer's opinion that had American practice been leavened somewhat more by British caution and thoroughness during the past decade, fewer fatal failures of reinforced concrete structures on this continent would have occurred.

An excellent feature of the work is the large number of actual problems which have been worked out in detail by the author. These comprise a great many types of construction in reinforced concrete, and are admirably adapted to the needs of the inexperienced designer. Graphical and analytical methods are employed, and the problems present great diversity.

The chapters on Retaining Walls, Water Tanks and Towers, Bunkers, and Arches and Bridges are among the most interesting in the book, and, as the reader will observe, investigate fields among the latest of those invaded by this material, whose applications in building construction are daily increasing in number. The volume is a marked improvement over the ill-digested amateurish stuff that, during recent years, has appeared on this side of the water, and could very properly find a place in the library of both young and old students of the subject.

Locomotive Boiler Construction.—By Frank B. Kleinhan, with additions by George L. Fowler, M.E. Published by Norman W. Henley Publishing Company, 132 Nassau Street, New York. 478 pages; 5 folding plates; 40 tables; 350 illustrations; cloth; 5½ x 8 inches. Price, $3.00 net.

Reviewed by R. W. Angus,
Professor of Mechanical Engineering, University of Toronto.

This is a practical treatise for the use of boiler-makers, boiler-users and inspectors; and, since it is designed for the practical man, there is none of the so-called theory, to speak of, in its subject matter.

The chapter on the types of boilers is very short, and is purely introductory, no illustrations being inserted. The laying out of the various sheets of a boiler, which is next dealt with, is a quite complicated and difficult matter, requiring much skill for exactness. The author has omitted the elaborate methods, substituting for them approximations which are probably accurate enough. Explanations as to why things are done are usually not given, and for this reason the reader might have trouble applying any of the methods to slightly different designs.

Considerable space has also been devoted to flanging, which has been treated entirely in a descriptive way, and illustrated quite fully. This is followed by chapters on punching, shearing, plate-planing, etc., the effort being to follow the various parts through the shop in order in which the work would be done. Riveting and staying receive some fair share of attention, and such matters as the mountings and general assembling are dealt with.

The concluding 120 pages contain tables of various sorts, many of which would be helpful, while the back of the book contains five folding plates.

To the builder or mechanic wanting general ideas on working out the details of a locomotive boiler the book would be of some interest, but as it deals only with the locomotive boiler it can scarcely be said to be of general interest. The problems connected with the building of the locomotive boiler are, however, similar to those with other types.

PUBLICATIONS RECEIVED.

Office and Field.—Seventh annual convention number of the L.U.A.C., Ottawa, 1913. 372 pages, 6½ x 10 inches. Published by W. B. Campbell.

Carbon Circuit Breakers.—Circular No. 1205, of the Canadian Westinghouse Company, Limited, Hamilton, Ont., is descriptive of a half-dozen types, and their auxiliary mechanisms.

Handbook of British Columbia.—Bulletin No. 23 (seventh edition) of the Bureau of Provincial Information, descriptive of British Columbia, as to its position, resources, climate, industries, etc.

The Resources of Tennessee.—This is a magazine published quarterly by the State Geological Survey, and devoted to the description, conservation, and development of the resources of Tennessee.

The Inflammability of Coal Dust.—Bulletin 50, of the United States Bureau of Mines, comprises the results of laboratory experiments by Messrs. J. C. W. Frazer, E. J. Hoffman, and L. A. Scholl, Jr.

Report of Nelson P. Lewis, Chief Engineer of the Board of Estimates and Apportionment of the City of New York for the year 1912. It is a volume of 300 pages, including 37 tables, together with various maps, etc.

Hamilton.—A 340-page book, published by Herbert Lister, Hamilton, Ont., descriptive of the city, its history, commerce, industries, and resources, and published in connection with the Centennial Industrial Exhibition held recently.

The Geology of the Cowganda Mining Division.—Memoir No. 33 of the Geologic Survey Branch, Department of Mines, Ottawa. It is a 120-page book, supplemented with maps and photographs covering the general and economic geology of the district.

Society of Railway Club Secretaries.—A 24-page booklet, indexing the papers and subjects discussed by railway clubs during the year ending May 31st, 1913. The secretary of the Society is Harry D. Vought, New York and Central Railway Club, New York City.

The Theory of Loads on Pipes in Ditches, and Tests of Cement and Clay-Drained Tile and Sewer Pipe.—Bulletin No. 31, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts. The authors are A. Marston and A. O. Anderson.

Mineral Production of Canada.—Bulletin No. 238, Mines Branch, Department of Mines, Ottawa, contains a general summary of the mineral production of Canada, 1912, compiled by John McLeish, B.A., Chief of the Division of Mineral Resources and Statistics.

The Textile Industry and the Tariff.—An address by A. F. Greene, delivered to the National Association of Cotton Manufacturers by Mr. Greene, retiring president. Published in booklet form by Lockwood, Greene Company, architects and engineers for industrial plants, Boston and Montreal.

Le District D'Ungava, Le Nouveau Quebec.—231 pages, 7½ x 10½ inches, illustrated, with map appended. Extracts from reports on the district of Ungava, recently annexed to the Province of Quebec. Published by the Bureaus of Mines and Fisheries, under the authority of the Minister, the Hon. C. R. Devlin.

Report on the Health of the City of Manchester, 1912.—203 pages, 6 x 10 inches, dealing with notified infectious diseases, and the work done to combat these under the various branches of the department of health. Issued by James Niven, M.A., M.B., LL.D., under the authority of the Department.

Commerce and Finance of the United States.—105 pages, 10 x 12 inches. Monthly summary of the foreign commerce of the United States, and of tables of commercial finance for July, 1913. Issued by the United States Bureau of Foreign and Domestic Commerce. A. H. Baldwin, Chief of Bureau, and O. P. Austin, Assistant Chief.

Oil and Gas Prospects of the North-west Provinces.—99 pages, 7 x 9 inches, with illustrations and map. Discusses the character of the district, and its general and economic geology. Published by Wyatt Malcolm, and by authority of the Hon. Robert Rogers, Minister of the Dominion Government Department of Mines.

Analyses of Coal.—Bulletin No. 22 of the Bureau of Mines, Department of the Interior, Washington, D.C. It is published in two volumes, Part I. of 320 pages, dealing with the analyses of coals in the United States, collected over a period of six years; and Part II., of 1,200 pages, dealing with descriptions of the various samples.

Forest Products of Canada—Poles and Cross-Ties.—A 16-page pamphlet published by the Forestry Branch, Department of the Interior, as Bulletin 30, containing statistics, compiled by R. G. Lewis, B.Sc.F., based upon reports from 389 companies, representing 95 per cent. of the wooden-pole users in Canada, concerning their purchases for 1912.

The Titaniferous Iron Ores in the United States.—First edition, June, 1913. Illustrated, 145 pages, 6 x 9 inches. Discusses the chemical composition of titaniferous iron ores, the economic importance of the deposits, and their character, situation, and possibilities. Published by Joseph T. Singewald, Jr., by authority of the United States Government Bureau of Mines.

Oil and Gas Prospects of the North-West Provinces of Canada.—Memoir No. 29E of the Geological Survey of Canada. Compiled by Wyatt Malcolm, and containing full information concerning the geological formations in that portion of the Dominion, comprising practically all of the Provinces of Manitoba, Saskatchewan and Alberta. The report occupies 100 pages, and is supplemented by tables and maps.

Report, Minister of Lands, Forest and Mines, Ontario—This report for the year ending October 31st, 1912, deals with the management, etc., of the Crown Lands of the Province of Ontario. It includes returns, statements of sales, of revenues, receipts and disbursements, timber dues, municipal surveys, Crown surveys, etc., etc. Several appendices are devoted to the construction of roads in Northern Ontario, and Mr. J. F. Whitson's report is included.

Wood-using Industries of Ontario. Bulletin No. 36, Forestry Branch, Department of the Interior, Ottawa. It is compiled by R. G. Lewis, B.Sc.F., and contains an account of the quantity, value and source of supply of the different kinds of wood used by the industries of Ontario. It includes detailed descriptions of the different classes of industries, and the properties of the woods used. A classified directory of manufacturers is appended.

Long Sault Rapids, St. Lawrence River.—By Arthur G. White, M.E., Engineer to the Commission of Conservation, Canada. This is an engineering report upon the rapids, containing an inquiry into the constitutionality of the Long Sault Development Company's charter, and into the effect on navigation, and the general advantages or disadvantages accruing to the people of Canada from the project to develop electric power from these rapids. The volume comprises 384 pages. It is accompanied by about 25 illustrations and maps. This is the Commission's report upon a question which was dealt with editorially in Sept. 4th issue of this journal.

Precise Levelling is the title of a publication of the Dominion Observatory, Ottawa; W. F. King, C.M.G., LL.D., Director. Mr. F. B. Reid, D.L.S., is the author. The report deals with the results of precise levelling done by the Geodetic Survey as far as they are ready for publication at the present time. Table I. outlines the routes followed between terminal points, and describes all bench-marks established. Table II. gives the distances between bench-marks; the difference between forward and backward levelling for each section between bench-marks; the elevations of the bench-marks; and the elevation also of bench-marks established by other surveys and connected with Geodetic Survey work. Table III. gives the elevations at railway stations along different lines of levels. The publication is supplemented by several maps descriptive of the routes.

American Society for Testing Materials, Index to Proceedings, Vols. I.-XII.—158 pages, 6½ x 9 inches. An index of the contents of Vols. I.-XII. of the proceedings of the American Society for Testing Materials, excluding only portions which relate to routine business. From 1898 to 1902, the society issued 28 bulletins, and these have been compiled as Vol. I. From 1902 to 1913, the association has issued a report of its proceedings annually, and these successive reports have been published separately in Vols. II.-XII.

Completing the Index is a Table of Contents of Proceedings, which gives the contents of the final eleven individual volumes. In this volume the titles of papers have been distinguished by quotation marks, and committee reports and specifications have been indexed under subjects appropriate to their titles. Prefixed to the Index is a list of key-words under which these subjects have been indexed; and the Index itself is classified under subjects and authors. The publication is issued by the society at the University of Pennsylvania, Philadelphia, Pa.

The Cobalt-Nickel Arsenides and Silver Deposits of Temiskaming, Report of the Bureau of Mines (Fourth Edition).—279 pages, 7 x 10 inches, fully illustrated and well supplied with inset maps. The book is divided into three chapters and four appendices. Chapter I. contains 132 pages, and deals with the district of Cobalt proper, the character and origin of its veins, ores and minerals. Chapter II. considers for 63 pages the Outlying Cobalt Areas, and a like discussion of their mineral products. Chapter III. gives in 30 pages an analysis of Lake Superior silver deposits, other Canadian Nickel-Cobalt ores, and foreign Cobalt deposits. The four appendices discuss respectively the Paleozoic Rocks of Lake Temiskaming, a profile from Toronto to Hudson Bay slope, the early history of the Cobalt industry in Saxony, and mining and concentrating methods at Cobalt. In this edition little is added to the economic geological description given in former editions; but some features have been treated more fully, such as underground work in the mines, which has furnished many details concerning the structural relations and the character of the veins.

Twentieth Annual Report of the Massachusetts Highway Commission, 1912.—333 pages, 6 x 9 inches, with map appended, containing Parts I. and II; the former dealing with State highways and motor vehicles; the latter, with the supervision of telephone and telegraph companies. Part I. comprises in 200 pages the report of the Massachusetts Highway Commission, consisting of Wm. D. Shier, chairman F. D. Kemp, and J. W. Synan; the report of Chief Engineer A. W. Dean, as Appendix A; and twelve additional appendices. A thorough discussion of the department's work upon State roads and in the supervision of automobiles marks the first portion of Part I. as most valuable, though the traffic census is also discussed at length, and constitutes a special phase of the book, which is elaborated in Appendix L by 28 pages of traffic records. Part II. consists of the annual report of the Massachusetts Highway Commission concerning companies engaged in the transmission of intelligence by electricity, which is supplemented by three appendices. There are three half-tone illustrations, two showing improved roads, and the third is of a 42-foot span reinforced concrete bridge. The appendaged map shows in tones of red the roads petitioned for, roads laid out, and town roads improved in Massachusetts. Wright & Potter Printing Company, Boston, Mass.

CATALOGUES RECEIVED.

Fractional Horse-Power Motors and Applications.—Illustrated leaflet, showing the various forms of fractional horsepower motors offered by the Canadian General Electric Company, Toronto.

Universal Bulletin.—Illustrated monthly, showing use of Portland cement in concrete bridges and buildings of various kinds. Published by the Universal Portland Cement Company, of Chicago, Ill.

A Thousand Uses for Gas.—The September number of an illustrated periodical issued to manufacturers by the Industrial Division of the United Gas Improvement Company, Philadelphia, Pa.

Efficient Roundhouse Lighting is the subject of a small pamphlet published by the Canadian General Electric Company, Limited, Toronto, and dealing with a type of reflector for use in roundhouses.

Incineration.—A neat 22-page pamphlet descriptive of some of the plants of the Decarie incinerator for the disposal of garbage and refuse. Published by the Decarie Incinerator Company, Minneapolis, Minn.

Steam-Driven Compressors.—A 12-page catalogue is published by the Canadian Pneumatic Tool Company, descriptive of Class "M" Chicago Pneumatic Corliss type compressor. It is Bulletin No. 24-T.

Country Sewage Purification.—Tuke & Bell, Limited, Sewage Specialists, London, E.C., describe their semi-septic system of sewage purification which they install for cottages, country houses, institutions, etc.

Condulets.—New types for railway requirements are listed and illustrated in Bulletin 101 of the Crouse-Hinds Company of Canada, Limited, of which Canadian General Electric Company are the selling agents.

Annual Report of the Quebec Railway, Light, Heat and Power Company, Limited.—An illustrated pamphlet, including maps, giving the report for the fiscal year ending June 30th, 1913, adopted by the company at its third annual meeting.

Mesta Gas Engines.—The Mesta Machine Company, Pittsburg, Pa., have issued a bulletin descriptive of their gas engines, which they build for any gas fuel—producer, blast furnace, coke oven, or natural, and in sizes from 350 B.H.P. upwards.

Catalogue "C" of the DeLaval Steam Turbine Company describes class "C" velocity-stage type. It is a catalogue of 108 pages, well illustrated and full of interesting data. The Turbine Equipment Company, Limited, Toronto, look after the sale in Canada.

Smut Diseases of Cultivated Plants.—Illustrated bulletin, giving a description of the different varieties, their history and treatment. Issued by H. T. Güsson, Dominion Botanist, and published by direction of Hon. Martin Burrell, Minister of Agriculture, Ottawa.

Illumination of Construction Work.—This is an illustrated description of the G. E. Type "W" flame arc lamp, and of its suitability for use by the modern contractor on his night-work jobs. The Canadian General Electric Company, Toronto, are selling agents.

Hand-Drills and Portable Compressors.—Illustrated pamphlet dealing with the Chicago Valveless Hand-Drill and the "Chicago Pneumatic" Portable Gasoline Engine-Driven Air-Compressor. Published by Chicago Pneumatic Tool Company, of Chicago and New York.

Wizard Rock Drills.—This product of the McKiernan-Terry Drill Company, New York, is described in a 12-page illustrated booklet. Prices and specifications of the various types and of their duplicate parts are given. Canadian Allis-Chalmers, Limited, Toronto, are agents.

Coal-Mine Fatalities in the United States.—A catalogue of tables, giving statistics of July coal-mine fatalities, and revised figures for preceding months. Compiled by Albert H. Fay, and published under the direction of the Bureau of Mines, United States Government, Washington, D.C.

Multi-Stage Type DeLaval Steam Turbines.—Described in Catalogue "D." The book is a 120-page description of the field, design, construction, and adaptation of the multi-stage DeLaval Turbine. A section of the catalogue is devoted to the company's double-helical speed-reduction gear. The catalogue is educative in the information which it contains, and shows, among other important details, the use of the DeLaval diagram and steam scale for determining the consumption of an engine or turbine under given steam conditions.

COAST TO COAST.

Regina, Sask.—To encourage the growth of smaller industrial companies, a movement has been begun in Regina to secure cheaper power for concerns using from 50 horsepower up. This means that the city council will be requested to grant the minimum rate to users of 50 horsepower or over instead of 100 horsepower as at present.

Ottawa, Ont.—The civic waterworks committee has appointed a sub-committee to investigate the meter system on water services as in vogue in some cities. This action has been taken merely to gain information concerning a method that might show how much water each place is consuming, so that the water rates might be based on the quantity of water consumed.

Fort William, Ont.—Actual work is now in progress on the extension of the Empire Avenue street-car line across the new C.P.R. bascule bridge to island number two. The work on the island has been proceeding for some time, and before the frost sets in, it is expected that all the rails will be laid from the bridge approach along Sixth Avenue to Eighth Avenue, and from thence down to the Mission River.

Hamilton, Ont.—Engineer Sifton, of the Hydro-Electric Department, has submitted statements to the board of control showing that the gross profits from the department for the past eight months have been over $26,000, the net almost $6,000. He furnished in addition an estimate of the amount required to complete the system so as to provide for the increased demands, showing an expenditure of $335,264, according to one plan, and $320,330, according to an alternative plan. For the larger amount, he informed the board that he would be in a position to supply eight times the number of customers that could be accommodated by the original system; and that cost about $500,000.

Fredericton, N.B.—The repairs and improvement being undertaken on the Fredericton-St. Mary's highway bridge are progressing satisfactorily both as far as efficiency and economy are concerned. The original estimate of cost was between $45,000 and $50,000; and President Remington, of the Foundations Company, Limited, the contracting company for the work, has stated after carefully inspecting the work and accounts thus far, that the estimate will not be exceeded, but rather that with favorable conditions, the work will be completed at less than the estimate, and will be a permanent piece of construction with which the best experts in America will be unable to find fault.

Ottawa, Ont.—Mr. L. G. Denis, expert for the Hydro-Electric Commission, has taken a thousand-mile trip through the northern Manitoba and Hudson Bay districts, and has given a report of his survey of important water powers, which disburses the possibility of the operation of the Hudson Bay Railway by hydro-electric power, an idea which has at times been promulgated. He states that though there are many water powers, economic conditions for development are not probable; since a continuous market for the power, for which there is little prospect, would be necessary to insure profit. The economic potentialities of the territory are such that any saving which might be effected by the operation of the road would hardly repay the cost of development.

Vancouver, B.C.—Mr. O. B. Dickeson, president of the White Pass and Yukon route, who has spent the greater part of the summer in the north, upon arriving in Vancouver, confirmed previous statements sent from Dawson City that his company will undertake important extensions to the transportation system in the North, and will also make every effort to provide for the present activity along the trails into the Shushanna country and the scene of the recent gold strike. The company's extensions into the White River district will be carried out, provided the development continues and it is possible to secure Governmental assistance. This he did not doubt, since the company's mining engineer had examined the territory, and had reported that, if transportation could be offered, the future of the White River country copper deposits was very promising.

Victoria, B.C.—Mr. Chambers, of the Irrigation Board of the Department of the Interior, recently visited Victoria, and while there made some interesting statements relating to the irrigation projects being developed in the Northwest provinces. He claimed that thousands of acres of semi-arid lands are being turned into valuable tracts and gave concrete evidence in instances of vastly improved germination that had come under his personal notice, to the greatest extent in the Bow River district. He said concerning the Bow River scheme that it was one of the largest projects of its kind on the continent, that the first two sections are completed, and their contributory lands under tillage, that the third section, which is fed by the Bassano dam, is rapidly nearing completion, and that the water will soon be let into the dam. The first section, which embraces an area of 300,000 square acres, is situated almost entirely south of the Calgary and Medicine Hat line down to the Bow River, and has been an important factor in the agricultural development of a section that was not looked upon very favorably in pre-irrigation days. Although these three units serve an immense area, it is the general opinion in Alberta that the C.P.R. will further develop this scheme and make it eventually one of the largest irrigated areas in the world. The dams are of concrete and splendidly constructed, and it is expected that there will be a big demand for the affected land when it is put on the market. In addition to the C.P.R., the South Alberta Land Company has irrigated large areas in that province. The Irrigation Board is not concerned with the actual work of construction, but it issues licenses for the utilization of the necessary number of cubic feet of water per second required for the development of the project, and all irrigation schemes and the structural details of the dams and ditches are submitted to the engineers of the board for sanction before the work is begun.

PERSONAL.

B. W. SETON, of the Dominion Engineering and Inspection Company, Montreal, has been appointed Toronto manager of his firm in order to handle the inspection work on the new Royal Bank Building, the Central Technical School, etc.

F. B. TAYLEY, resident engineer at London, Ont., for the Canadian Pacific Railway, has been transferred to the Montreal division, and is being succeeded at London by S. S. ROSSITER, of Cranbrook, B.C.

WALTER J. FRANCIS, C.E., consulting engineer, Montreal, read an address to the University of Toronto Engineering Society at the opening meeting for the 1913-14 session. The subject was "Engineering as a Profession."

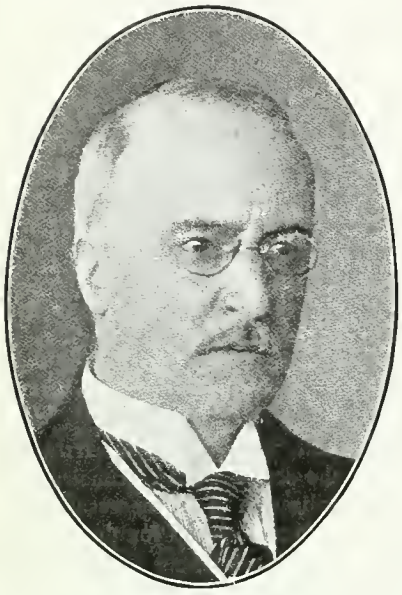
CUNNINGHAM CRAIG, former geological surveyor of Great Britain and of Trinidad and Tobago, consulting geologist to the British Government, is in Alberta at present, conducting a rigid survey of the oil lands to the south-west of Calgary. He has announced, unofficially, that the territory indicates that the possibilities for oil in abundance are tremendous. The Province is receiving wide attention from oil experts at present.

W. S. HARVEY, the new city engineer of Lethbridge, as recently announced in this column, has been connected

with the department of the city engineer for two years as assistant engineer in charge of sewers and waterworks. Previous to his going to Alberta, he spent some time in Toronto, as assistant engineer in the main drainage department. He spent eleven years on engineering work in England—on dock work at Bristol and Hull; on pumping station installation at Somerset; pier and coaling station construction at St. Vincent, Cape Verde Islands; sea defence work at Barry, South Wales; tramway construction at Chesterfield, and jetty work at Newport.

OBITUARY.

DR. RUDOLPH DIESEL, Hon. M. Am. Soc. M. E., of Munich, Germany, famous as an inventor of the Diesel oil engine, while on his way to London to attend the annual meeting of the Consolidated Diesel Engine Manufacturers, mysteriously disappeared from the steamer en route on the evening of September 29th, and, although for some little time hope was entertained of his being alive, it later developed that his disappearance was due to death by falling overboard through some mischance.



Dr. Rudolph Diesel.

Dr. Diesel was born in Paris in March, 1858. After courses of study at Augsberg, he entered Munich Technical College, where he graduated in 1879, specializing in thermodynamics. After spending some years on the staff of the college as assistant to Prof. von Linde he became manager of the French company for the manufacture of the von Linde refrigerating machinery in Paris.

Dr. Diesel's theories regarding prime-movers with higher thermal efficiency than the steam engine attracted world-wide attention in the early nineties, and in 1893 the first Diesel engine made its appearance. This experimental engine was wrecked by explosion at the first injection of fuel. The second Diesel engine, however, confirmed the inventor's theory of initiating combustion by compressed air. The third Diesel engine, built in 1897, and the fourth in the following year, were those that fixed the type upon which all slow-speed stationary Diesel engines have since been built. The progress and development of the engine during the past fifteen years is familiar to readers of this journal, it being now in service in practically every industrial country of the world.

Besides his honorary membership in the Am. Soc. M.E., Dr. Diesel was a member of the managing board of the Verein Deutscher Ingenieure. He was a director of five of the leading companies building Diesel engines in America and Europe.

W. F. DE VOE, connected with one of the British Columbia Government survey parties at Strathcona, lost his life by drowning while crossing Campbell River on October 19th. Mr. De Voe was a native of Los Angeles, Cal.

H. S. WESTBROOK, ex-Mayor of Winnipeg, and a prominent figure in the city's municipal development, died at his home in Winnipeg on October 19th. Mr. Westbrook was the father of President Wesbrook of the University of British Columbia. Another son is a prominent mining and metallurgical engineer in Duluth.

BRIDGE BUILDERS IN MONTREAL.

The American Railway Bridge and Building Association held its twenty-third annual convention last week in the city of Montreal. This is the second occasion of the Association's choice to convene in a Canadian city, Quebec having been previously chosen.

Mr. A. E. Killam, of Moncton, N.B., is president of the Association.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

Mr. James Spelman, vice-president of the John S. Metcalf Company, addressed the Montreal meeting of the Canadian Society of Civil Engineers, on October 16th, on the subject of the development of grain elevator construction. Mr. C. N. Monsarrat, chief engineer of the Quebec Bridge Company, was chairman.

At the November 6th meeting in Montreal, an important paper on "Filtration" will be read by Mr. F. F. Longley.

POSTPONED MEETING.

The convention of the Great Lakes International Pure Water Association, to have been held in Toronto, November 6th and 7th, has been postponed until further notice. The Secretary is Paul Hansen, Urbana, Ill.

A NEW CENTRIFUGAL PUMP.

At its meeting on November 11th in New York City the American Society of Mechanical Engineers will hear an address by Mr. C. V. Kerr, on a new centrifugal pump with helical impeller. Mr. Kerr, who is a sales engineer for the A. S. Cameron Steam Pump Works, claims that the reason for seeking a new type of pump is based on the characteristic behavior of the small steam turbine, which is commonly used in power plants, as the driving power for circulating pumps for condensers. The mathematical theory of the new type of impeller will be presented, also an illustrated description of the 8-in. experimental pump used, with methods and results of tests.

COMING MEETINGS.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

NATIONAL MUNICIPAL LEAGUE.—Annual meeting will be held in Toronto, November 12-15. Secretary, C. R. Woodruff, 705 North American Building, Philadelphia, Pa.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The annual meeting will be held in New York, December 2nd to 5th, 1913.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20579—October 7—Authorizing Quebec, Montreal and Southern Ry. Co. to construct siding for Mount Royal Brick Co., Limited, parish of Varennes, Co. Vercheres, Quebec.

20580—October 15—Approving plans Nos. 28 and 31, of city of Toronto, showing viaduct carrying Bloor Street across C.P.R., C.N.R. and G.T.R. Cos., authorized to be constructed under Order No 20437, dated September 23rd, 1913.

20581—October 8—Authorizing C.N.R. to connect its railway with the Manitoba and Saskatchewan Coal Co., Limited, spur in the N.E. ¼ Sec. 19-2-6, W. 2 M., near Bienfait, Sask.

20582—October 15—Approving deviation Lake Erie and Northern Ry. between stations 745.00 and 793.00, Tp. Townsend, Co. Norfolk, Ont.

20583—October 15—Authorizing Lake Erie and Northern Ry. to construct across two highways—namely, Con. Road between Station 771.97.5 to Station 772.60.5; 2. Given Road at Station 613.3.

20584—October 16—Suspending, pending hearing and determination of matter by Board, cancellation as from November 1st, 1913, of inter-warehouse arrangement for completion of carload shipments of grain, notice of which is given by Supplement No. 28 to C.P.R. Tariff C.R.C. No. E.2141, and Supplement No. 18 to G.T.R. Tariff C.R.C. No. E.2374.

20585—October 15—Approving location Lake Erie and Northern Ry. from Station 4.50 to George Avenue, Station 36.60.5, City of Brantford, Ontario.

20586—October 16—Rescinding Order No. 17885, October 29th, 1912, in so far as it authorized crossing of highway between Lots 118 and 119, parish St. Laurent, Co. Jacques Cartier, Quebec.

20587—October 16—Extending, until November 18th 1913, time within which C.P.R. install bell at crossing known as "Miller Crossing," ¾ mile west of Kingsbury, Que. Also extending, until October 30th, 1913, time within which bell at crossing of river road, about three miles east of Kingsbury, between Melbourne and Windsor Mills, Que., be installed.

20588—October 16—Approving plan, filed by C.N.R. and dated Winnipeg, September 10th, 1913, substituted for plans approved under Order No. 20058, authorizing construction of spur across N.E. ¼, Sec. 15, and N.W. ¼, Sec. 14-37-5, W. 3 M., Mun. Cory, Sask., and that Order No. 20058, dated August 11th, 1913, be amended accordingly.

20589—October 15—Authorizing C.P.R. to construct siding for Canadian Wire Co., Limited, situate in part Lot 3607, Emard Ward, Montreal, subject to terms of City's consent to crossing of St. Patrick Street, save and except provision reserving to City right to order Co., to remove said siding upon notice to company.

20590—October 4—Authorizing G.T.R. to reconstruct Bridge No. 202, carrying its railway over Big East River, mileage 150.75, on 12th District, near Huntsville, Ont.

20591—October 16—Authorizing G.T.P. Ry. to construct across and divert highway in Charles Indian Reserve, mileage 317, Prince Rupert East, Coast Dist., B.C., subject to inspection by Department of Public Works for Prov. of B.C.

20592—October 16—Approving location C.N.O.R. station grounds at Isle Jesus, parish Ste. Dorothee, on Lot No. 85, mileage 38.95, Hawkesbury East, Co. Laval, Que

20593—October 17—Authorizing C.P.R. to use and operate over spur of C.N.R. into Government Elevator at Port Arthur, Ont., subject to certain conditions.

20594—October 17—Authorizing C.P.R. to construct, at grade, an extra track allowance between Secs. 27 and 34-21-31, W.P.M., at Langenburg, Sask.

20595—October 17—Authorizing C.P.R. to construct, by means of a grade crossing, tracks of spur to ballast pit across road allowance, situate in N. ½ Sec. 5-7-19, W. 4 M.

20596—October 17—Authorizing C.L.O. and W. Ry. to construct Bridge No. 121.29 across road allowance between Lots 22 and 23, Con. A., Tp. Hamilton.

20597—October 17—Authorizing C.L.O. and W. Ry. to construct across Sinclair Street, Town Cobourg, by means of an undercrossing, at mileage 120.6. And rescinding Order No. 19093, dated April 19th, 1913, in so far as it authorizes crossing of Sinclair Street, at Grade.

20598—October 15—Directing that G.T.P. Ry., within ten days from date of this Order, construct crossing opposite Lot 384 on Queen Street, city of Fort William, Ont.

20599—October 16—Requiring that C.N.R. move loading platform at Bryant Station, Sask., from present location to a point convenient to west end of yard; grade good driveway from road allowance to approach to loading platform; and grade driveway 300 feet long, level with base of rail, at a point just east of proposed location of said loading platform, to be used for team track loading.

20600—October 17—Approving plan and specifications of drain, known as Fleming-Wigle Drain, proposed to be constructed under Windsor, Essex, and Lake Shore Rapid Ry. Co.; Ry. Co., to do work on its own lands.

20601—October 18—Authorizing G.T.R. to construct, temporarily, an additional track across or on road allowance between Cons. 1 and 2, Tp. Brantford, Co. Brant, Ont., subject to conditions that construction of said spur shall not in any manner encroach on travelled portion of said highway, and that highway be kept open and safe for public travel: switch be removed as soon as reasonably possible after machinery is delivered.

20602—October 18—Removing speed restriction of 20 miles an hour over portion of C.P.R. Kerrobert North Easterly Branch from mileage 0 to 25, and 15 miles an hour from mileage 25 to 36.1, Province of Saskatchewan.

20603—October 18—Approving location G.T.R. proposed new station at Seagrave, Tp. Reach, Co. Ontario, Ontario, to replace one recently destroyed by fire.

20604—October 8—Approving C.N.O.R. plan No. D29-1 of subway to be constructed at Wylde Street, town North Bay, Ontario.

20605—October 17—Authorizing G.T.R. to reconstruct Bridge No. 58, at mileage 146.42 from Black Rock, carrying 20th District of its Ry. across Bayfield Creek, at a point 2.11 miles east of Clinton Station, Tp. Tuckersmith, Co. Huron, Ont.

20606—October 18—Approving location Esquimalt and Nanaimo Ry. station at Qualicum Beach, on Comox Extension of its railway, Vancouver Island.

20607—October 18—Authorizing C.P.R. to construct spur for Continental Oil Co., Limited, Winnipeg, Man., from a point on westerly limit of its line in Lot M., plan 252, St. Boniface.

20608—October 17—Removing speed restriction of 15 miles an hour over portion of C.P.R. Wilkie Southeasterly Branch from Wilkie, mileage 0, to Kelfield, mileage 35.3, Sask.

20609—October 15—Approving revised location C.L.O. and W. Ry., Glen Tay to Cobourg Line, as set forth in recital of this Order; and rescinding Order No. 15289, September 22, 1911, approving original location. Authorizing C.L.O. and W. Ry. to take possession of portions of right of way and tracks of C.N.O.R. and authorizing city of Belleville to lay water pipe under C.N.O.R. at foot of Mary Street. Refusing rest of city's application.

20610—October 17—Amending Order No. 20318, dated September 12th, 1913, by striking out figures "20" after word "Range" in 4th line of operative part of Order, and substituting therefor the figure "2."

20611—October 9—Authorizing C.P.R. to install temporary interlocking appliances at crossing of Quebec, Montreal and Southern Ry. at mileage 18.81 from Farnham, Que., until June 30th, 1914.

20612—October 21—Authorizing city of Regina, Sask., to construct its Municipal Street Ry. over Bulyea and Colonsay Branch of C.P.R. at intersection of 4th Avenue, immediately south of Blocks 11 and 12, Eastview, Regina, Sask., subject to certain conditions.

20613—October 17—Authorizing township of Ancaster, Ont., to construct, at its own expense, Broadway Avenue, across T.H. and B. Ry. in West Hamilton, Ont. And dismissing application as to remainder of crossings.

20614—October 17—Authorizing, upon condition that authority granted herein shall be subject, in all respects, to terms of agreement dated December 1st, 1908, between C.P.R. and G.T.P. Ry., G.T.P. Ry., to construct spurs from its main line of railway, across Vickers Street, Fort William, Ont., to its proposed freight yards; and approving location of Co.'s proposed freight station, Fort William, Ont.

20615—October 17—Amending Order No. 19248, dated June 4th, 1913, by adding following words to paragraph 5 of Order: "and paid by the Applicant Company."

20616—October 21—Authorizing Hamilton St. Ry. Co., to operate its cars over crossing of T.H. and B. Ry., at intersection of Main and Trolley Streets, Hamilton, Ont.; interlocking plant be installed on or before November 30th, 1913.

20617—October 18—Authorizing G.T.R. to operate jointly and on equal terms with C.P.R., that Co.'s branch line serving the premises of Canada Foundry Co., Limited, north of Royce Avenue, Toronto, subject to condition that G.T.R. pay to C.P.R. a yearly rental equal to interest of 6 per cent. per annum upon one-half of cost of construction of track, and one-half of cost of maintenance thereof.

20618—October 21—Directing that, within three months from date of this Order, G.T.R. install gates to cover all tracks and sidings as well as main tracks, at crossing of first highway east of Clarkson Station, Ont., to be operated by day and night watchmen: question of apportionment of cost of installing gates be reserved for further consideration by Board. If gates are not erected and in operation within said three months, expense of day and night watchmen employed at crossing will be borne and paid by Ry. Co., until such gates are installed.

20619—October 17—Authorizing G.T.R. to construct siding into premises of Quinlan and Robertson on Lot 10, Con. 9, Tp. Huntingdon, Ont., subject to certain conditions.

20620—October 21—Directing that G.T.R. install, within 90 days from date of this Order, an improved type of automatic electric bell at crossing on Third line, immediately west of Etobicoke River, between lots 5 and 6, Con. 6, south of Dundas Street, Tp. Toronto; 20 per cent. of cost of installing bell be paid out of "The Ry. Grade Crossing Fund," remainder by Ry. Co.

20621—October 18—Directing G.T.R. to construct siding into premises of St. Mary's Portland Cement Co., Limited, being part of Lot No. 22, Con. 17, Tp. Blanchard; and to connect said spur with existing siding and spurs serving Applicant's plant; Applicant to convey to Ry. Co., necessary right of way. All subject to certain conditions. And rescinding Order No. 19365, dated May 21, 1913.

20622—October 21—Authorizing C.P.R. to construct diversion in S.W. ¼ Sec. 6-5-17. W. 4 M., at McNabb, Alta., on its Alberta Div., Coutts Subdivision.

20623—October 21—Extending, until December 15th, 1913, time within which C.P.R. install electric bell at crossing of Main Street, town of Milverton, Ont.

20624—October 22—Relieving C.P.R. from providing further protection at crossing known as Cote du Sud, mileage 11 from Place Viger Station, Montreal, Que.

20625—October 16—Authorizing C.L.O. and W. Ry. (C.P.R.) to construct its tracks, for a period of nine months from date of this Order, over portion of forced road running through Lot 24, Con. 8, Tp. Camden, Co. Lennox and Addington, at mileage 46.3, subject to certain terms and conditions.

20626—October 22—Authorizing T.H. & B. Ry. to open for traffic that portion of new second track from Welland to Welland River, mileage 0.49 to mileage 1.35, Ontario.

20627—October 22—Refusing application T.H. & B. Ry. for an Order declaring it to be senior at crossing of Birch Ave., Hamilton, Ont.; and declaring that city is senior at said crossing of Birch Avenue.

20628—October 22—Authorizing G.T.R. to reconstruct bridge No. 44, 20th Dist., mileage 116.16 from Black Rock, over Wellington St., Stratford, Ontario.

20629—October 22—Authorizing G.T.R. to reconstruct bridge No. 47, 20th Dist., mileage 116.65 from Black Rock, across John Street, city of Stratford, Ont.

20630—October 22—Authorizing C.N.R. and G.T.P. Ry. to operate their trains over crossing at Camrose, Alta., without their being brought to a stop.

20631—October 22—Approving location and details of C.N.R. station at St. Boniface, Manitoba.

20632—October 22—Rescinding Order 20024, dated Aug. 13th, 1913.

20633—October 22—Approving location C.P.R. station at Neptune, on Estevan-Forward Branch, Saskatchewan.

20634—October 21—Authorizing C.P.R. to construct spur for Whitworth Bros., from a point on existing spur in N.W. ¼ Sec. 5-18-18, W. 2 M., at Pilot Butte, on Co.'s main line, Sask. Div., Moose Jaw Subdivision, Sask.

20635—October 22—Authorizing C.P.R. to construct Lacombe-Easterly Branch across twenty-three (23) highways, mileage 155.63 to mileage 180.61, Alberta.

20636—October 21—Authorizing C.P.R. to construct tracks to freight sheds in its yard at Peterboro, Ont., across King St., and to change alignment and grade of other two tracks across King St.

20637—October 22—Rescinding Order No. 17667, October 4th, 1912, in so far as it relieves C.P.R. from fencing from mileage 6.8 to 7.6 on east side of track. 2. C.P.R. fence portion of right-of-way from mileage 6.8 to 7.6 on east side of track, and put fences on west side of track in a proper state of repair; work to be completed within 30 days.

20638—October 22—Directing that C.N.O.R. at its own expense, construct a farm crossing on property of L. O. Christmann, of Beachburg, Ont., on Lot 8, Con. 4, Tp. Westmeath, Ont., by connecting old farm road with road crossing railway, by diverting it as shown in red on plan.

20639—October 22—Authorizing Niagara, St. Catharines and Toronto Ry. to operate its trains over crossing of G.T.R. at Welland Ave., city of St. Catharines, Ont., for construction purposes only, for a period of 2 months from date of this Order.

20640—October 22—Authorizing C.N.O.R. to construct, at its own expense, its railway across Dawes Road, between Tps. Scarborough and York, Co. York, Ontario.

20641—October 22—Authorizing C.N.O.R. to construct, at its own expense, across public road between Lots 34 and 35, Con. C, Tp. York, Ontario.

20642—October 23—Authorizing C.N.O.R. to construct, at its own expense, across the Don Mills Road in Lot 1, Con. 3 F.Y., Tp. York, Ontario, and authority herein granted to be without prejudice to right of Twp. to apply at any time for a subway at the point in question.

20643—October 23—Authorizing city of Toronto, Ont., at its own expense, to reconstruct bridges across G.T.R. & C.P.R. at Strachan Avenue subject to and upon certain conditions. And reserving leave to city to make such application as it may be advised for an Order requiring contribution from Ry. Cos., in so far as any additional expense for new tracks is concerned.

20644—October 22—Authorizing G.T.P.Ry. to construct spur on Twenty-first Street, between Short Avenue and C.N.R. right-of-way, in city of Edmonton, Alta., subject to certain conditions.

20645—October 23—Authorizing G.T.P. Branch Lines Company to construct, subject to terms of consent, highway across Tofield-Calgary Branch, S.W. ¼ Sec. 10-42-21, W. 4 M., mileage 58.8, Dist. North Alberta, Alta.

20646—October 23—Authorizing G.T.R. to reconstruct overhead bridge carrying town line road between Tps. Guelph and Eramosa, Co. Wellington, Ont., over Middle Division, 15th Dist. at Mile Post 44.61, at Rockwood, Ontario.

20647—October 23—Approving deviation of Lake Erie and Northern Railway line between stations 538-52.8 and 553-19.3, Tp. South Dumfries, Ontario, subject to certain conditions.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Kingston, Ont., addition to public building	Nov. 5.	Oct. 23.	88
Lindsay, Ont., addition to public building	Nov. 5.	Oct. 23.	84
Ottawa, Ont., conveyance of mails	Nov. 14.	Oct. 16.	86
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., Nassau dam	Oct. 31.	Oct. 23.	82
Point du Bois, Man., electric switching, &c.	Nov. 4.	Oct. 23.	80
Port Hope, Ont., harbor improvements	Nov. 17.	Oct. 23.	84
Rainy River, Ont., pile protection work	Nov. 17.	Oct. 23.	82
Rocky Point, P.E.I., wharf	Nov. 12.	Oct. 23.	82
Saskatoon, Sask., sewer and water mains		Oct. 16.	78
Summerland, B.C., wharf	Oct. 31.	Oct. 2.	82
Toronto, Ont., steelwork for bridge	Nov. 25.	Oct. 16.	84
Toronto, Ont., pumping engines, &c.	Nov. 25.	Oct. 16.	84
Toronto, Ont., sub-contracts for Methodist Book and Publishing Co.		Oct. 16.	82
Toronto, Ont., sewers	Nov. 4.	Oct. 23.	84
Toronto, Ont., steel conduit	Nov. 18.	Oct. 23.	86
Toronto, Ont., casting, pipes, valves, &c.	Nov. 18.	Oct. 23.	86
Toronto, Ont., conveyance of mails	Nov. 14.	Oct. 23.	86
Toronto, Ont., conduit	Nov. 18.	Oct. 23.	82
Transcona, Man., electric wiring systems in N.T.R. shops	Nov. 4.	Oct. 23.	78
Winnipeg, Man., water supply		Oct. 16.	86

RAILWAYS—STEAM AND ELECTRIC.

Edmonton, Alta.—An act known as the light railways assistance act has been tabled in the Alberta Legislature, and provides, in the main, for the guaranteeing of bonds issued by companies constructing light railways in the province. It provides further that the guarantee shall not exceed 50 per cent. of the estimated cost of construction; and, in any event, shall not exceed $7,000 per mile of the mileage of such railways.

London, Ont.—The ratepayers have carried a by-law to raise $700,000 in debentures to electrify the London and Port Stanley Railway.

London, Ont.—Within two weeks the city council will nominate a commission of five members which will construct, equip, maintain, operate and manage the London and Port Stanley Railway. Semi-official information announces that Mayor Graham will be one member ex-officio, and the others in office the Hon. Adam Beck, Mr. Philip Pocock, Lieutenant-Colonel Gartshore and Mr. M. D. Fraser, K.C.

North Vancouver, B.C.—The Burrard Inlet Tunnel and Bridge Company are negotiating for the purchase of a railway right of way through the Seymour Indian Reserve, No. 2. The railway offers to pay $40,500 for 11½ acres of land, and $4,824.24 for improvements which will have to be destroyed or removed.

Ottawa, Ont.—In January, 1914, the residents of the town of Eastview will vote upon the question of extending the Ottawa Electric Railway line into Eastview. To perfect the scheme, Eastview is prepared to offer O.E.R. a bonus of $25,000.

▲ **Ottawa, Ont.**—Tenders will be received up till November 10th, 1913, for the construction of a line of railway from North Sydney to Leitches Creek, N.S. Plans and specifications may be obtained from the Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, Ont., L. K. Jones, Esq.

Quebec, Que.—The Government has decided to proceed with the construction of the Transcontinental Railway tunnel from Lampson's Cove to St. Malo in Quebec city; and in the opinion of leading lawyers, the contracts will have to be awarded to Mr. M. P. Davis.

Toronto, Ont.—The Board of Railway Commissioners has still under consideration the plans of the C.N.R. for the single track across the city, the part being debated which would run for three miles within the city limits, and would add eight new railway crossings on city streets.

+—Vancouver, B.C.—MESSRS. McARTHUR BROTHERS secured the contract for the construction of the joint section of the Hope Mountain line of the Kettle Valley railway.

Winnipeg, Man.—While in this city, Sir Thomas Shaughnessy denied the report from Milwaukee, Wis., that the C.P.R. would electrify its entire system. It is the intention, he stated, to electrify Roger's Pass tunnel; and should this prove successful in operation, to extend the electrification over the mountain division from Revelstoke to Field, B.C.

Yorkton, Sask.—Le Pas Board of Trade has written the Yorkton Board of Trade urging the endorsation of a resolution calling on the Government of Canada to adopt means to compel railways now holding charters for branch lines connecting with the Hudson Bay road, to commence construction of same under penalty of having said charters revoked.

GARBAGE, SEWAGE AND WATER.

London, Ont.—The city of London has carried the by-law for the construction of storm sewers. This will mean that the city must issue debentures to the extent of $400,000.

London, Ont.—Working plans and specifications for the storm water drainage construction as well as for the reinforced concrete protection for the river embankment, will be completed during the winter months, so that contracts may be let and construction started in the spring. It is expected that the storm water system construction will be extended over four years with annual expenditures of $100,000. A $75,000 extension to the existing sanitary system with disposal plant for the East End will be considered this winter and work commenced next year. Mr. Willis Chipman, of Toronto, is consulting engineer for the work, which will be carried out under the London City Engineer's Department.

London, Ont.—Plans for the extension of the city garbage are being perfected, so that by the beginning of the year a large new territory will be served.

▲—**Ottawa, Ont.**—Tenders will be received up till November 6th, 1913, for the construction of the West End inter-

epting sewer. Plans and specifications may be obtained from Arch. Currie, City Engineer, Ottawa, Ont.

Regina, Sask.—The works committee has decided upon several extensions to sewers and water mains to be finished this year, notably the extension of sewer to serve the Armour abattoir.

Regina, Sask.—The city council of Regina has agreed upon extensions to the municipal sewer system, amounting in all to $6,206.30.

+—Toronto, Ont.—The city council has sanctioned the acceptance of the tender of the GAWNE CONTRACTING COMPANY for the construction of Section No. 2 of Danforth Avenue storm sewer at a cost of $32,093.

Vancouver, B.C.—The Saanich council has decided by a majority vote of four to three to approve the tentative agreement with the Vancouver city council for participation in the Northwest trunk sewer system at a cost of about $52,000. The proposal is to be submitted to the ratepayers in the form of a by-law. The cost of connection with the Northeast sewer was set at $21,122.

Vancouver, B.C.—The waterworks committee has passed recommendations for the laying of $56,865 worth of water mains throughout the city. However, from 60 to 70 per cent. of this amount has already been expended in buying the pipe.

Winnipeg, Man.—Mr. A. F. D. MacGachen, manager of the Bank of Montreal, has announced the willingness of his institution to finance the entire $13,500,000 loan which is required by the Administration Board of the Great Winnipeg Water District project. The account is to be operated at present on the overdraft principle, and the necessary funds will be available wherever they may be drawn upon.

LIGHT, HEAT AND POWER.

Brantford, Ont.—The Dominion Power and Transmission Company have under consideration a plan to develop 2,500 horsepower at Mohawk Lake to take care of its peak load in Brantford, and to provide against emergencies.

Edmonton, Alta.—The city commissioners have approved the [illegible] of Superintendent Orm-by to install at once a temporary light [illegible] level bridge and to charge the cost to the [illegible] Company. This company has not [illegible] with the city on July 1st, 1913, for [illegible] standards, which were to be delivered [illegible] days.

Edmonton, Alta.—The city commissioners have authorized Superintendent Perry to submit a report showing what new equipment is required at the power house, and including plans, diagrams and specifications so that tenders can be called and that portion of the work started.

Fort William, Ont.—The city council has officially appointed Professor Herdt of Montreal, as the city's arbitrator on the arbitration commission of three which is to determine the actual comparative cost of electrical energy as supplied to the city of Fort William by the Kaministiquia Power Company with the Hydro-Electric Commission, acting as intermediary. The Kaministiquia Power Company must appoint an arbitrator within ten days, and the city and company together will select the third.

Guelph, Ont.—The city council has passed a resolution adopting the recommendation of the Railway and Manufactures Committee, which is as follows:—"Your committee recommend that the Hydro-Electric Power Commission of Ontario be requested on behalf of the municipal council of the city of Guelph to inquire into, examine and investigate and report upon the cost of constructing and operating an electric railway from Hespeler, connecting with Puslinch Lake, through Guelph to Elora, Fergus and Arthur, and also from Arthur connecting with Mount Forest, through the Beaver Valley to Meaford or Thornbury; upon the municipalities, the inhabitants of which will be served by such railway; upon the population of each of such municipalities as shown by the last enumeration thereof by the assessors; upon an estimate of the probable revenue from the railway; and upon the practicability of the undertaking and its economic value to the localities served by it, as provided for in section 3 of the Hydro-Electric Railway Act."

London, Ont.—An agreement has been reached between the Street Railway Company and the city of London, by which the company will take power from the city, providing that the agreement is approved by the Hydro-Electric Commission in Toronto. The price agreed upon was $36 a horsepower for alternating current, and $28 for direct current. The amount of power will be about 600 or 700 horsepower, but later the entire system using over 1,000 horsepower may be operated by Hydro-Electric current. This arrangement will necessitate the installation of converting apparatus in the Horton Street plant to convert the Hydro power into direct current, suitable for the use of the railway company.

Medicine Hat, Alta.—The city council passed unanimously the recommendation of a by-law providing $150,000 for extension to the electric power plant, which will be submitted to ratepayers on November 21st; also a by-law to be submitted upon the same date for an expenditure of $12,000 to furnish apparatus for the new fire station, to be erected next year upon the hill.

Nelson, B.C.—It has been announced that the construction of the new units at the plant of the West Kootenay Power and Light Company at Bonnington Falls, which is to supply power for the Rossland-Castlegar line, when that portion of the C.P.R. has been electrified, will commence about January 1st, 1914. The contract for electrification has been let, and the new units for the plant are being built.

North Battleford, Sask.—The city of North Battleford has ordered a thorough investigation to be made immediately as to the possibilities of developing power at a point three miles west of the city on the North Saskatchewan River. The proposition of erecting a wall, 100 feet high, across the river is being considered. Only in a few places would this necessitate the construction of retaining walls; for the banks of the river from North Battleford to Edmonton are high and precipitous, and between these two points there is a drop of about 700 feet in the river. It is believed that the scheme would allow of the production of 40,000 horsepower, at a reasonable figure. The estimated cost of such an undertaking, including a lock in the wall at North Battleford enabling navigation to pass, is fixed at $30,000,000.

Ottawa, Ont.—The department of railways has been advised that a part of the wireless telegraphic equipment which was lost in the wreck of the steamer "Cerenus," when en route to Hudson Bay, has been salvaged. There is a possibility that this will be erected so as to establish wireless connection with Port Nelson this winter.

Ottawa, Ont.—Ottawa local contractors for excavation work will urge that the contracts for the new pipe line to Thirty One Mile Lake be for short stretches similar to the method used in the construction of railways. To let one contract for the entire excavation would exclude contractors unable to finance such an undertaking.

△ **Ottawa, Ont.**—Tenders will be received up till November 4th for the furnishing and installing of the electric lighting systems required in connection with the equipment of the N.T.R. car shops at Transcona, Man. Plans and specifications may be obtained from W. J. Press, Mechanical Engineer, Ottawa, Ont. Signed, P. E. Ryan, Secretary of the Transcontinental Railway Commissioners, Ottawa.

Ottawa, Ont.—Tenders will be received up till November 8th for supplying four 7-foot standard cast-iron lighthouse lanterns to be delivered free of charges at the Dominion Lighthouse Depot, Prescott, Ont. Plans and specifications may be obtained from Alex. Johnston, Esq., Deputy Minister of Marine and Fisheries, Ottawa, Ontario.

Owen Sound, Ont.—The city council of Owen Sound has carried a resolution authorizing the Mayor and Clerk to sign the contract for the supply of 1,200 horsepower by the Hydro-Electric Power Commission. The price is not to be in excess of $31 per horsepower, according to the estimate of the commission's engineers. The plant is to be commenced as soon as material can be placed upon the ground next spring. This winter plans and specifications will be prepared, and contracts for various branches of the work awarded. The town will retain for some time the old steam plant, which will be used for cutting down the peak load in the winter months, when the power and light loads overlap in the evenings.

Saskatoon, Sask.—The City Commissioners have informed the council that Saskatoon is in a position to supply the Dominion Government Interior Elevator upon which work has already commenced with electric power at the low rate of 1.6 cents per kilowatt hour.

St. Catharines, Ont.—The citizens of St. Catharines give every evidence of carrying, with a large majority, the by-law to install a municipal hydro power plant at a cost of $116,000, which will be submitted in January next.

Winnipeg, Man.—The Winnipeg Electric Railway Company has secured the Great Falls Power Company's waterfall on the Winnipeg River, situated midway between Lac du Bonnet, the present site of the railway company, and the mouth of the river.

Winnipeg, Man.—Consulting Engineers Heidt and Kennedy have submitted to the Board of Control their report upon the second transmission line to Point du Bois. In it they recommend that either the braced or the flexible tower systems be used, the former costing $600,000, the latter $520,000. The construction will doubtless not be commenced this year; since the present line has a capacity of 22,400 kilowatts, and the peak load at present is not more than 11,050 kilowatts and is not expected to exceed the capacity of the line before 1915.

Winnipeg, Man.—The city council of Winnipeg has passed a by-law for the expenditure of $1,000,000 to extend the power plant, and ratepayers will vote upon the proposition in December.

BRIDGES, ROADS AND PAVEMENTS.

▲ **Assiniboia, Man.**—Tenders will be received up till November 25th, 1913, for the construction of an asphalt pavement. Plans and specifications may be obtained from the office of the Municipal Engineer, Municipal Hall, St. Charles, Man. Signed, Frank Ness, Esq., Rural Municipality of Assiniboia, Kirkfield Park P.O., Man.

Calgary, Alta.—The city commissioners and parks superintendent will submit to the city council for its approval a scheme of boulevard improvement in the inside districts of Calgary which will necessitate the expenditure of $200,000. The expenditure, however, would be carried over a couple of years.

Edmonton, Alta.—The city council has agreed upon a program of construction of 17 subways, underlying the C.N.R. and G.T.P. tracks at Edmonton, including the raising of tracks, at a cost approximately $1,000,000. This is to be brought before the board of railway commissioners at its meeting in Edmonton at the end of the present month.

Essex County, Ont.—The county council is preparing a by-law to submit to the ratepayers, [illegible], for the raising of $1,000,000 for the purpose of building roads to connect all towns in the county. Engineer Hubert has recommended concrete roads for the purpose.

+ **Fredericton, N.B.**—Tenders are asked for the superstructure for the new bridge on the Canada Eastern branch of the Intercolonial Railway at Penniac, [illegible] to MESSRS G. F. BAIRD AND GEO. E. TOWIE of Fredericton. Their estimate was approximately $25,000.

+— **Fredericton, N.B.**—The contract for the substructure of a bridge at Covered Bridge on the Canada Eastern branch of the Intercolonial Railway, has been awarded to MR. MORRISON, contractor, whose tender was in the vicinity of $7,000.

Hull, Que.—The Hull city council has decided to begin at once the construction of the macadamized road between Hull and Gatineau Point. They reached this decision in conformity with a letter received by the corporation from the department of agriculture, dated October 16th.

London, Ont.—The installation of the storm water drainage system in London, means the construction of extensive and much-needed paving in the city streets. Proposals are now being considered for starting to lay 2½ miles of asphalt pavement to be completed next year.

Medicine Hat, Alta.—The city council will submit to the vote of ratepayers upon November 21st, a by-law for the appropriation of $50,000 to be used in grading and gravelling streets, and also for the purchase of the plant and machinery.

Montreal, Que.—The Board of Control have contracted for the 1914 supply of asphalt at a price lower than the city has ever before paid, the cut in prices being over $5 a ton compared with what the city was paying a few years ago.

▲— **Ottawa, Ont.**—Tenders will be received up till November 4th for the erection of a temporary bridge over the Rideau River north of the present Billings Bridge. Plans and specifications may be obtained from Archibald Currie, City Engineer, Ottawa, Ontario.

Ottawa, Ont.—The [illegible] Ontario Highways Commission has been [illegible] Ottawa, representatives from the counties of Carleton, Prescott, Russell, Dundas, Stormont, Glengarry, Lanark, Leeds, Grenville and Renfrew being present. The commission is endeavoring to gain first hand information regarding the local needs of the people of the province.

Ottawa, Ont.—Tenders will be received up till November 4th, 1913, for the erection of a temporary bridge over Rideau River, north of the present Billings Bridge. Plans and specifications may be obtained from Archibald Currie, City Engineer, Ottawa, Ont.

South Vancouver, B.C.—Councillor Dickenson has announced his intention of bringing in a by-law for the widening of Victoria Road from Kingsway to No. 1. road.

South Vancouver, B.C.—The board of works has recommended an additional $1,000 to be used for the completion of improvements on boulevards, of repairs on sidewalks, and of grading work at intersections of Westminster Road.

Stratford, Ont.—A deputation of property owners on McPherson Heights has submitted a proposition to the city council for the opening of William Street East from James Street, for the closing of the survey of Frank Street, and the assurance of the construction of a bridge over the river at either Front or Queen Street. The proposal has been referred to the board of works.

Toronto, Ont.—Mr. George J. Castle has written to the city Board of Control suggesting that, when the widening of Yonge Street is undertaken and the subway built at North Toronto Station, elevated sidewalks should be constructed so that pedestrians would not have to walk down one hill and climb another in passing through the subway. This he claims would save $250,000 for the city.

+— **Toronto, Ont.**—The city council has awarded to the Contracting Company of Works the contract for a 60-foot reinforced concrete arch span between Centre Island and Olympic Island.

Toronto, Ont.—The city council has decided to widen Broadview Avenue to 80 feet from Danforth Avenue to the north city limit, at a cost of $[illegible].

Toronto, Ont.—Tenders will be received up till November 4th, 1913, for the construction of asphalt, brick block, bitulithic and concrete pavements and for sewers. Plans and specifications may be obtained from the Chairman of the Board of Control, R. C. Harris (Mayor), Toronto, Ont.

Windsor, Ont.—The county council of Essex has prepared a by-law for submission to the ratepayers of the county to be submitted at the time of the general elections, to provide for raising $[illegible] to be devoted to the construction of permanent [illegible] of concrete material selected by Provincial Engineer [illegible], [illegible] of the county.

INDUSTRIAL WORKS.

Calgary, Alta.—[illegible] for [illegible] 1,000 k.w. synchronous motor [illegible]. Plans and specifications may be obtained from J. M. Miller, Esq., City Clerk, Calgary, Alta.

Cornwall, Ont.—[illegible] received here that the St. Lawrence River Power Company has secured permission from the government authorities at Washington to dredge the Grasse River from the power house to the river's mouth, a distance of nine miles. The work is to be done at the company's expense, and is to be commenced at once. Work is to be commenced at Massena Centre, the shallowest part of the river; and before a dredge can be operated, it will be necessary to build an electric power transmission line to this point.

Edmonton, Alta.—Premier Sifton has introduced in the Legislature a bill for the proposed loan of $3,000,000, of which $1,000,000 is to be utilized in telephone extensions, $1,000,000 for the Farmers' Co-Operative Elevator Company, and $1,600,000 for public works throughout the province.

Edmonton, Alta.—An English company of capitalists, with Sir John Jackson at its head, has been expending $75,000 with a view to gauging accurately the power possibilities of the Saskatchewan River at Rocky Rapids, and now intend to erect a large dam at the rapids for the purpose of supplying power for the cities and towns within a large radius.

London, Ont.—The ratepayers of the city of London have carried the by-law to raise $25,000 in debentures for a breakwater in West London.

London, Ont.—In connection with the great scheme of civic improvement in London, the call for tenders for ironwork, gulley gratings, manhole covers, etc., in quantity, is expected early in the year.

+—Montreal, Que.—Authentic word has come from Rio Janeiro that the Brazilian Government has signed its acceptance of the design and price submitted by SIR JOHN JACKSON, LIMITED, for the Rio port works. The estimated cost was $7,500,000. This is but the beginning of work on harbor extension at Rio Janeiro, which will total an expenditure of not less than $20,000,000.

+—Montreal, Que.—The Board of Control has awarded to the CANADA FOUNDATION COMPANY the contract for the completion of foundation of the pump station at a cost of $20,000.

North Battleford, Sask.—An agitation is being made by numerous boards of trade to persuade the Government to take immediate steps to assure navigation, both practical and economical, on the North Saskatchewan River from Edmonton to Lake Winnipeg. This would create a waterway across the entire prairie which would affect materially the cost of transportation.

Orillia, Ont.—The Water, Light and Power Commission, represented by Messrs. J. B. Tudhope and C. H. Hale, has asked the council to consider the passing of a by-law to raise $80,000 for installation of new machinery and equipment in the new power house to be built at Swift's Rapids. The commission wish to be certain of the town's attitude before signing the agreement being entered into with the Department of Railways and Canals.

▲—Ottawa, Ont.—Tenders will be received up till November 21st for the construction of harbor and river improvements at Fort William, Ont. Plans and specifications may be obtained from W. P. Merrick, Esq., District Engineer, Fort William, Ont. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

+—Ottawa, Ont.—The contract for section 2 of the Welland Ship Canal has been awarded to BAWDRY, YERBURGH AND HUTCHISON, of London and St. Catharines, the contract price being approximately $5,500,000. The advertisements for section 4 of the canal are expected to be issued at once.

Ottawa, Ont.—According to the intimation of the Hon. Robert Rogers, the Government will appoint at an early date a commission to inquire into the economic possibilities of the Georgian Bay Canal.

Ottawa, Ont.—Tenders will be received up till November 12th, 1913, for the construction of a wharf at Rocky Point, West River, Queen's Co., P.E.I. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—The city engineer has recommended that heavier covers be put on 1,010 catch basins of the old style in the city, so that they may be rendered more safe. This would necessitate an expense of $10,000.

Ottawa, Ont.—The city Board of Control has decided to recommend that $300 be given by the city towards the Georgian Bay Canal campaign. This amount was subscribed also by Pembroke.

Ottawa, Ont.—It is announced from Ottawa that tenders are to be called at an early date for the construction of the 15-inch hydraulic dredge for use on the Arrow Lakes. The design submitted by Cartwright, Matheson and Company, of Vancouver, has been accepted by the Dominion Government The apparatus will be used for clearing a channel through the Narrows between the upper and lower Arrow Lakes from Nakusp to Killarney, in order to make possible navigation throughout the season. The operations will be supervised by J. P. Forde, government engineer.

Ottawa, Ont.—Tenders will be received up till October 31st for the delivery of track ties for the year 1914. Plans and specifications may be obtained from the office of General Tie and Timber Agent, Canadian Government Railways, Moncton, N.B. L. K. Jones, Secretary, Department of Railways and Canals, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till December 9th, 1913, for the construction of wharfs at Victoria Harbor, B.C. Plans and specifications may be obtained from R. C. Desrochers, Esq., Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till November 17th, 1913, for the construction of a wharf at Ainsworth, B.C. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

Quebec, Que.—Hon. R. L. Borden, while speaking at dinner in Quebec, made the assertion that the Dominion Government had acquired three miles of waterfront extending from Sillery to Cape Diamond, and that one of the largest and finest drydocks in the world was to be constructed at Lauzon. According to the statement compiled by the experts of the Department of Public Works, no larger dock is in existence or in contemplation in any British or American port than that which is being commenced within the limits of Quebec harbor.

+—Quebec, Que.—The contract for the Quebec drydock, at an estimate of $2,721,116, has been awarded to MR. M. P. DAVIS.

+—Saskatoon, Sask.—SHANNON BROS. AND CASSIDY of Saskatoon have been awarded the contract for excavating and building the concrete foundation of the new school in Mayfair section of the city, their tender estimate being $4,000.

Saskatoon, Sask.—Plans and specifications are being completed by the C.N.R. for a pumping station in Saskatoon at an estimated cost of $15,000. The company purpose to supply water to the tank, round house and engines at a lower rate than they are forced to pay to the city.

+—Toronto, Ont.—The contract has been awarded the THOR IRON WORKS, LIMITED, of Toronto, by the Canadian Mining and Finance Company for a stand pipe at Timmins, Ont. The stand pipe will be 20 feet in diameter, 95 feet in height and 225,000 gallons in capacity. Of this capacity 50,000 gallons will be held as a reserve for fire protection purposes at the top of the stand pipe by installing a hemispherical bottom about 15 feet from the top. The pipe is to be erected before winter sets in.

Vancouver, B.C.—Messrs. Hendry, McFee and McConnell are having constructed at the Wallace Shipyards a rock drill barge, which will cost about $25,000, and which will be used in connection with the construction of the Dominion Government wharf at Burrard Inlet.

+—Victoria, B.C.—McDONALD, GODSON AND COMPANY, the lowest tenderers for steel rivetted pipe in connection with the Sooke water scheme, has been awarded the contract, and will erect a local factory and do the work in Victoria.

Winnipeg, Man.—Tenders will be received up till November 15th, 1913, for the supply and installation of five complete pumping units, together with step down transformers, switch board and accessories. Plans and specifications may be obtained from the City Engineer, 223 James Avenue, Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control, Winnipeg.

MISCELLANEOUS.

Hamilton, Ont.—Managing director W. C. Hawkins of the Dominion Power and Transmission Company has announced officially that the company will build an auxiliary plant at the foot of James Street on the bay front, to develop 90,000 horsepower of electricity, and that the plant and equipment will cost $3,500,000. The work is to be commenced upon the construction next year, so as to have the plant in operation by next autumn. This plant will remove all possibilities of interruption by needle ice, and will always be in condition to supply power at short notice.

▲—Ottawa, Ont.—Notice is given that the time for the reception of designs in the first competition for the erection of Departmental and Court Buildings, is extended to April 2nd, 1914. R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Victoria, B.C.—The city council has authorized improvements to the city's electric light plant, which will provide workshop facilities for the employees. The building inspector is to submit an estimate and cost.

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Last Longest—Cost Least

THE proper unit in comparing the values of roofings is the cost-per-foot-per-year-of-service.

To have a low unit cost a roofing must be—

1st. Inexpensive to build,
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CURRENT NEWS.

Aylmer, Ont.—The contract for pavement which has been held by P. Secord and Son of Brantford, has been brought to a successful completion. The work has been carried on throughout most of the summer, and only one block of pavement, where the earth is still too loose for operations, has been left until next season.

Edmonton, Alta.—The Legislature is being asked to consent to the change of the name, Bassano Electric Railway Company, to Bassano and Bow Valley Railway Company. Also the promoters of this railway and the Alberta Interurban Railway will ask for a guarantee of securities from the Government under the Light Railways Assistance Act.

Fredericton, N.B.—Good progress is reported by the Foundations Company, Limited, upon their work at the Fredericton-St. Mary's highway bridge. The 18-foot concrete footing for the new draw span piers has been completed, and the masonry work commenced. The old span, which sank some 150 feet down the river from the bridge, is being removed.

Hamilton, Ont.—The Ottawa Construction Company, which is building the revetment wall extension at Hamilton Bay, has employed the largest hydraulic dredge on the Canadian lakes. Before winter, this dredge is to have completed a channel 1,100 feet long, 700 feet wide, and 21 feet deep at the foot of Wellington Street, where the new extension ends; and, in addition, a channel 600 feet to the east in preparation for the time when the wall is extended east of Wellington Street.

Kamloops, B.C.—The Canadian Northern Pacific Railway Company is commencing the construction of its second bridge over the North Thompson, above Kamloops. It is to consist of seven 80-foot spans. Steel on the railway construction has been laid from Port Mann to Nine Mile Creek, 125 miles from Port Mann, and also north of Kamloops for a distance of 80 miles. Rails have been laid 205 miles west of Edmonton.

Medicine Hat, Alta.—The city council are considering a by-law to provide $50,000 for gas wells and extensions for 1914. The object of the by-law is to put next year's council in a position to finance and perform necessary civic development work without delay. The city is considering also the widening of several portions of city streets.

Medicine Hat, Alta.—The Saskatchewan Bridge and Iron Company are commencing the construction of their plant west of Medicine Hat, which will be the first of its kind in Western Canada. Several carloads of steel have arrived in the city and have been hauled to the site of the building.

Montreal, Que.—Considerable agitation is being made in the city in an endeavour to submit to the Legislature a petition signed at least by 50,000 citizens as a protest against the present paving law.

Montreal, Que.—A commission comprised of Professor McLeod of McGill University, Mr. Arthur, surveyor, of Montreal, and Mr. C. R. Coutlee of Montreal, has been chosen to investigate and report upon the question of water levels on the St. Lawrence and the Great Lakes, with particular reference to the effect of the different schemes of water power development; the decision as to whether the headquarters of the commission shall be Montreal or Ottawa has been delaying procedure in operations.

Montreal, Que.—The installation of the new pump, No. 7, is almost completed at the city waterworks, Montreal. When this is in operation, 12,000,000 additional gallons of water will be supplied to the city daily. No. 6 pump, which is not working to its full capacity of an equal number of gallons, will then be stopped and repaired.

Montreal, Que.—According to the statement of Controller Lachapelle, the city and Montreal Tramways Company will not take up the question of a new franchise this year. Mr. McLeod, city traffic engineer, has not yet completed his report on the matter of franchises, and the recommendations connected therewith. At present, he is preparing a report for the relief in the present congestion in the outer wards; though the enforced cessation of work which is at hand will prevent much being done towards improvement of the Tramway Company's service in the outskirts until spring.

Montreal, Que.—The Hon. J. E. Caron states that the Government has constructed about 2,000 miles of macadamized roadway during the past season, and that the most of this work done has been on the King Edward highway. It is expected that this highway will be completed this fall.

Moose Jaw, Sask.—The work on the coal bunkers, coal carrier, and ash carrier systems at the power house, which had to be stopped early in the spring, is to be commenced again this fall. Much of the necessary material has been delivered, the coal bunkers inside the power house are fairly well completed; but the huge steel frame-work and the spur track for running in the cars are only commenced.

Moose Jaw, Sask.—The Eleventh Avenue subway which was commenced over a year ago, has reached completion and has been opened to vehicles and to the Street Railway traffic. A modern subway has been constructed at a total cost of $96,450, in which only the best of material has been used. The paving bricks are of a selected type, the drainage system provides for a collection of no surplus water at the lower portion of the subway; and granolithic sidewalks on both sides are provided with steel railings.

Moose Jaw, Sask.—Mr. F. B. Lane, C.N.R. bridge inspector, expresses pleasure at the progress made upon the C.N.R. bridge at Main Street in this city, and says that all possible haste will be made with the trestle bridge through the city.

Ottawa, Ont.—Tenders have been called for by the Dominion Government, to be in by November 5th, for plans and specifications for a grain elevator at Port Nelson of a 1,500,000 bushel capacity, to be located near to and to conform with the pier construction of the Department of Railways and Canals. When the Government has selected the type of building it deems advisable, construction tenders will be called.

Ottawa, Ont.—Mr. H. P. Mullarky, contractor for the section of the Canadian Northern Transcontinental Railway, between Ottawa and Pembroke, states that before severe cold weather sets in, steel will have been laid for 27 miles easterly from Pembroke. Two bridges over the Ottawa River have to be constructed along the line, one at Portage du Fort, and the other at Chatsfalls; and these are to be completed by next spring. This entire section of the transcontinental line is to be ready for operation in the fall of 1914.

Ottawa, Ont.—Investigations made in regard to the rainfall in the district tributary to the Trent Canal, show that the canal may become seriously affected by lack of water for the locks, if the Government does not take control of certain forest areas and protect them, as well as proceed with a program of reforesting.

Ottawa, Ont.—Mr. J. G. Kilt, president of the Morrisburg and Ottawa Electric Railway has stated that about six miles of the line running from Ottawa have been completed; and that the chief engineer has three staffs and about 50 teams engaged upon the roadbed construction.

Ottawa, Ont.—A gap of eight miles, about 208 miles east of Cochrane, is the only stretch remaining on the National Transcontinental line from Moncton to Winnipeg, where the laying of steel has not been completed. When this has been finished the eastern section of the railway, 1,804 miles in length, will be a unit of complete construction.

Outremont, Que.—Concerning the opening up of Van Horne Avenue to Mount Royal Heights, the town council decided to give the required notice for the undertaking, and, in consideration of the fact that the Tramway Company may be prevailed upon to extend its car service through to Mount Royal, to give the notice at once.

Port Arthur, Ont.—Grain is being received by the new Government elevator at Port Arthur. The formal opening of the structure has, however, not taken place, nor been yet arranged, owing to the uncertainty of the definite arrival in the city of the Hon. G. E. Foster, who will perform the ceremony.

Prescott, Ont.—On October 23rd, power was first transmitted to Prescott from Morrisburg, over the wires of the Hydro-Electric Power Commission. The power will light the streets and buildings of the town and also be used for the operation of machinery in small industrial establishments.

Prince Albert, Sask.—An investigation into the full nature and history of the Prince Albert power plant at Lacelle Falls is being made by a special committee in the endeavor to suggest finally, if possible, a solution to the difficulties confronting the city.

Prince Rupert, B.C.—The necessity of another port, to be situated north of Prince Rupert, and the urgency of put-

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ting before the Government at Ottawa the need of a new harbor here, is being demonstrated by Mr. James Cornwall, ex-M.L.A. for the Peace River District, Alta.

Prince Rupert, B.C.—J. R. Stirrat, chief engineering contractor for the construction of the cement piers for the drydock to be built here, is in the city and is setting in operation the dredging at that part where the waters of Hay's Creek empty.

Redcliffe, Alta.—Since August 10th, over four miles of new water pipe have been laid in Redcliffe, according to the statement of City Engineer Askwith. He reports also that the water tank has had a thorough test and has been proven perfectly tight in spite of the great weight of the water and the numerous rivets. The new pump which has been installed is practically complete, and will soon be in operation.

Saskatoon, Sask.—Reports from Wakaw, Sask., state that construction engineers from a Chicago firm have placed orders for sand and gravel, and state that work on the Grand Trunk bridge crossing the North Saskatchewan River at St. Louis, and completing the entry of the road into Prince Albert, will start at once.

Sidney, B.C.—The new wharf constructed by the Provincial Government at the foot of Third Street, Sidney, which runs out to Robert's Bay for a distance of about 2,000 feet, has been completed and is being used for passenger traffic.

South Vancouver, B.C.—Complying with the order of the railway commissioners, the B.C.E.R. Company have begun the raising of Rupert Street bridge by an additional height of 2 feet 2 inches.

Vancouver, B.C.—The Pacific Dredging Company have commenced dredging operations for the foundation of the new Government dock in Burrard Inlet. About 250,000 cubic yards are to be excavated, and this will require several months' time.

Vancouver, B.C.—The Pacific Dredging Company, which secured the contract for dredging out the side of the new Government wharf in Burrard Inlet, has commenced the work.

Vancouver, B.C.—An endeavor is being made by the C.P.R. to have the Eastern section of its new station ready for occupancy by February 1st. When this part is complete, the old structure will be raised and the ground will be prepared for the rest of the new structure. At present, the steel on the eastern section is about completed. Foundations have been started for the overhead bridge from the foot of Granville Street and preparations are under way for placing piers on the waterfront for the other end of the bridge. Abutments have been laid for the second viaduct, which will extend from Burrard Street to the water and the foundations for the piers have been completed.

Vancouver, B.C.—Construction is reported as having commenced from both ends on the joint section of the Kettle Valley Railway between Hope and the Coquehalla summit. Contracts have been let, roads for transporting supplies and equipment have been built, and a large force of men has been employed to work upon clearing and grading. The greatest engineering difficulties in the construction will be met near the Pas. Here, in order to transport supplies to the right-of-way from the roadway near the summit, a cable train will have to be used. The road is, in some places, nearly 1,000 feet from the route, and goods will have to be lowered over a big bluff into the valley below.

Vancouver, B.C.—An agitation is being made in Moncton for the consideration on the part of the city and the railway management to do away with level crossings, which are intersected by the railway.

Vancouver, B.C.—There has been considerable delay in connection with the construction of the four east end viaducts at G.N.R. crossings. This has been due to the fact that the chief engineer of the railway commission would not attach his signature to the plans prepared and forwarded by Mr. Fellowes, until the G.N.R. Company had approved the plans. A further hindrance, however, has been the consideration of the amount of expenditure required to be met by the city. Though the G.N.R. has agreed to all the details concerning the extent of its amount of cost, $300,000, official notification has not been forwarded to the city. Accordingly, the legal department has notified the company that unless the city is given notice of the company's approval of the plans before October 27th, application is to be made to the railway commissioners to compel the G.N.R. to do so, when they meet here upon that date.

Vancouver, B.C.—Preparation is being made for setting out upon the extensive scheme of harbor improvement at Vancouver. Mr. L. Nelson, superintendent of the dredging department of the Public Works of Canada, with headquarters at Vancouver, has sent to Victoria the two chief operators to familiarize themselves with details of dredge operation. Mr. Nelson conferred with Mr. F. H. Shepherd, M.P., at Nanaimo, on Friday, in reference to the harbor improvements, and more particularly with regard to the installation of the Lobnitz rock crusher ordered from Scotland by the Dominion Government, for special use in the Nanaimo Harbor to remove certain rocks. The rock crusher is now being assembled on the mainland, this is in accordance with instructions received from Ottawa. The hull will be launched in about a week's time and it is expected that the crusher will be at work within 60 days.

Victoria, B.C.—From Heriot Bay to Shoal Bay the Government telephone line is complete, and the contract has been let for the laying of the cable across Okis Hollow Channel and Nodall's Channel. The entire line and the work on the Government trails is expected to reach completion soon after the end of October.

Victoria, B.C.—Mayor Morley has explained the delay in progress on the new Johnson Street bridge as due to difficulties and grades which still have to be settled with Chief Engineer of Railways Gamble, who is acting in the matter. The chief difficulty is stated to lie in the final decision between the Johnson Street or Cormorante Street route.

Victoria, B.C.—Difficulties in regard to the C.N.P. Railway's right-of-way, which have been delaying the progress of the contractors in the grading of the Victoria-Patricia Bay section, are being overcome, and it is reported that negotiations are reaching a final settlement, and that the company will be in complete possession of all the property required within a week. The road is expected to be ready for rough operation early in the new year; but until much detail work has been completed, a regular service cannot be installed.

Welland, Ont.—The Dominion Dredging Company, contractors for No. I. section of Welland Ship Canal, have commenced work upon the various buildings for their plant at Port Weller. The dredges and delver to be used by the company are on their way from Quebec. It is expected that the steam shovelling work will be started about November 1st. Meanwhile, cleaning, grubbing and wheel scraping is being done along the construction railway; and a new siding is to be built, for which several trainloads of ties have already been delivered to the N.S.T.R.

Winnipeg, Man.—Rapid progress is reported upon the construction of the new Provencher bridge. Number 6 pier has been commenced, and the contractors propose, by working throughout the winter, to have the bridge ready for traffic and for the laying of a double street car track late next fall.

NEW INCORPORATIONS.

Calgary, Alta.—National Electric Manufacturing Co., Limited, $10,000.

Walkerville, Ont.—Heinze Electric Co., Limited, $50,000. P. Butler, B. B. Ames, B. Ames.

Chatham, Ont.—The National Forging Co., Limited, $100,000. G. H. Quesnard, R. W. Hees, E. G. Odette.

Napierreville, Que.—Napierreville Lumber Manufacturing Co., Limited, $49,000. J. E. A. Decelles, A. Cyr, A. P. Beaulieu.

Winnipeg, Man.—The Manitoba Electric Water Heating Co., Limited, $100,000. R. R. Lockhart, G. A. Glines, W. E. Wright.

Montreal, Que.—The Pierson Gas Producer Plant Co., Limited, $100,000. P. V. Rougher, A. Decary, A. de Montgaillard. East End Sand and Gravel Co., Limited, $50,000. J. A. Mann, C. G. MacKinnon, H. R. Mulvena.

Toronto, Ont.—Dominion Tactile Press, A. Gate, G. J. Gate, C. Elliott. Toms Contracting Co., Limited, $40,000. F. P. Toms, C. G. Toms, H. H. Toms. The Van Buren Excavator Co., Limited, $75,000. W. A. J. Case, H. E. Wallace, J. B. Taylor. Gray Pneumatic System, Limited, $500,000. J. MacI. Duff, F. Regan, W. G. Hanna.

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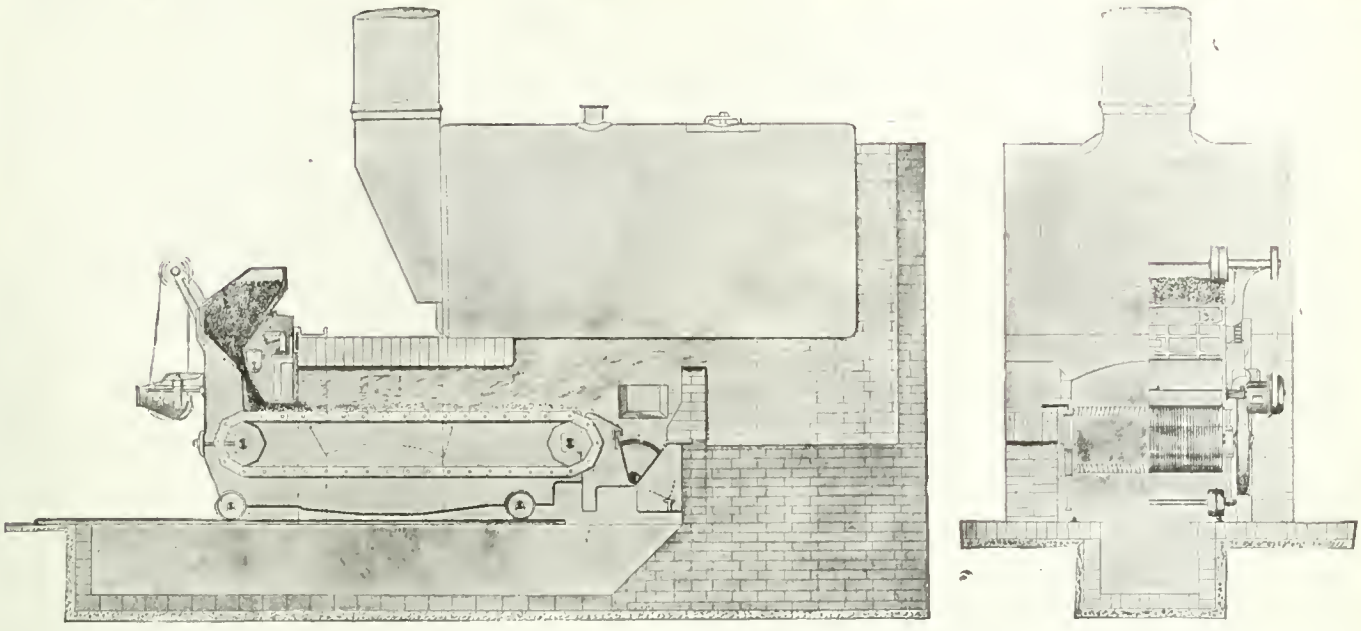

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COAST TO COAST.

(Continued from page 663.)

Fort William, Ont.—The board of works adopted this year a new method of carrying out its civic improvements, e.g., the letting of the work by contracts instead of undertaking the work itself, hiring its foremen and laborers. The large list of works completed, and a saving both in time and money, have proven the success of the scheme.

Bassano, Alta.—On October 21st the gates of the six million dollar dam of the C.P.R., which was constructed to divert the waters of the Bow River for irrigating 30,000 acres of land around Bassano, closed without preliminary announcement or ceremony. A tidal wave swept back up the river, and the western river began to rise, the eastern to fall. The operation of the dam will back up the river for eight miles, and the process of filling to the height of the dam, 45 feet, will take four weeks' time.

Vancouver, B.C.—According to advices from the Boundary district, steel will be laid on the Kettle Valley Railway from Midway to the Summit, 76 miles west of Midway, by December 1st of this year. Track-laying is complete from Wolfe Creek, a point 65 miles west of Midway; but the building of three bridges within a distance of three miles will make progress much less rapid. The contractors believe that the link of the Kettle Valley between the present end of steel and Penticton will be connected late next summer.

Saskatoon, Sask.—In the opinion of Mr. M. L. Hovis, of Gibsonburg, Ohio, and of Mr. W. R. Martin, of Medicine Hat, Alta., competent experts on the matter of gas wells, the fields at Medicine Hat and Calgary, extend far to the eastward over the three prairie provinces, and are not purely local, as has been generally considered up to the present. They are preparing to place before the city council of Saskatoon a proposal to drill a gas well within the city limits, and there is a strong civic opinion in favor of giving the experiment a sufficient test.

Saanich, B.C.—The beginning of a scheme which involves an expenditure of $340,000, and which will complete 22 miles of bitulithic highways in Saanich was given a ceremonial opening by Mr. W. W. Foster, Deputy-Minister of Public Works. Members of the Victoria Automobile Association, representatives of Saanich and Esquimalt, and others interested, were present to hear the addresses of those who took part in the festival ceremony. Actual construction work is to be begun as soon as the weather is favorable; and a good amount of the work is expected to be available for tourists next summer.

Montreal, Que.—Major Hutchison, manager of the Montreal Tramways Company, has announced that before winter snow comes to stop operations, the company will have expended about $3,000,000 of the $3,750,000 appropriations set apart at the commencement of the year for the complete reorganization of the system. The company is endeavoring to provide a perfected traction system, more especially at present to affect the outlying districts, but also to relieve central congestion and to inaugurate a rapid and frequent service throughout the entire city and suburbs where the Tramway Company will operate.

Montreal, Que.—Macdonald College, Ste. Anne de Bellevue, has added to its curriculum of studies a course in road making. Professor G. E. Emberely, of the college, will lecture on the art of constructing dustless highways of various materials, and those taking this course will graduate as fully qualified road-builders. This branch of study is really a part of the agricultural course of the institution, though for a long time students have aided in the construction of thoroughfares throughout the college grounds. However, a very thorough course in this science is now to be given, with the idea of teaching the prospective farmer how to build and maintain the roads on his own farm and the roads bordering upon that.

Victoria, B.C.—Within a month, the Commission of Conservation for Canada will conclude its extensive investigations in British Columbia in regard to water powers. Mr. A. V. White, who has spent the best part of a year in the province inquiring into water resources, their location and power capacity, states that during the last three years the co-operative work of the Commission and the Lands Department of the Provincial Government has been in progress, and has resulted in the gathering of an immense volume of valuable information concerning the aggregate amount of water in the province, together with its various capacities. The season now closing is likely to be the last devoted to this subject in the province, as, in the opinion of Mr. White, the subject is wellnigh exhausted, and he believes that the commissioners will proceed with their report upon the material in hand at the closing down of the present year's work.

Winnipeg, Man.—On October 18th, the C.P.R. internal terminal elevator at Transcona, Man., began to sink, and for twelve hours proceeded in a steady collapse at a rate of two feet every ten minutes. Before engineers could effect a stoppage in the tilting, the bridge connecting the elevator and the transfer house had fallen, and when the lean of the structure became too great for the overhanging bulk, the massive Cupola containing the distributing machinery collapsed. Owing to the wreckage of this machinery, considerable difficulty will be experienced in efforts to remove the grain from exposed bins before navigation closes. The bins have so far held together as a unit, and the transfer house has not been affected. It is the opinion of J. C. Sullivan, chief engineer of the C.P.R., that something was wrong with the earth of the floating foundation upon which the elevator was constructed, and that this was not known or discovered when the foundation was laid.

Regina, Sask.—The Saskatchewan Highways Commission has expended this year over $1,500,000 in an extensive programme of provincial road and bridge construction of about 150 small bridges, many of wood and others of steel, 25 steel bridges with concrete foundations, and the new traffic bridge at Saskatoon, which alone will cost approximately $350,000,—of these bridges, some have been finished, and others are still in process of construction; and in all, the expenditure on bridges this year will be $500,000. Work on bridges will be continued far into the winter; but the frost, which has now gone several inches into the ground, is necessitating the calling in of road gangs. But this year not only has much been done to construct and improve traffic facilities for new town communities, which are established in Saskatchewan at the rate of one every week; but for the first time the road from Fleming, near the Manitoba boundary, to Swift Current has been put into a condition suitable for continuous travel.

Quebec, Que.—The Premier of Canada, accompanied by many distinguished members of Government and prominent citizens of Quebec, on October 22nd proceeded on a tour of inspection to Cape Rouge to see the Quebec bridge in course of construction, and thence along the river front to observe the work completed in connection with the Transcontinental Railway terminus as well as to view the south site entrance of the railway tunnel to be built. The bridge, it is declared, will be the finest bridge structure in the world. It will measure 3,239 feet in all, the main span 1,800 feet, the width from centre to centre of the trusses 88 feet, and the clearing height above high water 150 feet. The masonry is especially

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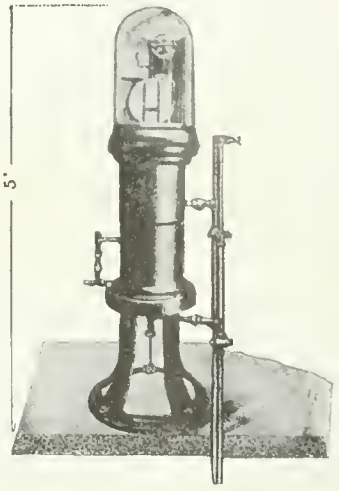

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massive in design, and the bridge will provide a width for two railway tracks and two-foot walks. The construction is being carried out by a commission comprised of C. N. Monsarratt, chairman and chief engineer; Messrs. Ralph Modjeska and C. C. Sneider; and is expected to be completed in 1917.

CATALOGUES RECEIVED.

(Continued from page 662.)

Sanitation at Mining Villages.—Illustrated pamphlet by Dwight E. Woodbridge, showing what has been accomplished by better sanitation at mining villages in the Birmingham district, Ala. Issued under the direction of Joseph A. Holmes, Director, Bureau of Mines, Washington, D.C.

The Influence of Inert Gases on Inflammable Gaseous Mixtures.—Illustrated pamphlet, showing experiments in the steel explosion cylinder, limits to explosibility, and the application of results. Published by J. K. Clement under the authority of the director, J. A. Holmes, of the United States Bureau of Mines.

Vitrified Segment Sewer Block.—This product of the American Sewer Pipe Company, Akron, Ohio, handled in Western Canada by Vitrified Clays, Limited, Calgary, is well described in Catalogue "C" of 24 pages, giving types, sizes, measurements, results of tests, endorsations, price lists, fittings, etc.

Census of Mineral Production of Canada.—A bulletin giving the fifth census taken of mineral production, e.g., for the year 1910 as enumerated under date of 1st June, 1911. Published by authority of Hon. Geo. E. Foster, minister of Trade and Commerce, and compiled by Archibald Blue, chief officer of the Census and Statistics Office, Ottawa.

Direct Current Railways.—A large, handsomely illustrated 132-page book under the name, "Bulletin No. 4958," General Electric Company, descriptive of 1,200, 1,500 and 2,400-volt direct current railways. The catalogue contains a full and comprehensive description of all apparatus and equipment pertaining to operation. Numerous installations are described and illustrated.

Light Mountain Transit.—A well-illustrated, carefully edited 32-page booklet has been received descriptive of the light mountain transits manufactured by W. & L. E. Gurley, Troy, N.Y. The catalogue is interesting in that it covers a wide range of transits adaptable to mountain or mine survey work, where portability is essential, and in this make of instrument the demand for lightness as well as quality appears to be well met.

Live Steam Separators.—Section A of an illustrated series of five pamphlets, comprising a bulletin which includes the introduction and general description of Cochrane Separators under the following heads: Section A, Live Steam Separators; Section B, Live Steam Separators and Receivers; Section C, Oil Separators; Section D, Vacuum Oil Separators; Section E, Low-pressure Receiver Oil Separators. Issued by the Harrison Safety Boiler Works, Philadelphia, Pa.

Road Rollers and Tractors.—Chambers, Limited, 152 Bay Street, Toronto, are distributing catalogues of the road rollers, steam-driven road locomotives and oil tractors manufactured by John Fowler & Company, of Leeds, England. "Fowlers'" are one of the biggest manufacturers of these lines of machinery in England, employing over four thousand men. They recently secured an order for six rollars from the city of Toronto, which was probably the largest single road roller contract ever awarded by a Canadian municipality.

IRRIGATION IN INDIA.

In the last ten years no less than 10,000 miles of canals had been opened in India, bringing the total in active use up to 53,000 miles. Thirty years ago the area served by irrigation in India amounted to about 11,000,000 acres. Twenty years later the total stood at about 19,000,000, and at present it amounts to about 23,000,000, which, when the works now under construction are completed, will be increased to 27,000,000. There are other large projects under consideration which will add another 10,000,000 acres to the irrigated areas. The Irrigation Commission estimates that a district insured by irrigation would give protection against famine to an area from twice to four times as large, and on this assumption the irrigation works in India may be said to protect a total area of considerably over 100,000 square miles—an area about equal to that of the British Isles.

Tuke and Bell, Limited, of London, England, have vacated their London office temporarily, as their building has been pulled down owing to the widening of Leadenhall St. They request all correspondence to be addressed to them at 509 High Road, Tottenham, London, N.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

WELLAND SHIP CANAL.

SECTION No. 5.

NOTICE TO CONTRACTORS.

Sealed Tenders, addressed to the undersigned and marked "Tender for Section No. 5, Welland Ship Canal," will be received at this office until 12 o'clock noon on **Tuesday, November 18th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, St. Catharines, Ontario.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered bank of Canada for the sum of $100,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Assistant Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 29th October, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—50010.

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- Strong Steam Traps
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- Burt Exhaust Heads
- American Safety Valves
- Trident Water Meters
- Palmetto Packing
- Durabla Packing
- Oster Stocks and Dies
- Tools and Fittings

ENGINE DEPARTMENT
- Fairbanks-Morse Oil Engines
- Fairbanks-Morse Marine Engines
- Fairbanks-Morse Tractors
- Farm Machinery
- Motor Boat Supplies
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- Fairbanks-Morse Steam Pumps
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- Hand Pumps
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- Spraying Outfits
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- Fairbanks-Morse Generaters and Motors
- Edison Storage Batteries
- Suburban Lighting Outfits

MACHINERY DEPARTMENT
- Pratt and Whitney Tools
- Brown and Sharpe Tools
- McDougall Lathes
- Bertram Tools
- Machine shop tools of all kinds
- Wood Working Machinery

TRANSMISSION DEPARTM'T
- Fairbanks Wood Split Pulleys
- Universal Giant Shaft Hange
- Skefko Ball Bearings
- Nicholson Couplings

RAILWAY AND SUPPLY DEPARTMENT
- Fairbanks-Morse Motor Cars
- Elwell-Parker Trucks
- Barrett Jacks
- Arthur Koppel Industrial Ry. Equipment
- Fairbanks-Morse Air Compressors
- Fairbanks-Morse Hoisting Engines
- Fairbanks Trucks
- Milburn Lights
- Smith Concrete Mixers

SMALL TOOL AND SUPPLY DEPARTMENT
- Pratt and Whitney Tools
- Brown and Sharpe Tools
- Yale and Towne Hoists
- Alundum Grinding Wheels
- Crystolon Grinding Wheels
- India Oil Stone
- Parker Vices
- Union Chucks

SAFE AND TYPEWRITER DEPARTMENT
- Dominion Safes and Vaults
- Noiseless Typewriters

TRUCK DEPARTMENT
- Mack Trucks (gasoline)

Send now for catalogue of goods that interest you

The Canadian Fairbanks-Morse Co. Limited

"The Departmental House for Mechanical Goods."

MONTREAL ST. JOHN QUEBEC OTTAWA TORONTO
WINNIPEG CALGARY SASKATOON VANCOUVER

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned and endorsed "Tender for Construction of Wharfs at Victoria Harbor, B.C.," will be received at this office until 4 p.m., on Tuesday, December 9, 1913, for the construction of Wharfs at Victoria Harbor, B.C.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the District Engineers' offices at New Westminster, B.C.; Victoria, B.C.; Confederation Life Building, Toronto, Ont.; Post Office Building, Montreal, P.Q.; and on application to the Postmaster at Vancouver, B.C.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to five per cent. (5 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 27, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—45197.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Harbor and River Improvements in the Mission River, Fort William, Ont.," will be received at this office until 4 p.m., on Friday, November 21, 1913, for the construction of the Harbor and River Improvements.

Plans, specifications and form of contract can be seen and forms of tender obtained at this Department and at the offices of W. P. Merrick, Esq., District Engineer, Fort William, Ont.; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; J. L. Michaud, Esq., District Engineer, Post Office, Montreal, P.Q.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank payable to the order of the Honorable the Minister of Public Works, equal to ten per cent (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 22, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—46879.

THE COMMISSIONERS OF THE TRANSCONTINENTAL RAILWAY.

NOTICE TO CONTRACTORS.

Tenders for the Installation or Completion of Electric Wiring System for the N.T. Ry., Car Shops, Transcona, Manitoba.

Sealed tenders, addressed to the undersigned and marked on the envelope: "Tender for Electric Wiring System," will be received at the office of The Commissioners of the Transcontinental Railway, at Ottawa, Ontario, until 12 o'clock noon of the 4th day of November, 1913, for the furnishing and installing of the Electric Wiring Systems required in connection with the equipment of the National Transcontinental Railway Car Shops at Transcona, Man., about six miles east of Winnipeg.

Plans may be seen and forms of tender and specifications obtained at the office of Mr. W. J. Press, Mechanical Engineer, Ottawa, Ont., and at the office of Mr. H. H. Pinch, Assistant Engineer, Transcona, Manitoba.

Persons tendering are notified that tenders must be made on the forms supplied by the Commissioners, and that each tender must be signed and sealed by all the parties to the tender, and witnessed, and be accompanied by an accepted cheque on a Chartered Bank of the Dominion of Canada, payable to the order of The Commissioners of the Transcontinental Railway, for a sum equal to five per cent. (5 p.c.) of the amount of the tender.

The cheque deposited by the party whose tender is accepted will be deposited to the credit of the Receiver-General of Canada as security for the due and faithful performance of the contract according to its terms. Cheques deposited by parties whose tenders are rejected, will be returned within ten days after the signing of the contract.

The right is reserved to reject any or all tenders.

By order,
P. E. RYAN,
Secretary.

The Commissioners of the Transcontinental Railway.
Dated at Ottawa, October 8, 1913.

Newspapers inserting this advertisement without authority from the Commissioners, will not be paid for it.—49048.

NOTICE TO CONTRACTORS.

INTERCEPTING SEWER.

Sealed tenders addressed to the Chairman of the Board of Control will be received by the Secretary of the Board of Control, City Hall, Ottawa, up to 4 p.m., Thursday, November 6th, 1913, for the construction of the West End intercepting sewer.

Any tender received after the above stated time will be declared informal.

Specifications and full particulars may be obtained on application at the City Engineer's office, City Hall, Ottawa.

The Corporation does not bind itself to accept the lowest or any tender.

ARCH. CURRIE,
City Engineer.

Ottawa, October 27th, 1913.

(For further Tenders see pages 86, 88 and 90.)

Insuring Pumps

against their destruction by fire requires engineering knowledge that is not needed in insuring dwellings, stores, etc.. We used the word "Pumps" only as an illustration. It requires sound engineering and expert insurance knowledge—combined in the one firm—to secure for any industrial or engineering firm the lowest possible insurance rates. Only a firm like ours—employing a staff of engineers—could appreciate your requirements—not only in fire insurance but also in special forms of insurance.

Correspondence solicited.

E. M. SELLON & CO.
LIMITED

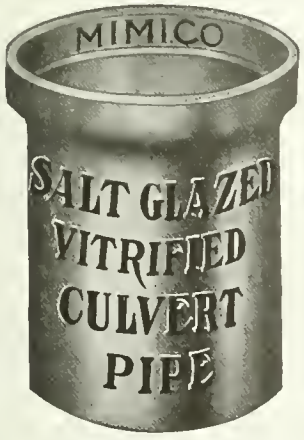
INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS:
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

Ground Water

must be kept out of the sewer. Less money will have to be spent on disposal plant if the amount of sewage to be treated is smaller. Every gallon of ground water that leaks into the sewer adds to the expense and seriousness of the sewage disposal problem.



MIMICO PIPE can be trusted at all times to be watertight.

Round Pipe and Square Dealings *Prices on request.*

The Ontario Sewer Pipe Co.
LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

Renouf Publishing Co.

25 McGill College Ave.
MONTREAL

EIGHTH EDITION, Re-written and Enlarged
TOTAL ISSUE, 103,000

Mechanical Engineers' Pocket-book.

By WILLIAM KENT, A.M., M.E. 16mo, xi+1461 pages, illustrated. Morocco, $5.00 net.

A reference book of rules, tables, data, and formulæ, for the use of engineers, mechanics and students.

Deflections and Statically Indeterminate Stresses.

By CLARENCE W. HUDSON, Member, American Society of Civil Engineers, Professor of Civil Engineering, Polytechnic Institute of Brooklyn, New York, Consulting Engineer. Small 4to, xiii+258 pages, profusely illustrated with figures in the text, and full-page plates. Cloth, $3.50 net.

A sufficient number of examples have been given in this book to show how the solution of problems in deflections and statically indeterminate structure may be made on terms of the elastic properties of the materials.

Notes on Plate Girder Design.

By PROFESSOR CLARENCE W. HUDSON, Polytechnic Institute of Brooklyn, New York. 8vo, vii+75 pages, figures throughout the text, and two folding plates. Cloth, $1.50 net.

These notes have been used by the author to give his civil engineering students the theoretical and practical information necessary to enable them to make a design and general drawing for a through plate-girder railway bridge.

Fire Prevention and Fire Protection as Applied to Building Construction.

A Handbook of Theory and Practice. By JOSEPH KENDALL FREITAG, B.S., C.E., Associate Member, American Society of Civil Engineers. 16mo, viii+1038. pages, 395 figures, including line and half-tone cuts. Morocco, $4.00 net.

Presents in a manner suitable for ready reference, the present status of fire-resistance as applied to buildings.

SIXTH EDITION, Re-written and Enlarged

The Elasticity and Resistance of the Materials of Engineering.

By WILLIAM H. BURR, C.E., Professor of Civil Engineering in Columbia University in the City of New York. 8vo, 1100 pages, illustrated. Cloth, $7.50.

Sets forth the treatment of concrete steel beams and other members with complete fullness to meet the requirements of that rapidly extending field of engineering construction.

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned, and endorsed "Tender for Addition and Alteration to Public Building, Lindsay, Ont.," will be received at this office until 4 p.m., on Wednesday, November 5, 1913, for the work mentioned.

Plans, specification and form of contract can be seen and forms of tender obtained at the office of Mr. Thos. Hastings, Clerk of Works, Postal Station F, Yonge Street, Toronto, at the Post Office, Lindsay, Ont., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 15, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—47381.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Harbor Improvements at Port Hope, Ont.," will be received at this office until 4 p.m., on Monday, November 17, 1913, for the construction of Harbor Improvements at Port Hope, Durham County, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the office of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Port Hope, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 16, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—47820.

MAIL CONTRACT.

Sealed tenders addressed to the Postmaster-General, will be received at Ottawa until noon on Friday, the 14th November, 1913, for the conveyance of his Majesty's mails, on a proposed contract for four years, six times per week each way, over Mono Road and Rural Mail Route, from the Postmaster-General's pleasure.

Printed notices containing further information as to conditions of proposed contract may be seen and blank forms of tender may be obtained at the Post Office of Mono Road, and at the office of the Post Office Inspector, Toronto.

A. SUTHERLAND,
Post Office Inspector.

Post Office Inspector's Office, Toronto, October 7th, 1913.

52 A.—2,500-26 9-12.

NOTICE TO CONTRACTORS.

TEMPORARY BRIDGE.

Sealed tenders addressed to the Board of Control will be received by the Secretary of the Board of Control, City Hall, up to 4 p.m. Tuesday, November 4th, 1913, for the erection of a temporary bridge over the Rideau River north of the present Billings Bridge.

Any tender received after the above stated time will be declared informal.

Specifications and full particulars may be obtained on application at the City Engineer's office, City Hall, Ottawa.

The Corporation does not bind itself to accept the lowest or any tender.

ARCHIBALD CURRIE,
City Engineer.

Ottawa, October 23rd, 1913.

RURAL MUNICIPALITY OF ASSINIBOIA.

NOTICE.

Sealed tenders, marked "Tenders for pavement," will be received by the undersigned up to 4 o'clock p.m., on Tuesday, the 25th day of November, 1913, for the construction of an asphalt pavement, on the north side of Portage Road, from the westerly limit of Lot 113, St. Charles, to the westerly limit of the Municipality—an approximate length of 7¼ miles—the first 1¼ miles to be 24 feet in width, and the balance 16 feet in width.

Plans and specifications may be seen at the office of the Municipal Engineer, Municipal Hall, St. Charles.

A marked cheque for 5 per cent. of the amount of tender must accompany each tender, which will be forfeited, should the successful tenderer refuse or neglect to enter into a contract, or to proceed with the work, as required in the specifications.

Tenders will also be accepted for pavements other than asphalt, in which case persons tendering must furnish plans, specifications and details of same.

The lowest or any tender not necessarily accepted.

By order of the Council.

FRANK NESS, Clerk,
Rural Municipality of Assiniboia.

Kirkfield Park P.O., Man., October 24th, 1913.

(For further Tenders see pages 84, 88 and 90.)

MEXICAN EAGLE ASPHALT

TRADE MARK

Delivered to meet the specifications of the American Society for Municipal Improvements or any other standard specifications.

Purchase MEXICAN EAGLE ASPHALT Because:

1—It is more cementitious than other asphalts.

2—Water will not readily injure it.

3—Exposure to sun and air will not cause its deterioration.

4—It has great cohesive strength.

5—It is more ductile and flexible than other asphalts.

6—Shocks will not crack it. It is very malleable.

7—We will supply asphalt having the proper penetration for your needs.

8—It is best adapted to Canada's climate—will not mark in hot weather—nor are snow or ice likely to crack it.

9—It has over 99 per cent. bitumen. Purest on the market—therefore free from deleterious matter.

10—It is so constituted that it will not be injured by the heat necessarily applied to melt it for paving operations.

Samples, prices, analyses, etc., on request.

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

SECOND-HAND MACHINERY

Contractors' Machinery For Sale

We have in stock for immediate delivery.

6½"x8", 6"x12", 7"x12", 8"x12" Beatty hoists.
5" x 7", 6½" x 8" Napanee hoisting engines.
5" x 6" builder's reversible hoist.
No. 2 boom swinger
1 yd. "Faivrette" clam bucket.
No. 3 Ransome concrete mixer.
No. 2 Ransome concrete mixer.
8"x 10"x 8" steam driven air compressor.
6" x 6" belt driven air compressors.
4", 5" and 6" centrifugal pumps direct connected to vertical engines.
1½", 3" and 4" centrifugal pumps direct connected to gasoline engines.

Write for prices.

SELLING AGENTS FOR M. BEATTY & SONS.

H. W. PETRIE, LIMITED
Front St. W., TORONTO, Ont.

HOISTING ENGINE and other machinery for sale: in good order. Apply to W. J. Kett, Latchford, Ont., or John Donogh, Traders Bank Building, Toronto.

PANAMA CANAL EQUIPMENT FOR SALE.—The Isthmian Canal Commission will offer for sale in the near future the equipment used in building the Panama Canal, such as rolling stock, excavating machinery, floating equipment, miscellaneous plants, and miscellaneous equipment, including locomotives, cars, steam shovels, cranes, unloaders, earth spreaders, track shifters, rock drills, well drills, dredges, barges, tugs, launches, pile drivers, concrete handling plants, pumps, rock crushers, etc. Inquiries from users of such equipment are invited for its purchase. Catalogues listing the equipment offered for sale and other information may be obtained upon application to the General Purchasing Officer, Isthmian Canal Commission, Washington, D.C. F. C. Boggs, Major, Corps of Engineers, U.S.A., General Purchasing Officer.

FOR SALE.—One model 41 Marion steam shovel, less than a year old; one Porter locomotive; ten 4-yard Western cars; one 40 H.P. boiler. Please address Box 154, *The Canadian Engineer*, Toronto.

FOR SALE.—One 35 h.p. gas engine, in good condition, suitable for city or natural gas. Apply Box 1505, General Post Office, Winnipeg.

Tenders Called For

SPECIAL NOTICE TO CONTRACTORS.

RE GREATER WINNIPEG WATER SUPPLY.

(Estimated Cost $13,500,000.)

Notice is hereby given to Contractors that tenders will be invited early in the year 1914 for the construction of works necessary for the delivery of water from Shoal Lake to the Greater Winnipeg Water District. The following is a brief description of the proposed works:—

1. A dyke and channel for the diversion of the Falcon River into Snowshoe Bay.
2. 85 miles concrete aqueduct.
3. 10 miles pipe line (probably 1916 work).
4. 900 lineal feet tunnel under Red River.
5. 85 miles of construction railway.
6. Telephone line.
7. Clearing and ditching.

The fall season of the year affords the best opportunity for inspection of proposed route of the aqueduct, and it is recommended that contractors having a view to tendering on the work should send their inspectors over the line at as early a date as possible.

Particulars as to estimated cost of the work and map of approximate location and profile of aqueduct may be obtained from the undersigned.

M. PETERSON,
Acting Secretary of the Administration Board,
Greater Winnipeg Water District.

City Hall,
Winnipeg, Canada,
October 6th, 1913.

Note.—Copy of report of the Consulting Engineers, plan and profile of work and typical details of design may be seen at the office of *The Canadian Engineer*, 62 Church Street, Toronto.

PROPOSED GOVERNMENT BUILDINGS, OTTAWA, ONT.

EXTENSION OF TIME.

Notice is hereby given that the time for the reception of designs in the first competition for the erection of Departmental and Courts Buildings, is extended for three months to Thursday, April 2nd, 1914.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
—49657. Ottawa, October 23, 1913.

CANADIAN GOVERNMENT RAILWAYS.

TENDER.

Sealed tenders addressed to the undersigned and marked on the outside, "Tender, Diversion of Line, North Sydney to Leitches Creek," will be received up to and including

Monday, November 10th, 1913,

for the construction of a line of railway from North Sydney to Leitches Creek, N.S.

Plans and specification may be seen at the office of the undersigned at Ottawa, Ont., at the Station Master's Office, North Sydney, N.S., at the office of the Resident Engineer, at New Glasgow, N.S., and at the office of the Chief Engineer, Moncton, N.B., where forms of tender may be obtained.

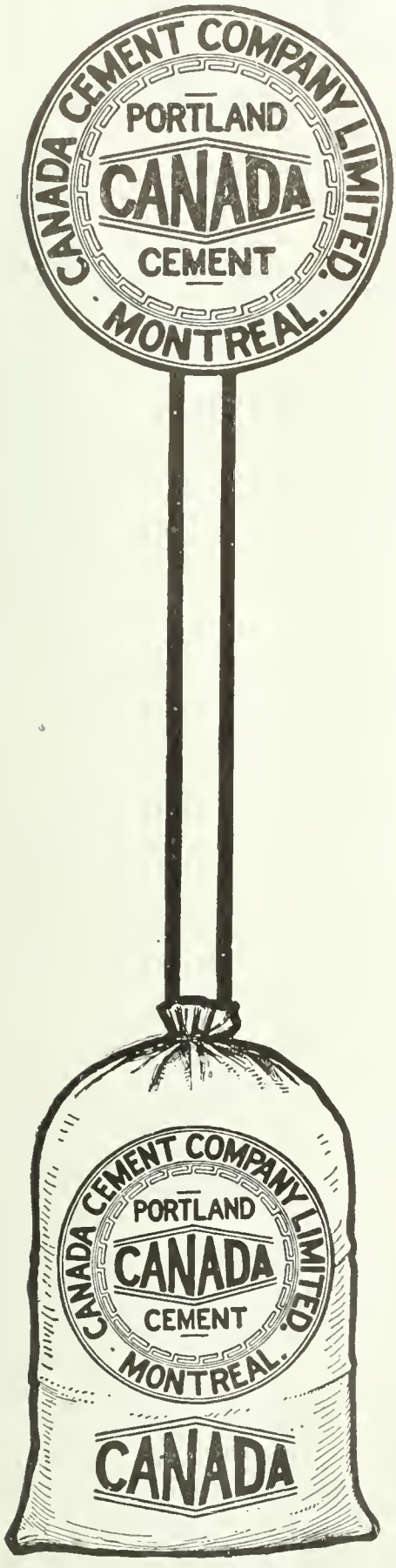
All the conditions of the specification must be complied with.

L. K. JONES,
Assistant Deputy Minister and Secretary, Department of Railways and Canals.

Ottawa, Ont., October 24th, 1913.

(For further Tenders see pages 84, 86 and 90.)

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.—Assistant Engineers, Transitmen, Levellers, Rodmen, Chainmen, Inspectors and Draftsmen for all branches of engineering work. We make no charge to enroll you on our books. Send for application form. Civil Engineer's Employment Bureau, P.O. Box 391, Montreal.

ENGINEERING SALESMEN.—Good future offered for a few clean cut engineering salesmen, technical graduates preferred, to act as outside representatives for an established Consulting Engineering and Construction Corporation, based on co-operative plan. Main offices in Cleveland. Highest reference and financial interest required. Contract with salary, commission and expenses guaranteed. Box 172, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

AN ELECTRICAL ENGINEER; ten years' experience in Western Canada, head office, Winnipeg, is desirous of getting in touch with firms wishing Western Representative. Have managed sales office of one of the largest manufacturing concerns in Canada for the past five years, so am in close touch with conditions. 482½ Main Street, Winnipeg, Man.

CIVIL ENGINEER, 26, college graduate, 5 years' experience in surveying, reinforced concrete structures, and waterworks, field and office, desires position. Familiar with water power investigations. Excellent references, thoroughness. Box 170, *The Canadian Engineer*, Toronto.

MECHANICAL DRAFTSMAN.—Young man with technical education, including steam power plant design, with shop and office experience, desires position with engineers, who design steam and hydro-electric power plants. Location preferably in Ontario or Quebec. Is employed in Montreal. Box 160, *The Canadian Engineer*, Toronto.

STENOGRAPHER.—Experienced in engineering correspondence, estimating and accounting, desires position, preferably as secretary. Gilt-edged references. Please address, Box 168, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

FOUNDRY AND SHOP WANTED.—United States manufacturer desires to lease Canadian foundry and machine shop. Please give full particulars of equipment and state terms desired. All letters confidential. Address Box 156, *The Canadian Engineer*, Toronto.

FOR SALE.—Old-established and well-known Canadian engineering company, doing large business from coast to coast—an excellent opportunity for investors or for anyone wishing to extend operations in Canada by taking over a going concern, with complete plant staff and extensive connection. All communications strictly confidential. Address Box 164, *The Canadian Engineer*, Toronto.

Tenders Called For

(Continued from page 88.)

TENDERS FOR 84-IN. STEEL CONDUIT.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on

Tuesday, November 18th, 1913,

for the supplying and laying of an 84-inch steel conduit from the Pure Water Reservoir on Toronto Island to the South Tunnel Shaft.

Specifications and tender forms may be obtained upon application at the Department of Works, Room 10, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering, as prescribed by city by-law, must be strictly complied with, or the tenders may be declared informal. Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company, approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, October 17, 1913.

(For further Tenders see pages 84, 86 and 88.)

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17, Victoria Street, London, S.W.:—A firm at Newcastle-on-Tyne, desire the addresses of Canadian exporters of asbestos.

From the branch for City trade inquiries, 73 Basinghall Street, E.C.:—A Sheffield company, manufacturing tool, alloy and mining drill steel, also certain tools, saws, etc., would like to secure the services of some first-class firm, preferably in Winnipeg, to act as their representatives for Western Canada.

MONTREAL MARKET LETTER

Montreal, October 27th.

The local iron and steel trade is a little demoralized by the uncertainty of outside markets. During the past few weeks advices have been received both from the United States and from abroad to the effect that the price of steel products have declined all the way round. This has affected the local market and as a consequence prices of certain products, such as, bar iron and steel plates and pig-iron, are all lower than they were a week ago. Pig-iron is attracting considerable attention. There has been a fair amount of activity of late, but large contracts are withheld and it is likely that the bulk of the orders placed recently have been brought out very largely by the knowledge that freight rates will advance in the course of a very few weeks, and in order to take advantage of the low freights the goods must be shipped ere a great length of time. Prices have been marked down on a number of products as will be seen from the following list:—

Black Steel Plates.—¼-inch, $2.30 per 100 lbs.; 3-16-inch, $2.60 per 100 lbs.; 10-gauge, $2.70 per 100 lbs.; 12-gauge, $2.75 per 100 lbs.; 14-gauge, $2.50 per 100 lbs.; 16-gauge, $2.50 per 100 lbs.; 18-gauge, $2.60 per 100 lbs.; 20-gauge, $2.60 per 100 lbs.; 22-24-gauge, $2.70 per 100 lbs.; 26-28-gauge, $2.80 per 100 lbs.

Manufacturing 48" Pipe at Berlin, Ontario, Canada.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, October 25th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.01; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¼ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21.25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, October 29th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¾-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for gond Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, October 28th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7.16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 pe cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. nits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5.15. Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 pe· cwt.

Steel Plates, Rolled—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe caulk, $4.50 base tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

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Contents of this issue on page 681

The Canadian Engineer

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HANDLING MATERIALS BY BUCKET CARRIERS

THE "ONE-PIECE" SYSTEM FOR ELEVATING AND CONVEYING TYPES, CAPACITIES, ECONOMIC SPEEDS, HORSE-POWERS—ADVANTAGES AND DISADVANTAGES*

By REGINALD TRAUTSCHOLD, M.E.,
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ALL conveying and elevating apparatus so far discussed has had one and the same limitation; that is, each particular type of equipment has been destined for practically but one operation, either that of conveying in a more or less horizontal plane or else elevating more or less vertically. From a purely economic standpoint such limitation is actually an advantage, for the use of a separate and distinct equipment for each main operation is frequently advisable, particularly in installations where the various operations of conveying and elevating must of necessity be continuous. A breakdown in an elevator or conveyer would then not necessarily mean a shutdown, for some temporary makeshift—possibly manual handling of the load—could be resorted to for carrying past the damaged conveyer or elevator and the balance of the operations performed as ordinarily. However, one apparatus for performing both operations of elevating and conveying has the advantage of simplicity and, though a breakdown anywhere in such equipment must necessarily mean a complete shutdown of the entire conveying and elevating system while repairs are made, this more flexible outfit is frequently installed in preference to the more reliable but more complex systems in which the various main operations are performed by individual apparatus. The "one-piece" system frequently possesses the advantage of lower initial cost, and further, the advantage that material may be carried in either direction. For elevating, the "one-piece" system necessitates a succession of buckets, somewhat similar to those of the bucket elevator, and the conveying operations must necessarily be performed by the same buckets. The apparatus is commonly designated as a "bucket carrier," both to distinguish it from a bucket elevator and because such equipment can be, and is sometimes, used to carry material only in a horizontal plane or in an inclined plane.

Classification and Construction.—Two distinct types of bucket carriers are in general use—those in which the buckets are rigidly attached to the endless carrying chains so that on horizontal stretches the buckets act as do the flights of flight conveyers and drag the load along a trough; and those in which the buckets are suspended from the carrying chains so that they maintain an upright position in whatever plane they may be advancing. The latter type of bucket carriers, those with pivoted buckets, require discharging devices which tip the buckets so that their load may be discharged at a specified point. This limits the distributing capability of the pivoted bucket carrier, for but one discharge point is all that is possible without greatly complicating the equipment—that is, only one discharge point without shifting the discharging, bucket tipping, device. The annoyance and inconvenience of frequently shifting the discharging device may be somewhat reduced by the installation of systems of distributing chutes, etc. The pivoted bucket construction also complicates the loading of the carriers to some extent, as they are nearly invariably loaded on a horizontal stretch of carrier, in order to avoid the necessity and complication of a receiving receptacle similar to an elevator boot employed for bucket elevators. The carrier's buckets must then be proportioned so that, on horizontal stretches, there may be no gaps between buckets—only possible when the buckets are provided with lips that extend from one bucket over the edge of the succeeding bucket—or else the bucket carrier must be provided with a reciprocating feeder that delivers load to the carrier only when the succeeding buckets are each in the proper position for receiving their load. Rigid bucket carriers, on the other hand, may be loaded as steadily and uniformly as a flight conveyer.

The construction of bucket carriers permits them to run in almost any conceivable path provided the buckets always lie in the same vertical plane. That is, the elevation of the bucket carrier path may be rectangular, a series of steps with the return run of buckets in a series of descending steps or, as is more common, with the buckets brought down vertically from the end of the carrier travel in the first general direction to the plane of the loading point and thence in a more or less horizontal path to the point where the general direction of advance is upward, etc., etc. Bucket carriers traveling in rectangular paths are the more common and are also the more convenient in that one load can be elevated and then carried horizontally to the desired discharge point while a second load can be carried over the lower horizontal run, elevated and discharged where desired. This type of carrier is frequently installed in power houses where coal is elevated and discharged to coal bunkers by the forward run of buckets and the return run of buckets is employed to carry the ashes from under the grates and discharge to an elevated ash bin from which they may be subsequently removed by other means.

Bucket carriers can, of course, be equipped with buckets of almost any conceivable size and shape, but practice has standardized a rectangular shape with a

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depth about equal to the width. Such buckets are referred to in terms of length and width of bucket, so that the carrying capacity of any standard bucket carrier, loaded with any given material, is dependent upon the spacing of the buckets and the speed at which the carrier is run. Table XI. gives the average carrying capacity of certain common sizes of bucket carriers (length of bucket times in width) when handling material weighing 100 pounds per cubic foot at a carrier speed of 50 feet per minute. At equal spacing of buckets, the carrying capacity of bucket carriers handling other material at other speeds is directly proportional to both weight of material carried and speed of carrier. These definite relations and the fact that all standard buckets are similarly proportioned, permits the expression of the carrying capacity of any standard bucket carrier in the form of a convenient equation. (See Formula XXI.).

Table XI.—Capacity of Bucket Carriers in Tons Per Hour. Material Weighing 100 Pounds Per Cubic Foot. Carrier Speed, 50 Feet Per Minute.

Bucket	Spaced			
length x width	18 in.	24 In.	30 in.	36 in.
12 in. x 12 in.	25.76	19.36	15.41	12.84
16 in. x 12 in.	34.24	25.68	20.55	17.12
16 in. x 15 in.	53.60	40.20	32.15	26.80
18 in. x 15 in.	60.15	45.10	36.10	30.07
20 in. x 15 in.	—	52.40	41.90	33.45
24 in. x 15 in.	—	60.10	48.00	39.60
20 in. x 20 in.	—	88.80	71.00	59.30
24 in. x 20 in.	—	106.70	85.40	70.40
30 in. x 20 in.	—	—	106.70	89.10
36 in. x 20 in.	—	—	128.00	106.70
30 in. x 24 in.	—	—	—	124.60
36 in. x 24 in.	—	—	—	153.72

Capacity: $W = \frac{0.00535 \times w^2 \times l \times w'}{S''}$ Formula XXI.

Where:
- W = Capacity in tons per hour.
- w = Width of bucket in inches.
- l = Length of bucket in inches,
- w′ = Weight of material handled in lbs. per cu. ft.
- S″ = Spacing of buckets in inches.

Though the average speed of a bucket carrier is about 50 feet per minute, all materials are not most economically carried at that speed. Certain materials permit considerably higher speeds, while others must be handled more slowly, or excessive breakage, etc., is apt to occur. Table XII. gives speeds that have been found to be economic for certain of the common materials usually handled by such equipment. These speeds are by no means fixed, however, and considerable variation is permissible and not infrequently advisable. In fact, some authorities recommend quite different speeds for some of the materials mentioned in Table XII. However, the data of this table has been collected from numerous efficient installations of bucket carriers and may safely be used as a basis of operation.

Table XII.—Economic Speeds of Bucket Carriers for Various Materials.

Material	Advisable Speed
Coke	40 feet per minute
Broken Stone (coarse); Lump Coal—R.M.	50 feet per minute
Ashes, Lime and Cement	60 feet per minute
Ore, Crushed Stone, Sand and Gravel	70 feet per minute
Fine Coal	80 feet per minute

The consumption of power by the rigid bucket and by the pivoted bucket types of bucket carriers naturally differs considerably, but the difference is somewhat equalized by the fact that the pivoted bucket type is nearly invariably furnished with a reciprocating feeder that consumes quite appreciable power. Other than for this special feature of the pivoted bucket carrier, three distinct operations consume power whether the carrier is of the rigid bucket or pivoted bucket construction: 1st, the running of the apparatus itself, which depends upon the total weight of the moving parts—the weight of the endless chains, the buckets and the attachments; 2nd, the carrying of the load horizontally; and 3rd, the operation of elevating the load. Although load may be carried in two general directions by a bucket carrier, such double transfer of load is seldom, if ever, accomplished at the same time, so that it is customary to figure an allowance of power for conveying in one direction only. The elevating operations consume only about the theoretical power required for the load, as the descending buckets and chains compensate for the work of raising these parts and the friction and other unavoidable losses are almost independent of the height of lift, so are allowed for in the power provisions for horizontal travel of load. Standardization of equipment permits the expression of the weight of the moving parts of the carrier in terms of its carrying capacity in tons per hour, for the strength, hence the weight of the chains, attachments and buckets vary very closely with the load that the carrier is capable of handling. In the derivation of Formulæ XXII. and XXII-a, the value of all constants are based on actual results obtained in a number of successful and economic installations of such equipment and, though the results given by such formulæ may be somewhat higher than the claims advanced by certain manufacturers of bucket carriers, dependence upon the use of formulæ for deriving horsepower requirements of bucket carriers that give smaller results is inadvisable, for so many conditions really effect the question of power consumption by such equipment that no theoretical equation can be derived that will fit all cases.

Horsepower:—

- W = Weight of load handled in tons per hour.
- L = Length (total) of horizontal stretches of Carrier in one general direction in feet.
- H = Height (total) or distance through which load is elevated in feet.
- V = Velocity (speed) of Carrier in feet per minute.
- W_c = Weight of moving parts of Carrier in lbs. per foot.
  - = 0.608 W—Carriers with rigid buckets.
  - = 0.756 W—Carriers with pivoted buckets.
- W′ = Weight of load handled in lbs. per minute.
  - = 33 W

$\frac{W'}{V} = \frac{33\ W}{V}$ = weight of load handled in lbs. per minute per foot.

- f_s = Speed factor = 0.18 —Carriers with rigid buckets.
  - = 0.035—Carriers with pivoted buckets.
- f_l = load factor = 0.70—Carriers with rigid buckets.
  - = 0.20—Carriers with pivoted buckets.

Horsepower required to run empty carrier:—

Carriers with rigid buckets.

Total weight of moving parts = $2(H + L)W_c$
Average velocity of Carrier (V) = 50 feet per minute.

$$HP = \frac{2(H + L)W_c \times V \times f_s}{33000} = \frac{2(H + L) \times 0.608\ W \times 50 \times 0.18}{33000}$$

$$= \frac{33\ (H + L)W}{100{,}000}$$

Carriers with pivoted buckets.

Total weight of moving parts = $2(H + L)W_c$
Average velocity of Carrier (V) = 50 feet per minute.

$$HP = \frac{2(H + L)W_c \times V \times f_s}{33000} = \frac{2(H + L) \times 0.756\ W \times 50 \times 0.35}{33000}$$

$$= \frac{8(H + L)W}{100000}$$

Horsepower required for handling load on horizontal travel:—

Carriers with rigid buckets.

$$HP = \frac{W' \times f_1 \times V \times L}{33000 \times V} = \frac{33\ W \times 0.70 \times L}{33000} = \frac{70\ WL}{100{,}000}$$

Carriers with pivoted buckets.

$$HP = \frac{W' \times f_1 \times V \times L}{33000 \times V} = \frac{33\ W \times 0.20 \times L}{33000} = \frac{20\ WL}{100{,}000}$$

Horsepower required for elevating load:

All types of Bucket Carriers.

$$HP = \frac{33\ W \times H \times V}{33000 \times V} = \frac{100\ WH}{100{,}000}$$

Horsepower required for Reciprocating Feeder:—

Carriers with pivoted buckets only.

$$HP = \frac{9\ W}{100} \text{ (from experiment).}$$

Total horsepower required:—

Carriers with rigid buckets.

$$HP = \frac{(103\ L + 133\ H)W}{100000}$$ Formula XXII.

Carriers with pivoted buckets

$$HP = \frac{(28\ L + 108\ H)W}{100000} + \frac{9\ W}{100}$$ Formula XXII-a

The average bucket carrier is now pretty well standardized as to cost as well as in design, so that unless the buckets are of abnormal proportions or very complicated in design and the carrier chains are efficiently economical such a close relationship exists between the cost of the component parts of such a system and its size and length that an equation may be derived that will closely approximate the cost of any ordinary installation. As far as cost is concerned, the component parts naturally fall into four general groups: 1st, the chains which depend upon the total length of the bucket carrier and the weight of the load to be carried; 2nd, the buckets and attachments which also depend upon the total length of the carrier and the weight of the load; 3rd, the trough, gates, etc., for carriers with rigid buckets, or the rails, discharging devices, etc., for carriers with pivoted buckets, all of which depend upon the size of the buckets and the horizontal travel of the carrier in one direction; and 4th, the sprockets, drive, etc., which depend upon the size of the buckets, or size of carrier—to which must be added the cost of the reciprocating feeder for bucket carriers with pivoted buckets, which latter varies directly in cost with the square root of the product of the width and length of the buckets. As the weight of the load to be carried depends upon the size of the buckets and their spacing, it is possible to derive an equation for ascertaining the approximate cost of any system in which the variable factors are those of total length of bucket carrier, size of bucket and weight of material to be handled. Such an equation follows as Formulæ XXIII. and XXIII.-a, the results attained from the use of which will give very close approximations of the cost of any average standard type of bucket carrier equipment, including an allowance sufficient to cover the cost of a simple installation.

Initial Cost:—

C = Cost of Bucket Carrier equipment in dollars.
wl = Size of buckets in square inches = width x length.
H = Height (total) to which load is elevated in feet.
L = Horizontal travel (total) of buckets in one direction in feet.
S = Spacing of buckets in inches.
w' = Weight of material to be handled in lbs. per cubic foot.

Carriers with rigid buckets.

Average cost of chains $\dots\dots \frac{0.024\ wl(H + L)}{S} \times w'$

buckets $\dots\dots \frac{0.026\ wl(H + L)}{S} \times w'$

Average cost of trough, gates, etc. $\dots\dots 0.005\ wl\ L$

sprockets, drive, etc. $\dots\dots 15.25\ \sqrt{wl}$

$$C = \frac{0.05\ wl(H + L)}{S} \times w' + 0.005\ wl\ L + 15.25\ \sqrt{wl}$$ Formula XXIII.

Carriers with pivoted buckets.

Average cost of chains $\dots\dots \frac{0.025\ wl(H + L)}{S} \times w'$

buckets $\dots\dots \frac{0.045\ wl(H + L)}{S} \times w'$

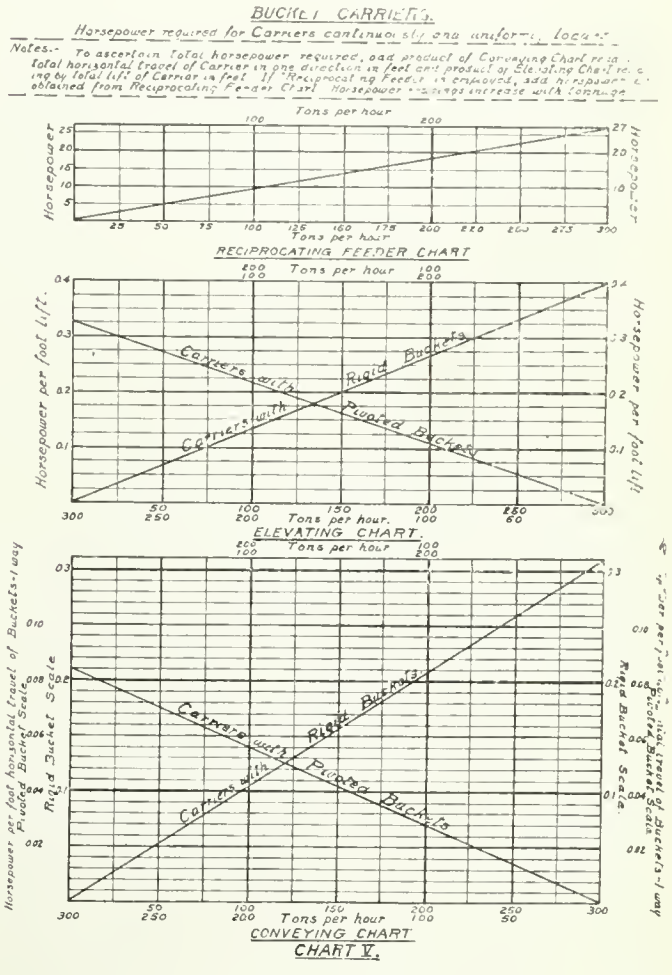
rails, discharging device, etc. $0.05\ \sqrt{wl}\ L$

sprockets, drive, etc. $\dots\dots 15.25\ \sqrt{wl}$

reciprocating feeder $\dots\dots 0.75\ \sqrt{wl}$

$$C = \frac{0.07\ wl(H + L)}{S} \times w' + 0.05\ \sqrt{wl}\ L + 16\ \sqrt{wl}$$ Formula XXIII-a.

The close relationship that exists between the carrying capacity of a bucket carrier and the size of its buckets (spacing of buckets depending almost entirely


BUCKET CARRIERS.
Horsepower required for Carriers continuously and uniformly loaded.
Notes:- To ascertain total horsepower required, add product of Conveying Chart reading by total horizontal travel of Carrier in one direction in feet and product of Elevating Chart reading by total lift of Carrier in feet. If Reciprocating Feeder is employed, add horsepower obtained from Reciprocating Feeder Chart. Horsepower increases directly with tonnage.
Tons per hour
Horsepower
RECIPROCATING FEEDER CHART
Horsepower per foot Lift.
Carriers with Rigid Buckets
Carriers with Pivoted Buckets
ELEVATING CHART.
Horsepower per foot horizontal travel of Buckets-1 way
Rigid Bucket Scale
Pivoted Bucket Scale
CONVEYING CHART
CHART V.

upon their size and hence not varying greatly comparatively) allows the expression of cost of equipment in terms of tonnage handled (capacity) suitable for use when considering the factors that enter into the net operating cost. An error enters the initial cost of equipment as

ascertained by such means, because the initial cost of an equipment for handling material of any given weight does not really vary directly with the weight, although it does increase somewhat as the weight of the material to be handled increases, but this error is greatly discounted by the comparatively small proportions of the initial cost of equipment that actually enters into the question of net operating cost, being in fact only the fixed charges represented by interest on investment, taxes, insurance, etc. Depreciation, on the other hand, usually increases more rapidly than the increase in initial cost apparent when handling heavier materials, so that, being figured as a percentage of the initial cost, the inaccuracy of figuring a fixed rate of depreciation is compensated for by unduly high initial cost upon which it is figured. Power costs entering into net operating cost are, of course, directly dependent upon the tonnage handled, so that no error is apparent that is due to the high initial cost as expressed in terms of tonnage the carrier is capable of handling. In fact, the only error that appears at all is in figuring the fixed burden of interest, etc., which is but a relatively small percentage of the total net operating cost. Hence, Formulæ XXIV. and XXIV.-a, expressing the net operating cost of handling a ton of material over any bucket carrier system, may be considered conservatively accurate. More accurate results would be unattainable without most careful and complicated bookkeeping—far more systematic and painstaking than is practiced in any indsutrial undertaking or power house—so that the use of Formulæ XXIV. and XXIV.-a should prove of considerable value to the present operator of such a system of mechanical material handling as well as aiding his or others in forming an opinion as to the advisability of any contemplated bucket carrier installation, such formulæ giving the true economic value of the layout.

Net Operating Cost (N.O.C.):—

W = Weight of load handled in tons per hour.
L = Length (total) of horizontal travel of Carrier in one general direction in feet.
H = Height (total) or distance through which load is elevated in feet.

Carriers with rigid buckets.

Average cost of chain .....0.2420 W(H + L)
buckets .....0.2621 W(H + L)
trough, gates, etc. .....0.03 WL.
sprockets, drive, etc. .....5.5 W
Total average cost = 0.5041 W(H + L) + 0.03 WL + 5.5 W

Fixed charges:—
Interest .. 6% total cost
Insurance.. 1%
Taxes .... 2%—¾ cost
= 0.04286 W(H + L) + 0.0255 WL + 0.4675 W

Depreciation, renewals, repairs, etc.:—
Depreciation on chains .....0.03025 W(H + L)
buckets .....0.05242 W(H + L)
trough, gates, etc. ....0.01 WL
sprockets, drive, etc. ..0.55 W
Depreciation account—0.00827 W(H + L) + 0.001 WL + 0.055 W

Total depreciation (summation) = 0.09094 W(H + L) + 0.011 WL + 0.605W

Then:—
Yearly Burden = 0.13380 W(H + L) + 0.0365 WL + 1.0725 W
N = Number of hours (total) Carrier is in use per year.
P_c = Price (cost) of a horsepower per hour.
Cost of power .....$(0.00103\ L + 0.00133\ H)WNP_c$
attendance ....$(0.0000145\ L + 0.000075\ H)WN$
supplies .....$(0.0000455\ L + 0.000045\ H)WN$

Burden depending upon use of Carrier:—
$= (0.00103\ L + 0.00133\ H)WNP_c + (0.00006\ L + 0.00012\ H)WN$

$$N.O.C. = \frac{13380(H + L) + 3650\ L + (103\ LP_c + 133\ HP_c + 6L + 12H)N + 107250}{100{,}000\ N}$$

Formula XXIV.

Carriers with pivoted buckets.

Average cost of chain .....0.2520 W(H + L)
buckets .....0.4504 W(H + L)
rails, etc. .....0.0180 WL
sprockets, drive, etc. ..5.5 W
reciprocating feeder ....0.25 W
Total average cost = 0.7024 W(H + L) + 0.018 WL + 5.75 W

Fixed charges:—
Interest.... 6% total cost
Insurance.. 1%
Taxes .... 2%—¾ cost
= 0.05970 W(H + L) + 0.0153 WL + 0.4888 W

Depreciation, renewals, repairs, etc.:—
Depreciation on chains.....0.0315 W(H + L)
buckets .....0.06756 W(H × L)
rails, etc. .....0.002 WL
sprockets, drive, etc.....0.55 W
reciprocating feeder ....0.032 W
Depreciation account—0.0099 W(H + L) × 0.0002 WL + 0.058 W

Total depreciation (summation) = 0.10896 W(H + L) + 0.0022 WL + 0.64 W

Then:—
Yearly burden = 0.16866 W(H + L) + 0.0175 WL + 1.1288 W
N = Number of hours (total) Carrier is in use per year.
P_c = Price (cost) of a horsepower per hour.
Cost of power ... ..$(0.00028\ L + 0.00108\ H)WNP_c + 0.009\ WNP_c$
attendance .$(0.0000145\ L + 0.000075\ H)WN$
supplies, etc..$(0.0000455\ L + 0.000045\ H)WN$
Burden depending upon use of Carrier:—
$= (0.00028\ L + 0.00108\ H)WNP_c + 0.009\ WNP_c + (0.00006L + 0.00012H)WN$

$$N.O.C. = \frac{16866(H + L) + 1750L + (28LP_c + 108HP_c + 6L + 12H)N + 112880 + 900NP}{100{,}000\ N}$$

Formula XXIV-a.

Examples:—

1. Conditions:—
Bucket Carrier—Rigid Buckets—Rectangular Path
Horizontal travel of load (total) .....I.D. = L = 100′ 0″
Load elevated (total) ..... = H = 50′ 0″
Service:—2400 hours per year ..... = N
Cost of power:—$0.02 per horsepower hour = P_c

$$N.O.C. = \frac{2372000 + 1539 \times 2400 + 107250}{100{,}000 \times 2400} = \$0.02572$$ per ton of material handled

2. Conditions:—
Same as Example 1 except that service is for but 1200 hours per year.

$$N.O.C. = \frac{2372000 + 1539 \times 1200 + 107250}{100{,}000 \times 1200} = \$0.03605$$ per ton of material handled

3. Conditions:—
Bucket Carrier—Pivoted Buckets—Rectangular Path
Horizontal travel of load (total) .....ID = L = 100′ 0″
Load elevated (total) ..... = H = 50′ 0″
Service:—2400 hours per year ..... = N
Cost of power:—$0.02 per horsepower hour = P_c

$$N.O.C. = \frac{2704900 + 1364 \times 2400 + 112880 + 43200}{100{,}000 \times 2400} = \$0.02556$$ per ton of material handled

4. Conditions:—
Same as Example 3 except that service is for but 1200 hours per year.

$$N.O.C. = \frac{2704900 + 1364 \times 1200 + 112880 + 43200}{100{,}000 \times 1200} = \$0.03748$$ per ton of material handled

The examples cited are based on conditions frequently found in actual practice, and bring out two interesting and important facts: First, that the hours of service of a bucket carrier installation have considerable effect upon the net operating cost of the system, and second, that the hours of service bear a greater effect upon bucket carriers with pivoted buckets than upon those in which the buckets are rigidly attached to the chains and must therefore scrape the load over horizontal stretches. The first of these facts is because the items depending upon the cost of power are relatively small compared with the other factors entering into the question of net operating cost. The items chargeable to depreciation are by far the most important, and these vary little, whether the carrier is in use continually or only half time, for the wear and tear on a well cared for carrier that is in continual use is little, if any, greater than

the general depreciation that is bound to occur in an equipment allowed to remain idle half the time. The second fact is due the cost of necessary power to operate the system being even relatively smaller in the case of the more refined bucket carrier than in the case of carrier with buckets rigidly attached to the chains, making it even more imperative to use the carrier with pivoted buckets continually if the greatest benefits are to be attained. A comparison of the net operating cost of a bucket carrier with the net operating cost of a combined system of bucket elevator and any other conveyer so far discussed shows that the advantages of the more flexible system is rather a matter of convenience than economy. It costs more to operate a bucket carrier over a given path than it would to operate a combination of bucket elevator for the lifting operation and any conveyer, even one as relatively uneconomical as a flight conveyer, for the horizontal carry of the load. This is due, of course, to the much greater power requirements of the empty bucket carrier than is required for the similar work entailed in running both the elevator and conveyer without load. Nevertheless, bucket carriers do possess the advantage of simplicity and, though somewhat more expensive to operate than more complex systems, are excellent for many installations where the cost of operation is of less importance than convenience. Their greatest disadvantage is that a breakdown means a shutdown unless every possible provision is made to provide other means of handling part of the load while necessary repairs are in progress.

IMPORTANT FACTORS IN THE DESIGN OF SEWERAGE SYSTEMS.

IN the construction of a new sewerage system, or of new sewers, one of the problems which first arises is the question, shall the sewers be built on the combined or on the separate system, or partly on both? The question often cannot be answered without careful study, as consideration has to be given to numerous factors. Two factors of the greatest importance are the questions of cost and of sewage disposal. In a paper presented on October 7th to the convention at Wilmington, Del., of the American Society of Municipal Improvements, Mr. John H. Gregory, consulting engineer and sanitary expert, of the firm of Hering & Gregory, New York City, discusses some phases of the subject, as well as some of the relations which the sewers bear to the problem of sewage disposal, as follows:—

As a general proposition, where both sewage and storm water are to be removed in artificially constructed channels, it is probably safe to say that the cost of building a combined system, in which both the sewage and storm water flow in the same channel, generally spoken of as a combined sewer, is less than that of constructing a separate system, in which the sewage flows in one set of pipes, frequently called sanitary sewers, and the storm water in another set, called storm water drains. This is especially true where the territory to be served is more or less closely built up and the streets are already surfaced or paved.

On the other hand, in suburban territory, not closely built up and not likely to be so built up in the near future, and where the storm water is easily and quickly diverted into natural watercourses, the separate system will in general cost less, for the reason that the sanitary sewers need only be built at first, the construction of the storm water drains being deferred for a period of years, or only such drains built as are immediately required. The cost of building a combined system in such a territory might easily be so great as to be actually prohibitive, whereas, the construction of the sanitary sewers of a separate system, as just outlined, could be carried out and would serve all requirements for a considerable period of time.

Topography an Important Consideration.—With steep grades and relatively high velocities in the sewers, it might prove more advisable, on account of the relatively small additional cost, to build combined rather than separate sewers, although the character of the development of the territory might hardly be such as to require the removal of the storm water by this means.

In narrow streets and in congested districts combined sewers have one advantage in that only one sewer is required, thereby reducing to a minimum the amount of sub-surface obstructions. True, the combined sewer will be slightly larger than the corresponding storm water drain which would be required, but the increase in size of the latter is generally so small as to be of little importance. With the separate system, however, two pipes are required, and sometimes three, when a sanitary sewer is laid on each side of the storm water drain, this condition being forced when the storm water drain has to be built so close to the surface of the street as to prevent the carrying of house connections over it.

Again, with the combined system, but one house connection is needed, whereas with the separate system, especially in closely built-up districts with paved yards and areas, two are required, one for the removal of the sewage and the other for the removal of the storm water from roofs, paved areas and other impervious surfaces. The practice of discharging storm water across the sidewalks to the gutters is not one to be recommended. The storm water is, however, sometimes removed by pipes laid just below the surface of the sidewalk and discharging at the gutter. Such pipes frequently give trouble, and often would not be low enough to drain paved areas adjacent to or in the rear of buildings. Two house connections, of course, cost more than one, but not necessarily twice as much as one.

With a combined sewer laid in the middle of the street, as is generally the case, the cost of the house connections to the abutting property owners on each side of the street is equalized. With a separate system the cost of the house connections may be greater to the property owners on one side of the street than on the other, unless the sanitary sewer and storm water drain are equally distant from the centre of the street. If the connections to the curb or property line are put in at the expense of the municipality the cost to the abutting property owners as a whole is as nearly equalized as possible.

Combined sewers are generally laid on flatter grades than separate sewers and may increase the area which can be served without pumping. They may even eliminate pumping entirely. It sometimes happens that combined sewers can be advantageously adopted for a part of the system and separate sewers for the remainder. The writer has in mind one of the large cities in the east where no pumping is required and in which three-quarters of the city is sewered on the separate system and one-quarter on the combined system. The section of the city sewered on the combined system was too low to be sewered on the separate system without pumping and it was in order to avoid pumping that this section of the city was sewered on the combined system.

Higher velocities are required in combined sewers in order to prevent the deposition of grit. Velocities which would be permissible in sanitary sewers would not give satisfactory results in combined sewers. Deposits would be likely to accumulate, especially if a great variation existed between the minimum rate of dry weather flow and the maximum rate of storm flow. When deposits occur in combined sewers organic matter is likely to be held back and settle out or become stranded. If putrefaction of this organic matter takes place before it is washed away malodorous conditions arise. With a long-continued very low dry weather flow deposits may cause the sewage to be ponded with the result that the sewage may become stale, or possibly septic, a condition which should by all means be avoided, independent of whether the sewage is to be treated or not.

The Disposal of the Sewage.—If the sewage is to be discharged into a body of water without any treatment whatsoever, a condition less and less likely to arise in the future, combined sewers would frequently offer the simplest and cheapest solution of the problem. If, however, the sewage is to be treated, separate sewers have certain advantages. In order to limit somewhat the scope of the paper it will be assumed that the sewage must receive some treatment before final discharge and that the treatment will be at one point. Further, that ample opportunity is afforded for the discharge of storm water without having to carry it any great distance.

Sewage treatment works cost money. It is therefore desirable to keep them as small as possible, and in order to do this the volume of liquid to be handled must be kept at a minimum. Rarely, if ever, would it be the case that all of the storm water would have to be treated; hence in this discussion the question of treating other than the first wash of the streets, in addition to the sewage, will not be considered.

With a separate system the volume to be handled at the treatment works is the total sewage flow in the sanitary sewers. The liquid is made up of house sewage, ground water leakage and trade wastes. The flow may, however, be increased in times of storm by taking in the first wash of the streets from the storm water drains, should it be found necessary or desirable to treat the first wash.

With a combined system, under dry weather conditions, the volume to be handled ordinarily is what is commonly spoken of as the dry weather flow, and is also made up of house sewage, ground water leakage and trade wastes. In times of storm, however, the flow in the combined sewers is increased by the storm water from the streets. The liquid then consists of a mixture of house sewage, ground water leakage, trade wastes and storm water.

The effect of the storm water in combined sewers is two-fold—it not only increases the volume of liquid flowing but it changes its character. The first wash from the streets is often exceedingly foul and may increase the organic content of the liquid flowing in the sewers, giving what may be called a stronger sewage. As more and more storm water enters the sewers the storm water becomes cleaner and cleaner, and with the greatly increased flow in the sewers the organic content of the liquid is decreased, resulting in what may be called a weak or dilute sewage.

The volume of liquid to be handled at the treatment works from a combined system depends on whether only the dry weather flow or the dry weather flow plus some storm water is to be intercepted. If only the dry weather flow is to be intercepted, then the volume to be handled at the treatment works would, in general, be substantially the same from the combined system as from the separate system.

One fundamental difference between the two systems, however, exists. With the separate system no raw sewage escapes to the streams or watercourses, while with the combined system raw sewage must at times be discharged into them. If it is planned to intercept only the dry weather flow, then, during storms, just as soon as the flow in the combined sewers exceeds the maximum rate of dry weather flow the surplus flow, over and above that which can be intercepted, escapes, with the result that a mixture of sewage and storm water must reach the streams.

It is true that the overflow of raw sewage from combined sewers into the streams ordinarily would take place only during periods of storm, but even the occasional discharge of raw unscreened sewage into a stream is a question which must be carefully considered. It might be the case, and probably often would be the case, that as far as the temporary reduction of dissolved oxgyen in the stream is concerned no harm would be done, but floating particles of paper and faecal matter are offensive to the sight. If, however, the stream into which the overflow of sewage would take place is sluggish and with but little velocity it may easily be that the continued overflow of sewage into it, from time to time, with the accumulation of sludge deposits on the bottom, would lead to offensive conditions.

Consideration for the Community.—While considering the question of the overflow of raw sewage from combined sewers one point of view of the public should not be overlooked. In general, the public knows but little of the difference between the separate and the combined system. They know that sewers are needed, that the sewage must be treated before being finally disposed of, and that a disposal works must therefore be built. Their natural inference is then that all of the sewage will be treated at all times. If the separate system is adopted—well and good. But if, instead, the sewers are built on the combined system and the public sees raw sewage, even if dilute, discharged into the streams from time to time will they be satisfied? And again, will the state authorities be satisfied? The question is one, aside from dollars and cents, which should and must receive the most careful consideration.

With a combined system, in order to reduce the number of times during the year that raw sewage would overflow, it might be planned to intercept some storm water as well as the dry weather flow. One direct effect which this would have on the sewage treatment works would be to increase their size, and consequently their cost, over and above that which would be required if the separate system had been adopted.

If it is found desirable or necessary to intercept and treat the first wash from the streets the separate system is more advantageous than the combined system, as by its adoption no overflow of raw sewage to the streams will take place. The storm water drains receive only storm water and the first wash from the streets can be intercepted in the storm water drains and discharged either into the sanitary sewers, or into the intercepting sewer leading to the treatment works. As the flow in the storm water drains increases, the surplus water, over and above that intercepted, overflows to the streams but carries no sewage with it.

The separate system, under certain conditions, offers greater flexibility in the disposal of trade wastes than does the combined system, unless the first wash of the streets is to be intercepted and treated. Some trade wastes are offensive and if discharged into the sewers in such a condition must be treated. On the other hand, some trade wastes are inoffensive and can be discharged direct into the streams without causing any nuisance or trouble.

With the separate system the offensive trade wastes can be discharged into the sanitary sewers and the inoffensive wastes into the storm water drains. The offensive trade wastes only would then be carried to the treatment works. With the combined system all of the trade wastes, the inoffensive as well as the offensive ones, would have to be intercepted and carried to the treatment works, with the result that the treatment works would have to be somewhat larger in size, and hence would cost more than would be the case if the separate system had been adopted.

With a community which is largely residential in character, the volume of trade wastes would affect but very little the total sewage flow. With a manufacturing community, however, the trade waste might amount to quite a large percentage of the total flow and in extreme cases might equal in volume the house sewage. Under such conditions it is evident that, if any considerable percentage of the trade wastes is inoffensive, separate sewers would be of decided advantage, as they would permit of the inoffensive wastes being discharged direct into the storm water drains, the offensive wastes only being discharged into the sanitary sewers and by them carried to the treatment works.

With a combined system automatic regulators are generally used on the connections between the combined sewers and the intercepting sewer to limit the amount of flow from the combined sewers to the intercepting sewer. With a separate system automatic regulators are not required unless the first wash from the streets is intercepted in the storm water drains. Automatic devices in sewers, as a general proposition, no matter how well designed, are to be avoided wherever possible.

The Removal of Grit.—The presence of grit at a sewage disposal works is generally more or less of an annoyance, especially when the sewage has to be pumped and passed through settling tanks. With combined sewers, receiving as they do storm water from the streets, a considerable amount of grit must be expected to reach the disposal works, not only during wet weather but during dry weather also. With separate sewers the amount of grit received at the disposal works is relatively small unless the first wash from the streets is intercepted in the storm water drains and carried to the disposal works.

It has been suggested that a considerable amount of grit could be prevented from reaching the disposal works from combined sewers by inserting a catch basin or sand catcher on each connection between the combined sewers and the intercepting sewer. It is probably true that such would be the case, but it is a question whether this would be a good method of removing grit. In the first place these sand catchers would sooner or later fill up, and unless cleaned at proper intervals would fail to serve the purpose for which they were built. Again, it is very probable that more or less organic matter would be deposited in them, especially when only the dry weather flow, consisting as it would mainly of sewage, was passing through them. The retention of organic matter would lead to offensive conditions as soon as putrefaction began.

The inserting of sand catchers between storm water drains and an intercepting sewer would seem to be a more practicable proposition as the possibility of retaining offensive matter from sewage would then be eliminated. The sand catchers would still, however, have to be cleaned in order to make them effective.

With combined sewers or with separate sewers in which the first wash from the streets is intercepted in the storm water drains grit must be expected. Such being the case, it is a question if the simplest way of handling the grit is not to admit it into the intercepting sewer from the combined sewers or storm water drains, without attempting to intercept any portion of it, and then to transport it with a good velocity in the intercepting sewer direct to the sewage disposal works. Even with sand catchers on the connections between the combined sewers or storm water drains and the intercepting sewer enough grit is sure to reach the sewage disposal works to require its removal before the sewage is pumped or passed through settling tanks. The removal of grit at one point instead of at numerous points has many advantages.

The common practice of removing grit at a sewage disposal works is to pass the sewage at a slow velocity, roughly about one foot per second, through a grit chamber, the grit settling out and being retained on the bottom of the chamber. In large works mechanical means are provided for removing the grit from the grit chamber, but in smaller works it is common practice to drain out the liquid from the grit chamber and to then shovel the grit out by hand.

With a separate system, in which the first wash from the streets is not intercepted from the storm water drains, a question arises as to the necessity of providing a grit chamber at the sewage disposal works. Practice varies. At some disposal works grit chambers have been provided and at others not. If the sanitary sewers are properly designed and built and are provided with tight covers but very little grit should get into the systems, but with macadam or dirt streets and perforated covers some grit must be expected. The safest plan, under ordinary conditions, seems to be to provide a grit chamber, even if it be a small one. The grit would require removal only at more or less infrequent intervals.

Perhaps the question may arise as to the necessity of removing the grit. It would, of course, be perfectly possible to pump the grit along with the sewage, but this would cause unnecessary wear and tear on the pumps. Again, if the grit is not removed before reaching the suction well, it may easily settle in and clog up the suction well causing thereby a shut-down until the well is cleaned out.

If the grit is admitted to the settling tanks it may cause trouble there. It depends, of course, on what type of tank is used and on the method of operation. If the tank is an Imhoff tank the grit, by settling down into the sludge digestion chamber, may check or prevent the proper digestion of the sludge and consequently affect the satisfactory operation of the tank. The admission of grit to a septic tank may also interfere with its satisfactory operation. If admitted to a plain settling tank, which is cleaned out at frequent intervals, the main trouble to be expected would be in the cleaning out of the tank.

With sewage from a combined system the volume of sludge accumulating in settling tanks is greater than with sewage from the separate system. It may even be nearly

(Continued on page 680.)

THE PROTECTION AND UPKEEP OF ROAD EQUIPMENT.*

By Daniel J. Hauer,
Construction Economist and Consulting Engineer.

NO matter whether roads are built by contractors or by day labor forces under the direction of engineers, the item of plant and equipment is one of the prominent factors of cost. Inadequate plant means to materially increase the cost of construction. Only recently the writer stood watching some road building upon which only a few tools were being used, and most of them were ill-adapted to the work. It was difficult to accurately calculate the exact amount of money that was wasted, due to a lack of road equipment, but it was easily estimated that the cost of construction was increased at least twenty-five per cent. Likewise, too much plant can make an added cost. Even with the proper plant, and handled in an efficient manner, the plant item in road construction is a larger per cent. of the total cost of the work than in most other classes of construction. This is due to two causes. First, the plant necessary to build a wagon road is much more expensive than that to build, to illustrate we will say, a railroad. With light grading on both, the same equipment will be needed to do the excavation. For the railroad a small concrete mixer may be needed, and some track-laying tools to complete the job. On the other hand, for the wagon road there will be much hauling of road materials, thus wagons and a traction engine will be needed, then road scrapers or graders, and spreading machines, water sprinklers, oil sprinklers, and heating apparatus will be necessary; scarifiers, harrows and rollers must be used, while for concrete culverts and bridges, mixers, derricks, buckets, barrows, and other appliances are called for to do the job in an efficient manner. The writer has constructed a section of a railroad costing about $100,000, with a plant costing only about $5,000, while a contract for less than $50,000 of wagon road work took an outfit costing nearly $20,000; forty per cent. of the total cost instead of five.

The second reason for the larger cost of plant for wagon road construction is that this class of work is let out in small scattered contracts that are uneconomical from a constructive standpoint. The season, too, for road building in nearly every section of the country is short.

Naturally the life of any machine is dependent upon the use and care given it. The longer the life, the less the annual depreciation, consequently some of the high plant cost can be eliminated from road construction by the proper care and upkeep of the equipment, and by selecting the most improved and economical types.

As far as possible the same machines should be used for many different purposes. This can be done in two ways: By trying out machines designed for one particular kind of work for other kinds, and by adding attachments to machines that thus adapt them to three or four different things.

To illustrate, a contractor once found by experimenting that a certain kind of road grader would spread crushed stone for macadam at a very much less cost than it could be done by any other known method, at that time. Then a road roller that can be used as a traction engine, with a scarifier attachment, and likewise for operating a stone crusher, or other machines, can be said to be four tools in one; not that it is possible to use it for more than one purpose at a time but in the present method of building roads a roller is only used a small portion of the time, so it is economical to adapt it to as many uses as possible. In this manner the cost of plant, or rather the investment in plant, can be maintained at the minimum.

In like manner, wagons, which are an important factor in road building, should be of the most improved type, and adapted as far as possible to all kinds of hauling. So, too, with concrete mixers. Some contracts demand a hot mixer as well as one for mixing ordinary concrete. Money is saved when one mixer will answer for both purposes.

Another item in the cost of plant is in the character of the plant purchased. Cheap and poorly made plant means money lost to the contractor in several ways. Delays occur through breakdowns and these are always expensive. Cheaply made tools mean continual repairs and a short life, and are an added expense to any job. Only well made tools should be used. A guarantee as to the construction of a machine can and does mean little. It does not mean payment for delays caused by breakdowns nor for poor work being done. The ability of a manufacturer for swearing his product is a good one is not a help to a contractor or engineer in getting his work done, nor in showing that the machine in question is well built. The greatest asset is in buying from a firm of recognized responsibility, one of integrity, and one that is so well advertised that they must stand behind their products by putting into them only the best of materials and workmanship. This is the best guarantee possible. This means work done at a low cost. A firm with such a reputation means that thousands of dollars have been spent by them and their customers in obtaining these results. The new customer profits from these past expenditures.

These are all possible factors in plant and equipment, upkeep and maintenance cost. The problem that the contractor and construction engineer must solve in this connection is a very difficult one, owing to the many adverse conditions.

Road work is done in comparatively short stretches, usually in a single season, which varies in length from about one hundred to one hundred and eighty days, according to the climatic conditions. A contractor's plant is moved on to a job, and is used along the line of the work, part or all of the time during the season. Much of a contractor's plant is made up of transportation machinery, and even other items of plant are only working in one place for a few days at a time, so that to protect plant while at work on such jobs is very difficult, and in many cases any kind of a protection is a detriment, and a great hindrance to the free movement of the men and teams.

All machinery should be protected when it is not being used, and some when in use. Boilers at work, use much more fuel when not protected. Some kind of a house, built in sections should always be used to protect boilers. Such sheds can have one side left out, and a canvas curtain used when necessary. If the sides and tops are built in sections they can be hooked together with hooks and rods and staples so as to be rigid enough to stand up against the wind and weather.

*Read at American Road Congress, held at Detroit, Mich., Sept. 29 to Oct. 4, 1913.

Machinery that cannot be protected while at work, can be covered with canvas coverings over night, during rainy spells and at such times when they are not in use. Every traction engine and roller should be thus protected. Steam drills and such tools can be covered with a canvas jacket. The machinery part of a concrete mixer can be so protected, and also pumps and other equipment. Heavy water-proofed canvas will be found to be excellent for this purpose, and not only keep the machinery clean from dust and mud, but will likewise prolong the life of the equipment. As the canvas becomes worn from use, it must be re-treated with water-proofing liquids to preserve it.

At the end of the season, with the job finished, the question always arises, "What shall be done with the plant?" To move it from its present place to some central storage point, will mean an added expense to get it on to a new job. If the work on the same road is to be continued the next season the entire outfit may have to be moved back. The plant can be moved to the next job at the minimum cost from the site upon which it last worked. Then the question comes as to how repairs should be made, and the protection to be given the plant from the winter weather.

Situated away from the machine shops, the proper overhauling cannot be given to all the plant, but it will be possible to replace many of the worn and broken parts with new ones, tighten up all loose keys and nuts, true up all bearings, and do all repairing that can be done in the open. Then all iron and wood work can be painted. This is a protection not only against the weather, prolonging the life of the plant, but is also a business proposition that pays well, as every one is impressed with machinery that looks well, and paint covers a multitude of defects.

In some localities it is possible to obtain an empty warehouse or barn in which the various machines can be stored while they are idle, or during the winter season. This keeps them entirely out of the weather, and also allows of repairs being made under cover, which means not only quicker, but also cheaper work.

For winter storage it is also possible to group a number of machines together, and build over and around them a temporary shelter made of cheap boards and single ply tar paper, which will last during a winter season. By using the tar paper, the boards can be spread six inches or more apart, both on the sides and roof. Around this temporary shed a ditch should be dug so as to prevent surface water from getting to the machines.

If it is not possible to protect the machines by any of these methods, then the canvas coverings can be resorted to, with fairly good results. These covers should, as far as possible, be shaped to the machine upon which they are to be used. Good and substantial brass eyelets should be fastened in the well bound edges, so that the coverings can be tied tightly to or under the machines, otherwise the wind will flap them loose, soon beating the covering into shreds, as a flag is worn out by the wind, and thus exposing the machine to the weather. Canvas coverings made to fit any machine will always be found useful in protecting machines over night or when not in use for a few days.

Whenever machines are not stored for the winter in buildings, they should be stripped of their brass and glass parts, otherwise these fixtures will be broken or stolen, which means a serious loss. The parts from each machine should be placed in a separate box, nailed up and properly labeled, the box being stored away for safe keeping. If the machines are stored in a building, it is not necessary to take off parts, as if any one breaks into the building they must go to the trouble of taking off the brass, while if the parts are stored in boxes, the rascals take box and all, giving them much less trouble, and thus assisting them in making a clean sweep of all the brass fixtures.

When a new machine is purchased, there should always be bought at the same time a number of spare parts, which should be kept on hand to be used as needed. No man can build a machine that will not break down in some vital part sooner or later. A breakdown in a construction job means not only a delay, but a waste of money, for even if men can be laid off and not paid, or can be given other work, yet the job, due to the changes made necessary by the breakdown, will not be worked in the most economical manner. It is true that many contractors do keep some spare parts, but they seldom have on hand enough, or the proper ones, due to the fact that as the parts are used to replace broken ones, new ones are not ordered from the factory. Then either one of two things occurs: the job is shut down or some part of it, or the machine is worked with the broken part until a new one can be ordered and put in place. This means that the machine is racked by the work it does, doing permanent injury to it.

A good blacksmith shop on the job, equipped with forge for heating heavy steel and with stocks and dies for bolts and pipe, and with good drills and vises, will be found to be a great assistance in the upkeep of road equipment. For heavy machines a few roller bearing or small hydraulic jacks will be found useful in making repairs and renewals.

Small tools can be repaired promptly in a blacksmith shop. Attention should be given to these as well as to the larger machines. To prevent such tools being lost, they should not only be branded with a die of the contractor's name or initials, but they should likewise be painted with a set of colors, selected by the contractor, to designate his equipment and advertise his business. These colors can be used on the head of some tools, and in most cases on the handles. Tools can thus be seen at some distance, and thus prevent their being stolen or lost. All bright parts of tools and machines that can't be painted should be well greased so as to prevent rusting.

Many of these suggestions seem useless, or more or less self evident, but any one who has much to do with road construction knows that tools and machines are scattered along the entire line of a piece of new road construction, just where they were last used, and there they stay, neglected, until they are needed again. Then they are found out of order, and to repair them, frequently new parts must be ordered, some days intervening before such parts arrive. The tool or machine depreciates greatly in value by such treatment, and thus contractors are compelled to figure a heavy plant expense item against every job. The cost of caring for this equipment is much less than the depreciation figured against it from neglect.

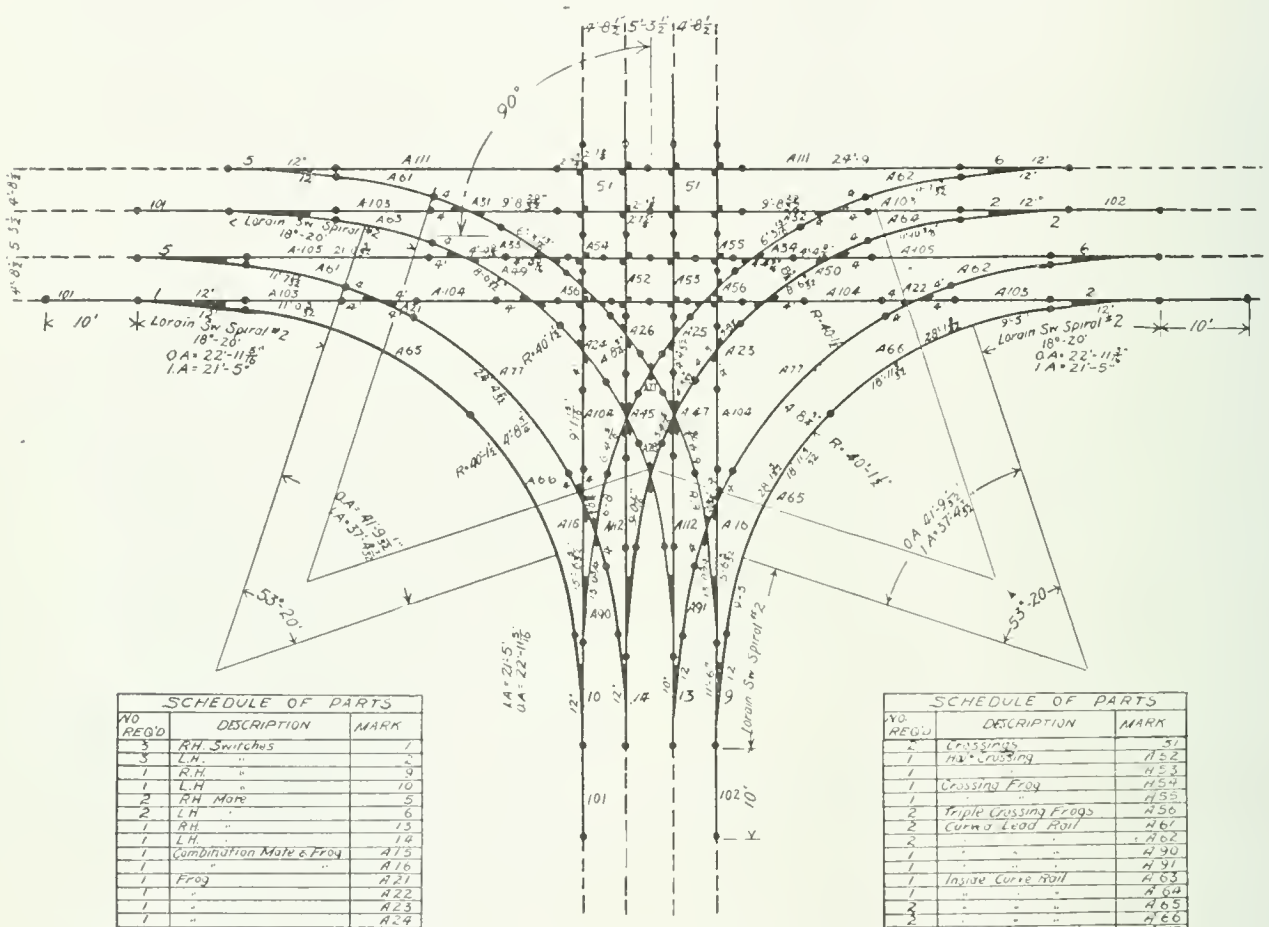
Such extra costs mean higher prices for road work, and as there are many thousand miles of roads that need improving, every dollar wasted means less mileage built each year. Both engineers and contractors are interested in obtaining good roads, and they should do everything possible to save money in the construction of roads.

STANDARDIZATION OF STREET RAILWAY SPECIAL WORK.

IN line with the policy of standardizing as much of the material used by it as possible, the Metropolitan Street Railway Company, of Kansas City, Mo., has adopted a set of standards for special work which are very complete. The standards have been tried out for a year or more, and the results so far obtained are very satisfactory. They were worked out under the direction of Mr. A. E. Harvey, chief engineer, who describes them in an article in "Electric Traction," and includes details of rail curvature sections, lengths, etc., in connection with them. The following information is extracted from it, to show how standardization methods are applied in cases where layouts are renewed or new work put in, it being exceedingly desirable that the work be of such character as to be interchangeable and renewable, piece by piece, from stock.

In the establishing of something that could be standard the following points were included in Mr. Harvey's problem as it had to be solved: rail section, radii of curves, length of pieces, material, design, and various minor details in regard to the assembling of the work which present themselves as the larger details are developed.

Rail Section.—In the selection of the section of rail to be used in the special work, consideration had to be given to the fact that a very considerable percentage of the tracks in the paved streets of Kansas City were laid with 100-lb. A. S. C. E. section. This rail has proved exceedingly satisfactory; there was no reason why the section should be changed, and it was desirable that the special work should be constructed so that it would fish with this section without the use of compromise joints. Various problems presented themselves in the detailing of this special work, particularly the question of guarding, but with this problem solved, it was decided that this was the most desirable section for use in the construction of the work.



SCHEDULE OF PARTS

NO REQ'D	DESCRIPTION	MARK
3	RH. Switches	1
3	L.H. "	2
1	R.H. "	9
1	L.H "	10
2	RH. Mate	5
2	LH "	6
1	RH. "	13
1	L.H. "	14
1	Combination Mate & Frog	A15
1	" "	A16
1	Frog	A21
1	"	A22
1	"	A23
1	"	A24
1	"	A25
1	"	A26
1	"	A27
1	"	A28
1	"	A31
1	"	A32
1	"	A34
1	"	A35
1	Double Frog	A44
1	" "	A50
1	Triple "	A45
1		A47

SCHEDULE OF PARTS

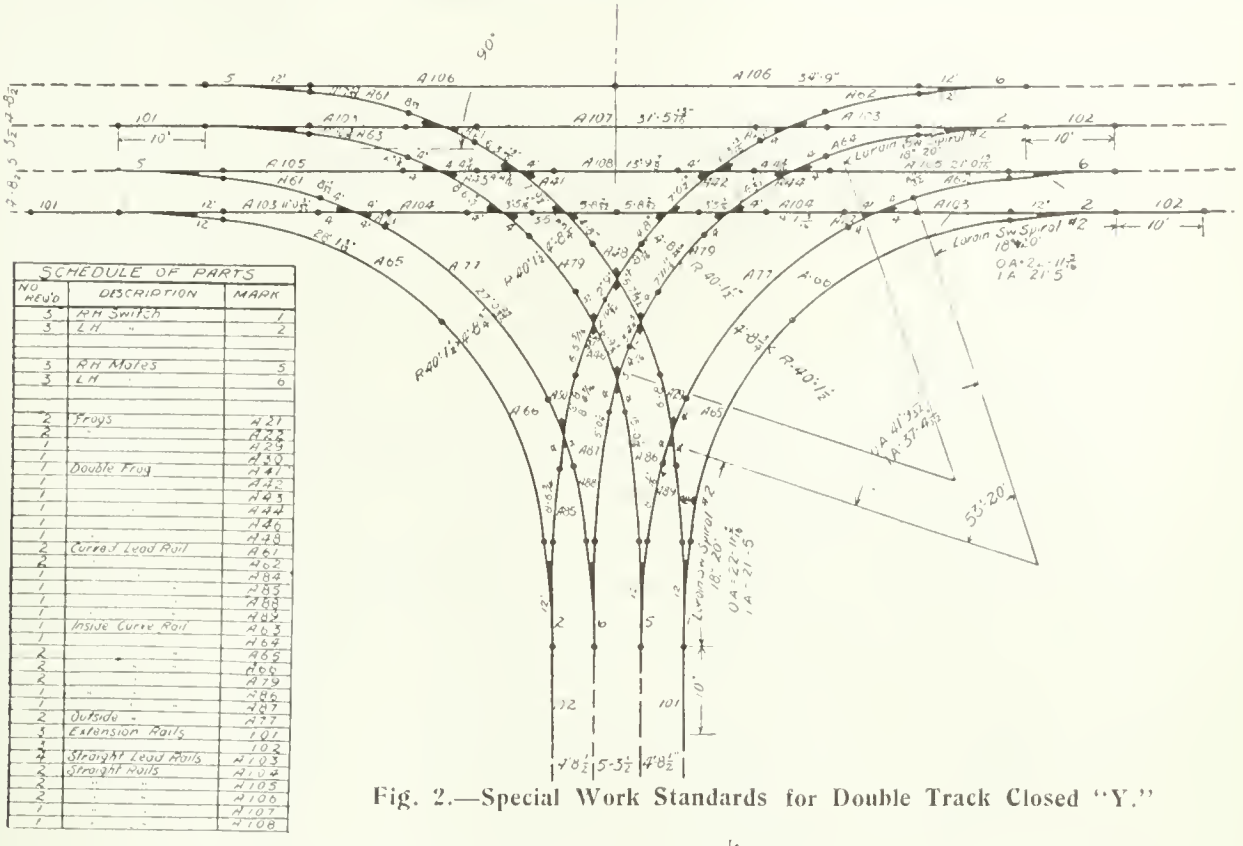
NO REQ'D	DESCRIPTION	MARK
2	Crossings	51
1	Half Crossing	A52
1	" "	A53
1	Crossing Frog	A54
1	" "	A55
2	Triple Crossing Frogs	A56
2	Curved Lead Rail	A61
2	" " "	A62
1	" " "	A90
1	" " "	A91
1	Inside Curve Rail	A63
1	" " "	A64
2	" " "	A65
2	" " "	A66
2	Outside Curve Rail	A77
3	Extension Rail	101
3	" "	102
4	Straight Lead Rails	A103
2	" " "	A112
4	" Rails	A104
2	" "	A105
2	" "	A111

Fig. 1.—Special Work Standards for Double Track Closed "Y" and Crossing.

Radii of Curves.—The radii of the curves selected for the standard work is controlled to a certain extent by the width of streets in Kansas City. Some of these are of such width that it was impracticable to use a curve of less radius than 42.5 ft. This, therefore, was adopted as the minimum. There are few places where a larger radius than 65 ft. can be used. These two radii, with one intermediate standard of 50 ft., were adopted as standard, and the special work designed upon this basis. These curves were all used in connection with Lorain spirals No. 2. Using these radii as a basis, the various combinations that might be used in any layout on an angle

of 90 degrees are detailed in the manner shown in the accompanying figures. These combinations were all laid out on an angle of 90 degrees, which could in almost

Material.—Recognizing the fact that in some locations one kind of material might be required and in others a cheaper grade, the question of standard material



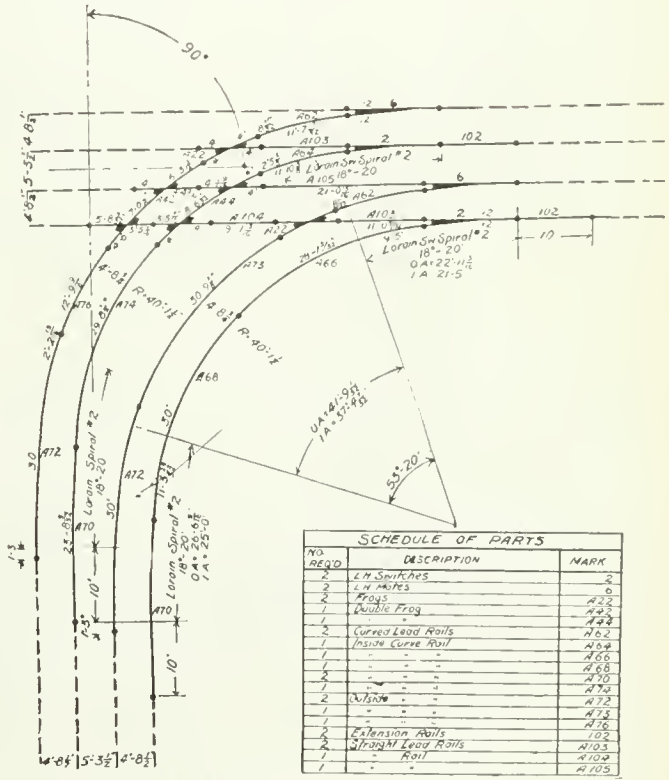
SCHEDULE OF PARTS

NO REQ'D	DESCRIPTION	MARK
3	RH Switch	1
3	LH "	2
3	RH Mates	5
3	LH "	6
2	Frogs	N 21
2	"	N 22
1	"	N 23
1	"	N 40
1	Double Frog	N 41
1	"	N 42
1	"	N 43
1	"	N 44
1	"	N 46
1	"	N 48
2	Curved Lead Rail	A 61
2	" " "	A 62
1	" " "	N 84
1	" " "	N 85
1	" " "	A 86
1	" " "	N 87
1	Inside Curve Rail	A 63
1	" " "	A 64
2	" " "	A 65
2	" " "	A 66
2	" " "	A 79
1	" " "	N 80
1	" " "	N 81
2	Outside "	A 77
3	Extension Rails	101
3	" "	102
4	Straight Lead Rails	N 103
2	Straight Rails	A 104
2	" "	N 105
2	" "	A 106
1	" "	N 107
1	" "	N 108

Fig. 2.—Special Work Standards for Double Track Closed "Y."

every case be used in Kansas City, particularly where a few minutes can be thrown in the angle of the next block.

Length of Pieces.—It will be noted that the pieces are detailed so far as length is concerned, making a minimum number of joints, and establishing the length of each arm so that standard pieces are interchangeable. Under this design a minimum number of standard pieces is secured, as there are quite a number of pieces that are common to both a single track turnout and all the more complicated combinations; that is, the switch frogs and diamonds are the same in the plain turnout crossing the second track as would be found in a double track closed wye. The number of different kinds of switches is reduced to two, a right and a left, except that in some of the more complicated layouts there is a slight variation in the arm lengths for switches and mates, and in layouts which are designed for clearance, and which are used where it is practicable to obtain such clearance, a 150-ft. radius is used instead of 100 ft. The advantages of these standards and the interchangeability of these switches are manifest. In future years the cost of renewals would be very much reduced, and repairs and renewals could be made from stock without carrying a stock of any great amount. The advantage derived from it at present is that the work, as required, may proceed by taking stock pieces and assembling them in any combination required, and where material which might be ordered for one location, upon which the work for any reason might be delayed, may be used elsewhere and not stored indefinitely. All of this would tend to decrease the size stock that it is necessary to carry in our store yard.



SCHEDULE OF PARTS

NO REQ'D	DESCRIPTION	MARK
2	LH Switches	2
2	LH Mates	6
2	Frogs	A 22
1	Double Frog	N 42
1	"	N 44
2	Curved Lead Rails	N 62
1	Inside Curve Rail	N 84
1	" " "	A 86
1	" " "	N 87
2	" " "	A 68
2	" " "	A 70
1	" " "	A 74
2	Outside "	A 73
1	" " "	A 75
1	" " "	A 76
2	Extension Rails	102
2	Straight Lead Rails	N 103
1	" Rail	A 104
1	" "	N 105

Fig. 3.—Special Work Standards for Left Hand Double Track Branch-off.

has been left open, and the detail of the design only carried to a point where it would not forbid the use of pieces made from either solid manganese, cast bound work, built-up work or cast steel.

Design.—In the detail of the design of this work the most serious obstacle met was that of guarding the T-rail section. Various devices were tried out with more or less success, but it was finally settled that the guard

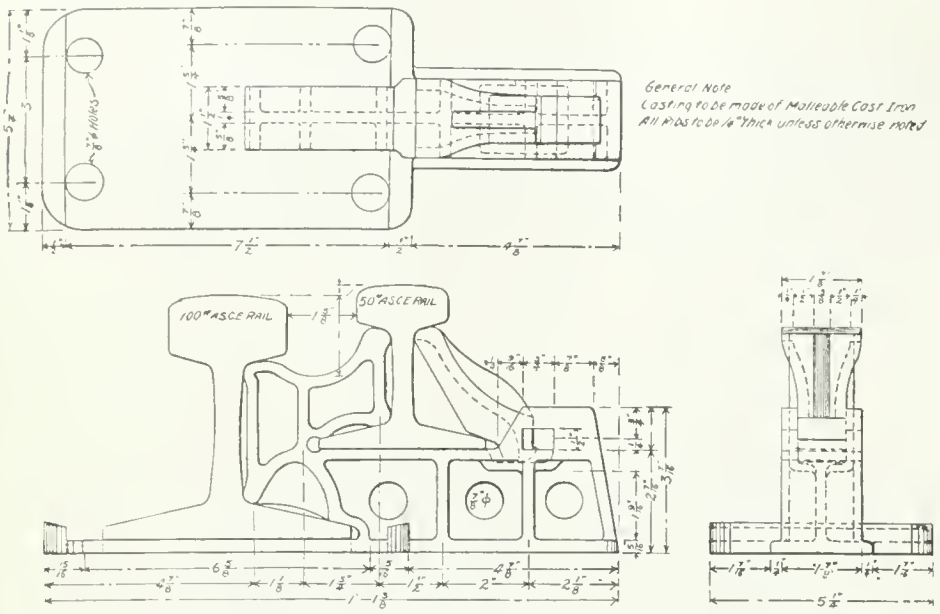

General Note
Casting to be made of Malleable Cast Iron
All Ribs to be 1/8" thick unless otherwise noted
100# A.S.C.E. RAIL
50# A.S.C.E. RAIL

Fig. 4.—Guard Rail Support for 50-lb. T-rail Guarding 100-lb. T-rail.

best adapted to this section was the 50-lb. T-rail. A section of this in its relation to the main rail is shown in Fig. 4, which also illustrates the standard chair adopted for the securing of this rail, or rather chair in combination with tie plate. This, with the omission of the plate and a slightly different arrangement for attaching it to the tie is adaptable to the use of steel ties.

This chair consists of a malleable casting in combination with the plate, together with a brace and wedge. The strain of the guard rail from the main line is taken eventually through the plate under the base of the rail and against the screw spike on the outside of the rail. A number of advantages are secured in this device:

1. Both the main rail and guard rail are standard sections that are rolled by almost any mill, and can always be secured at standard prices and for less money than specially rolled sections.

2. The guard rail is secured to the main rail without the use of bolts and without the necessity of drilling through the main rail, a distinct advantage in construction as well as in renewals.

3. The strain that comes upon the guard rail is transmitted directly from the head through the casting instead of being transmitted through the web of the rail, and at a point where considerable leverage would be secured against the bolt as it is ordinarily applied.

4. The guard is renewable without any interference whatsoever with the running rail. The paving does not have to be removed from the outside of the main rail at all, and on the inside only to the base of the 50-lb. rail, which can be loosened up and a new rail slipped in place, or the old rail adjusted for wear, and moved in closer to the main rail, either by a light grinding of the bearing points on which the guard rests, or by removal of shims, which

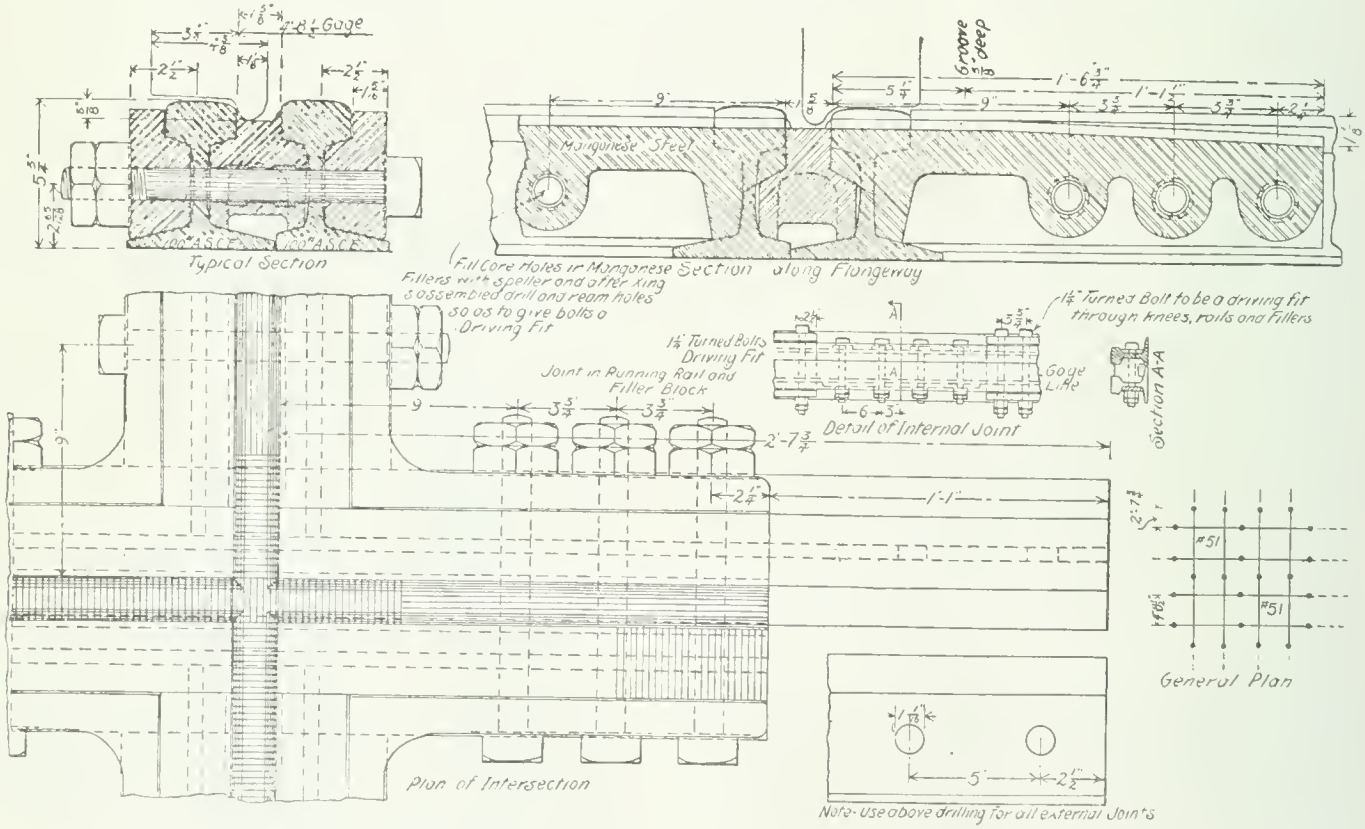

Typical Section
Manganese Steel
Fill Core Holes in Manganese Section along Flangeway
Fillers with spieller and after xing assembled drill and ream holes so as to give bolts a Driving Fit
1¼" Turned Bolts Driving Fit
1¼" Turned Bolt to be a driving fit through knees, rails and Fillers
Joint in Running Rail and Filler Block
Detail of Internal Joint
Section A-A
Gage Line
Plan of Intersection
General Plan
Note- Use above drilling for all external Joints

Fig. 5.—Details of Standard Double Track Crossing With 100-lb. A.S.C.E. Rail and Solid Manganese Filler.

may be put in originally in order to provide for such wear. The design has been used in a modified form by the Metropolitan Street Railway Company for some time, and is proving exceedingly satisfactory.

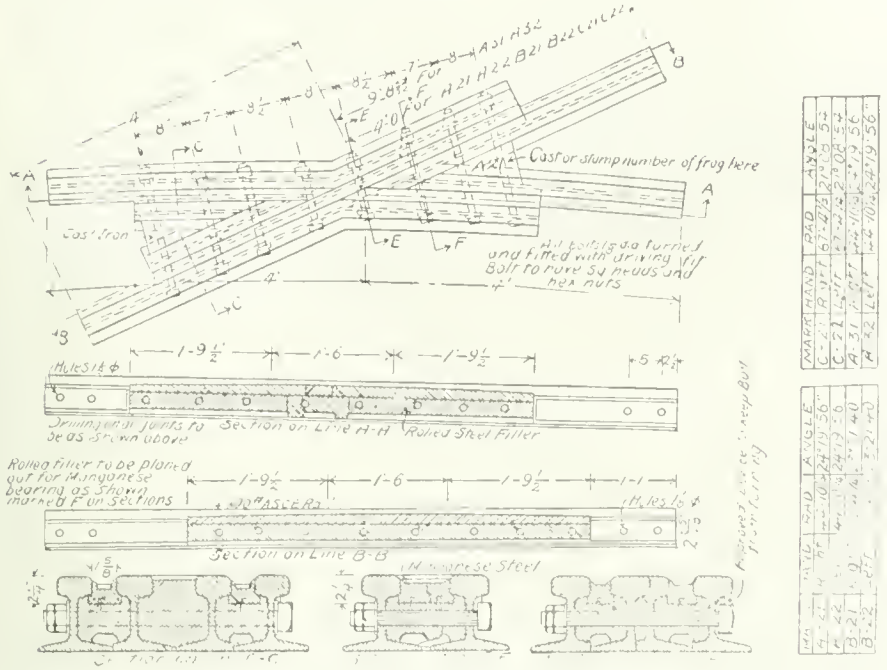

Cast or stump number of frog here
Cast Iron
Rolled Steel Filler
Rolled filler to be planed out for Manganese bearing as shown marked F on Sections
Section on Line B-B
Manganese Steel

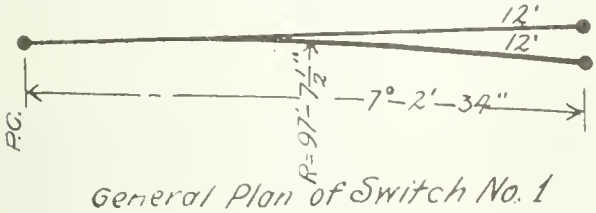
Fig. 6.—Standard Built-up Frog With Manganese Filler.

The connection of this guard to the pieces is one detail of the design that had to be solved. It was undesirable to put a joint in this guard rail connecting up to a piece of the guard cast in the cast-bound work, or guard would connect up closely with the manganese plate in cases of cast-bound work; and in cases of solid manganese work a small pocket at the end connecting with the manganese guard, and in cases of built-up work to attach it securely to the built section by means of the standard chair. In designing these standard pieces it was the object so far as possible to specify only those points which were necessary to obtain the results at which we aimed, and not specify those things that would interfere with the manufacturer's design or shop practice.

The most important feature in the design of street railway frogs is the detail of the flangeway, particularly where the flange bearing is desired. The writer believes that this matter has not been properly understood, nor the best results obtained in the past in flange-bearing work, and the work which we are now specifying is designed to overcome the objectionable features that exist in flange-bearing work as it is generally put upon the market.

A flange bearing as it has been understood in the past, and as it has been designed, has aimed at having just at the intersection a floor upon which the flange would rest while passing over the intersection. In theory this is perfect. In practice it has led to a great deal of trouble.

It is impossible to get a flangeway that is just the depth of the flange. It is either itself worn too deep, it may be constructed too shallow, treads wear and wheel



MARK	HAND
1	Right
2	Left

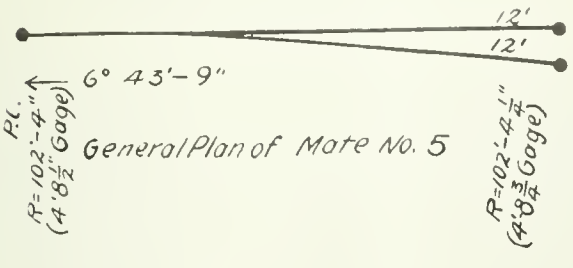
Note:- Switch No. 2 same as switch No. 1 except of opposite hand

RAIL	ROWS OF HOLES	DIST. FROM BASE TO CTR	SPACING FROM RAIL END
9" Girder & Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64"	3½"x5"x5"
7" Gird & Tril	Single Row	2 13/16"	2½"x4"x4"
100 # A.S.C.E.	"	2 65/128"	2½"x5"
	"		

NOTE - All joint holes 1⅛" ϕ

Fig. 7.

otherwise attach it to a piece of other design. Any joint of that kind is necessarily unsatisfactory, and moreover, the part of the guard that was not removable from one of the pieces would wear, and could not be renewed or flanges become long so that the percentage of wheels that will take the flange bearing and pass the intersection without a blow is exceedingly small, and where the flangeway is made shallow enough so as to take care of this



MARK	HAND
5	Right
6	Left

NOTE:- Mate No. 6 same as mate No. 5 except of opposite hand.

RAIL	ROWS OF HOLES	DIST. FROM BASE TO CTR	SPACING FROM RAIL END
9" Girder & Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64"	3½"x5"x5"
7" Gird & Tril.	Single Row	2 13/16"	2½"x4"x4"
100 A.S.C.E.	...	2 65/128"	2½"x5"

NOTE: All joint holes 1⅛" ϕ

Fig. 8.

adjusted as could the balance of the guard around the curve. The problem was solved by making a pocket in each of the pieces and the T-rail guard was inserted and spelt ered in this pocket, running in so that the detachable the wheels, particularly worn wheels, will strike the metal in the bottom of the flangeway a blow that endangers the flange, chipping it. The effect is very much the same as the placing of a block of steel in the flange-

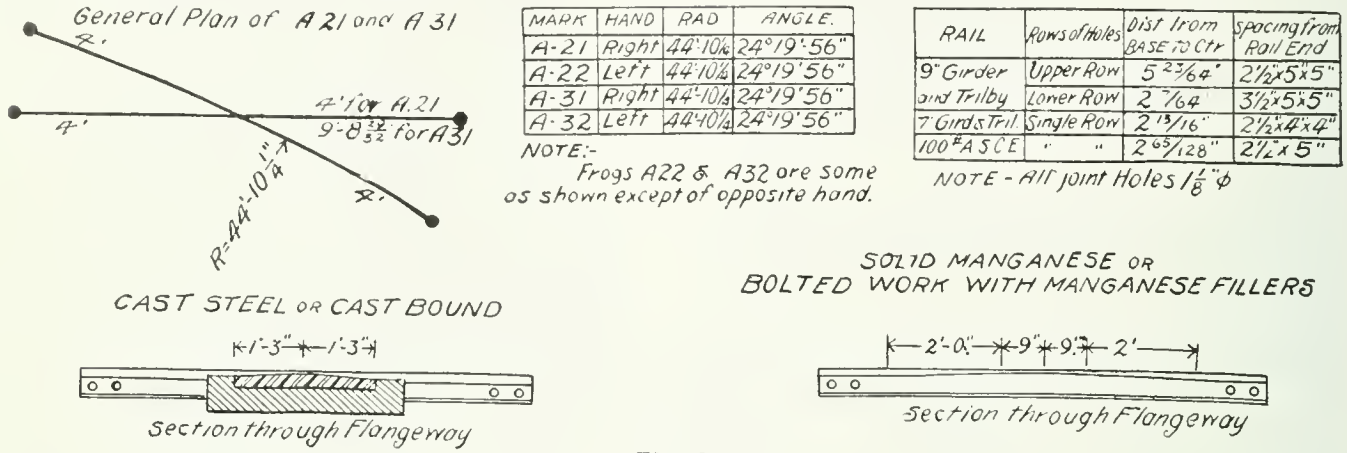
way for the wheel to run over. It results in a jolt and a blow that is detrimental to the wheel, to the car and to the special work, making a noisy and hard riding crossing.

The theory upon which we have proceeded with this work is that the wheel should be picked up on this flange with as light an angle of impact as possible at a considerable distance from the intersection, and ride upon its flange entirely across the intersection and be let down again upon its tread. Every time this proposition is presented some one will say: "What does this do to your wheel flanges?" What is the other doing to the special work and the paving? The taking of a wheel with a light angle of impact and riding it upon its flanges is easier on the track, paving, the wheel and the car, on the nerves of the public, and on adjoining buildings. It is not only upon this theory that the design of the flangeway and special work is based, but from actual experience with these flangeways, it has been found that all that has been said in regard to this matter is confirmed by results obtained in practice.

Other details of the special work pieces are rather immaterial so long as the design and profile of the flangeway are carried out, and this flangeway may be built in any type of work. In cast-bound work it can be obtained if the plate is made large enough, and some work has been furnished in this way, but the manufacturers have overlooked in some cases the object at which we were aiming, and apparently construed the specifications that more manganese was desired, which was not necessarily the case. It is not the amount of the manganese that governs the situation, but the profile of the flangeway. This flangeway is readily made in built-up work where the manganese cross is used as a base upon which may be bolted wings of rolled rail. It is giving good results in our built-up bolted work where the manganese strip, or the manganese filler, is used between the rails. Of course, this profile is readily made in solid manganese, and in that case has the advantage of keeping the treads away from the weaker points at the intersection and prevents chipping.

The writer believes that this question of the profile of flangeways has had a great deal to do in the past with certain difficulties that have been charged to solid manganese work, i.e., where the defect that has appeared in solid manganese, particularly in square crossings, has been due to the blows of the treads of the wheels upon the points, and that this trouble would never appear should flangeways be constructed as described above.

Among other designs, attention is called to our 100-lb. crossing with a flange bearing from end to end for both tracks shown in Fig. 5. This design, it will be noticed, has in it comparatively little manganese and consists of 100-lb. rail bolted to the manganese filler. We have had several of these crossings in service for over a year, and the results that are being obtained from them are exceedingly satisfactory. They are easier on the cars, easier riding and easy to maintain. We have



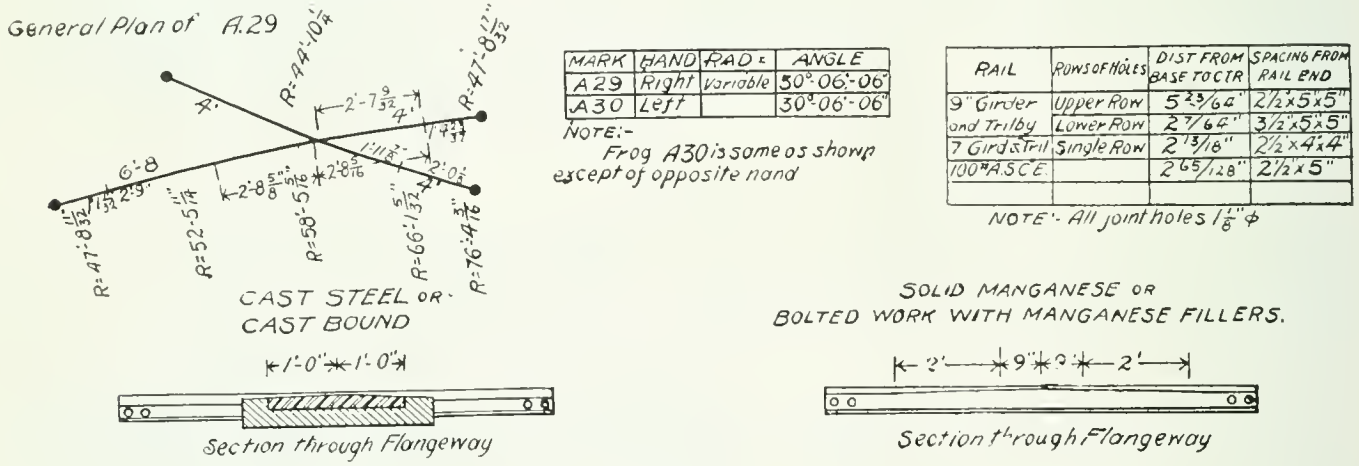
MARK	HAND	RAD	ANGLE
A-21	Right	44'-10¼	24°19'-56"
A-22	Left	44'-10¼	24°19'56"
A-31	Right	44'-10¼	24°19'56"
A-32	Left	44'-10¼	24°19'56"

NOTE:- Frogs A22 & A32 are same as shown except of opposite hand.

RAIL	ROWS OF HOLES	DIST FROM BASE TO CTR	SPACING FROM RAIL END
9" Girder and Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64	3½"x5½"x5"
7" Gird & Tril.	Single Row	2 13/16"	2½"x4"x4"
100# A.S.C.E.	" "	2 65/128"	2½"x5"

NOTE - All joint Holes 1⅛" ϕ

Fig. 9.



MARK	HAND	RAD ε	ANGLE
A29	Right	Variable	30°-06'-06"
A30	Left		30°-06'-06"

NOTE:- Frog A30 is same as shown except of opposite hand

RAIL	ROWS OF HOLES	DIST FROM BASE TO CTR	SPACING FROM RAIL END
9" Girder and Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64"	3½"x5½"x5"
7 Gird & Tril	Single Row	2 13/16"	2½"x4"x4"
100# A.S.C.E.		2 65/128"	2½"x5"

NOTE:- All joint holes 1⅛" ϕ

Fig. 10.

adopted them as our standard crossing in all work. It may be a little difficult to build in complicated layouts where curves intersect the crossings. In such cases these complicated parts are built in solid manganese.

In the design of switches nothing is specified outside of the outside dimensions of these switches and the section of the rail.

Solid manganese work built with the flange bearings as specified by us is a most satisfactory design, and where constructed in accordance with standards so that pattern charges are not repeated from time to time, its cost will be so reduced and its advantages over other types of work such that it is an ideal special work. It has a distinct advantage over the cast-bound work in

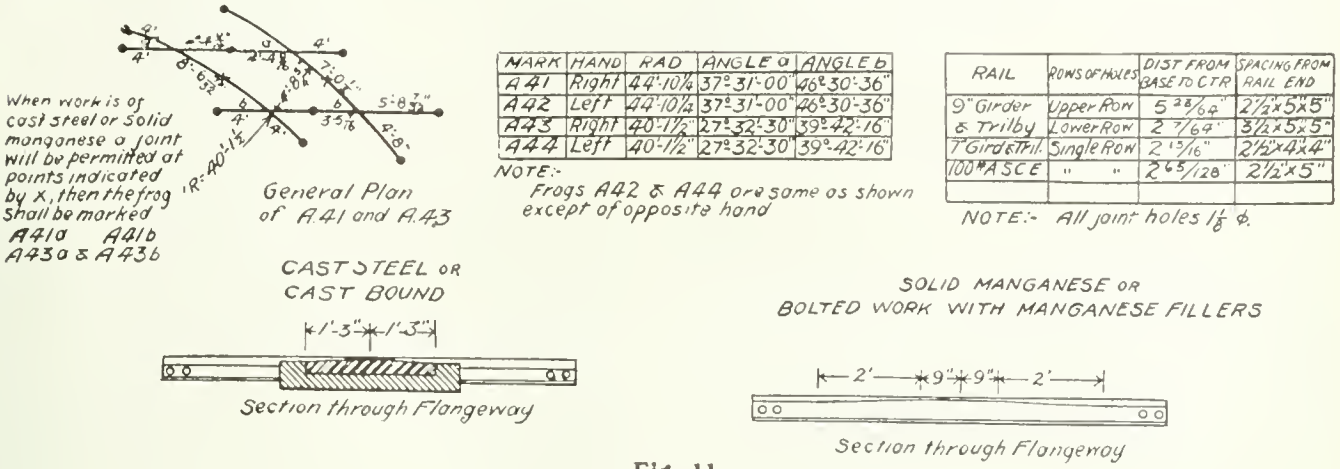

When work is of cast steel or Solid manganese a joint will be permitted at points indicated by X, then the frog shall be marked A41a A41b A43a & A43b
General Plan of A41 and A43
MARK | HAND | RAD | ANGLE a | ANGLE b
A41 | Right | 44'-10¼ | 37° 31'-00" | 46° 30'-36"
A42 | Left | 44'-10¼ | 37° 31'-00" | 46° 30'-36"
A43 | Right | 40'-1½ | 27° 32'-30" | 39° 42'-16"
A44 | Left | 40'-1½ | 27° 32'-30 | 39° 42'-16"
NOTE:- Frogs A42 & A44 are same as shown except of opposite hand
RAIL | ROWS OF HOLES | DIST FROM BASE TO CTR | SPACING FROM RAIL END
9" Girder & Trilby | Upper Row | 5 23/64" | 2½x5x5"
 | Lower Row | 2 7/64" | 3½x5x5"
7" Gird & Tril. | Single Row | 2 13/16" | 2½x4x4"
100# A.S.C.E | " " | 2 65/128" | 2½x5"
NOTE:- All joint holes 1/8 ϕ.
CAST STEEL OR CAST BOUND
1'-3" 1'-3"
Section through Flangeway
SOLID MANGANESE OR BOLTED WORK WITH MANGANESE FILLERS
2' 9" 9" 2'
Section through Flangeway

Fig. 11.

In regard to the class of work specified: Cast steel is permissible under our specifications, and nothing is standardized outside of this, except in regard to the dimensions and matters heretofore mentioned that are common to all classes of work. Cast-bound work is acceptable in its usual form, the specifications in regard to that consisting only of those matters relating to the flangeway, to the section of rail, and to the question of keeping the cast iron down on the outside of running rails so that it may not receive a blow from a worn wheel. The writer finds that this is the most common cause of the many defects that appear in cast-bound

that all special work is of the same depth and facilitates the spacing and placing of the ties in special work. This is particularly applicable to the placing of such work on steel ties.

The specifications for standard switches Nos. 1 and 2 are as follows:—

Cast Steel or Cast Bound Switches.—They must conform accurately to the general dimensions shown on Fig. 7.

Switch tongues must be of solid manganese and of heavy design and must be provided with lug for the attachment of spring lock or electric throw. The tongue must be ground to fit closely to its bed. The heel must fit perfectly so as to

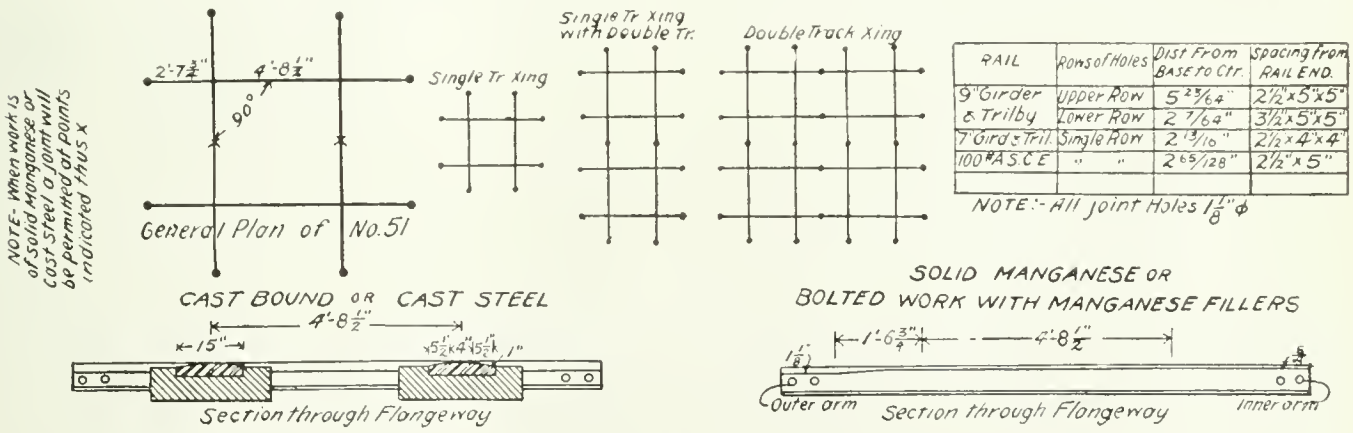

NOTE- When work is of Solid Manganese or Cast Steel a joint will be permitted at points indicated thus x
2'-7½" 4'-8½" 90°
General Plan of No. 51
Single Tr Xing
Single Tr Xing with Double Tr.
Double Track Xing
RAIL | ROWS OF HOLES | DIST FROM BASE TO CTR | SPACING FROM RAIL END
9" Girder & Trilby | Upper Row | 5 23/64" | 2½x5"x5"
 | Lower Row | 2 7/64" | 3½x5"x5"
7" Gird & Tril. | Single Row | 2 13/16" | 2½x4"x4"
100# A.S.C.E | " " | 2 65/128" | 2½"x5"
NOTE:- All Joint Holes 1 1/8" ϕ
CAST BOUND OR CAST STEEL
4'-8½"
15"
Section through Flangeway
SOLID MANGANESE OR BOLTED WORK WITH MANGANESE FILLERS
1'-6¾" 4'-8½"
Outer arm
Section through Flangeway
Inner arm

Fig. 12.

work, resulting in the breaking of the casting and the loosening of plates and the rail in the pieces. Built-up work with a manganese filler forming the flange bearing is a type that we are using in some cases. Fig. 6 shows the detail of this design. The principal points of the specifications require that all bolts in this work must be turned, all holes reamed and the bolts put in with a driving fit. This type of work was designed primarily that we should have a type of work that could be built in our own shops without delay, and without the necessity of foundry work. This type has proved exceedingly satisfactory in all respects.

prevent the entrance of snow, ice or sand under the bearing. All parts of the body which might be struck by the overhanging part of the tread on worn wheels shall be kept ¼-in. below the top of the adjoining rail.

For T-rail work the guard rail pocket shall be so constructed that the removable guard extends to the manganese centre.

Solid Manganese Switches.—They must conform accurately to the general dimensions shown on Fig. 7.

Switch tongues must be of solid manganese and of heavy design, and must be provided with lug for the attachment of spring lock or electric throw. The tongue must be ground to fit closely to its bed. The heel must fit perfectly so as to prevent the entrance of snow, ice or sand under the bearing.

Those for standard mates, Nos. 5 and 6, are as follows:—

Cast Steel or Cast Bound Mates.—They must conform accurately to the general dimensions shown on Fig. 8.

Manganese plates shall be of liberal size and of heavy design.

Flangeways shall be 11/16-in. deep for a distance of not less than 6 ins. ahead of and 6 ins. back of the ½-in. point, and shall slope evenly to a depth of 1 in. at the edges of the plate. The inclined portion of the flangeways shall in no case be less than 18 ins. long.

All parts of the body casting which might be struck by the overhanging part of the tread on worn wheels, shall be kept ¼-in. below the top of the adjoining rail.

Solid Manganese Mates.—They must conform accurately to the general dimensions shown on Fig. 8.

Flangeways shall be 11/16-in. deep for a distance of not less than 6 ins. ahead of and 6 ins. back of the ½-in. point, and shall slope evenly to a depth of 1 in. The inclined portion of the flangeways shall in no case be less than 18 ins. long.

Specifications for Standard Frogs Nos. A21, A22, A31 and A32.—Flangeways through manganese plates shall be not less than 30 ins. long, measured along the gauge lines, and they shall extend an equal distance each way from the intersection of the gauge lines. Flangeways shall be 11/16-in. deep for a distance of 4 ins. each side of the intersection of the gauge lines, and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall be 11/16-in. deep for a distance of 9 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1⅛ ins. at points 2 ft. 9 ins. from the intersection of the gauge lines.

Specifications for Standard Frogs Nos. A29 and A30.—Flangeways through manganese plates shall be not less than 24 ins. long measured along the gauge lines, and they shall extend an equal distance each way from the intersection of the gauge lines.

Flangeways shall be 11/16-ins. deep for a distance of 4 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall be 11/16-in. deep for a distance of 9 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1⅛ ins. at points 2 ft. 9 ins. from the intersection of the gauge lines.

Specifications for Standard Double Frogs Nos. A41, A42, A43, and A44.—Flangeways through manganese plates shall be not less than 30 ins. long, measured along the gauge lines, for frogs of an angle less than 28 degrees, or less than 24 ins. long for frogs of an angle greater than 28 degrees; and they shall extend an equal distance each way from the intersection of the gauge lines.

Flangeways shall be 11/16-ins. deep for a distance of 4 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall be 11/16-in. deep for a distance of 9 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1⅛ ins. at points 2 ft. 9 ins. from the intersection of the gauge lines.

Specifications for Standard Crossing No. 51.—Flangeways through manganese plates shall be not less than 15 ins. long, measuring along the gauge lines, and they shall extend an equal distance each way from the intersection of the gauge lines.

Flangeways shall be 11/16-ins. deep for a distance of 2 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall conform accurately to the profiles shown above.

In case of single track crossing, or single track crossing with double track, the outer arms shall conform to the profile shown for outer arms.

In all cases the specification requires the number of the piece to be plainly cast upon the top surface at some convenient point. When the work is of cast steel or solid manganese, the arms are required to be accurately ground to conform to the rail sections specified for the work.

IMPORTANT FACTORS IN THE DESIGN OF SEWERAGE SYSTEMS.

(Continued from page 671.)

twice as much, as has been found to be the case by comparison of the quantities of digested sludge removed from different Imhoff tanks, some of which have been connected with combined systems and others with separate systems. The greater volume of sludge from the combined system may mean that less organic matter has reached the streams than would have been the case if the sewers had been built on the separate system. If, however, the first wash from the storm water drains of a separate system is intercepted and carried to the treatment works, then the volume of sludge should be approximately the same as if the sewage came from a combined system. Similarly the amount of organic matter reaching the streams should be approximately the same, although it is possible that it might then be somewhat less.

In many instances, probably in the majority of cases, pumping is required in order to pass sewage through a treatment works. This is generally due to the fact that the site of the treatment works is more or less distant from the territory sewered and by the time the sewage has reached the treatment works enough head has been lost to prevent passing the sewage through the works by gravity. It may even be that the sewage would be delivered at an elevation below that of the stream into which the effluent was to be discharged.

With a combined system the total height to which the sewage would have to be pumped would probably be somewhat less than with a separate system, but the difference would not be great. Some saving in fuel might therefore result from the adoption of the combined system, but the same operating force would be required in either case. So long as pumping is required the actual saving in cost due to pumping the sewage against a less head, due to the adoption of the combined system, would be slight compared with the total cost of pumping, including fixed charges.

In conclusion, no hard or fast rules can be given for the adoption of either the combined or the separate system. Each has certain advantages. These, as well as local conditions and cost of construction and operation, must be taken into account. Other things being equal, especially as more and more attention is being given to the question of sewage disposal, the separate system seems to offer greater advantages. With either system, however, to secure satisfactory results, too much stress cannot be laid on the necessity of not only proper design but satisfactory maintenance and operation.

In France, efforts are being made to further a scheme for the development of river communication between Geneva and Lyons. A Franco-Swiss committee has been formed, and a meeting held recently at Satigny was attended by delegates from the Swiss communes in the vicinity of the Rhone. They discussed and supported the advisability of forming local committees to aid in popularizing the scheme.

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ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Preservation of Health in Construction Camps 681
The Views of the People on Road Improvement 681

Leading Articles:

Handling Materials by Bucket Carriers 665
Important Factors in the Design of Sewerage Systems 669
The Protection and Upkeep of Road Equipment 672
Standardization of Street Railway Special Work 674
Letters to the Editor 682
Engineering as a Profession 685
The Leonard Locomotive and Car Shops of the National Transcontinental Railway 688
The Municipal Engineer and Public Health .. 690

Coast to Coast 693
Personals 694
Coming Meetings 694
Railway Orders 73
Construction News 76
Technical and Municipal Societies 94

PRESERVATION OF HEALTH IN CONSTRUCTION CAMPS.

With the word "camp," military or constructional, there has always been associated the thought of liability to pestilence and disease, and it has been more or less of a foregone conclusion that every large camp must pay toll. Without question, however, the value of human life has risen and its safety is viewed more sanely. The scientific prevention of unsanitariness and disease has become a prominent factor in military manoeuvres, and it is to be noted with satisfaction that it has its place of similar importance in the maintenance of construction camps, as well.

The construction of the Panama Canal is memorable in this respect, and the scientific campaign against tropical diseases has been so successful as to rate it as one of the important features of the great piece of engineering. Measures for the maintenance of health were far more comprehensive than had hitherto been attempted. Streets were widened, drained, and paved; houses, as well of the poor as of the rich, were re-built and protected from mosquitoes by screens of wire gauze. The whole ground of Colon, for example, was raised above the surrounding marsh with mud taken therefrom by means of suction pumps. The breeding places of mosquitoes within 100 yards of all permanent habitations were removed, and marshes drained or filled in. The floors of the houses were cemented to afford no refuge for plague rats. Good drinking water has been constantly provided. A fine hospital is maintained.

As a result, the death rate has fallen to 7.5 per thousand per annum, and the total cost has been only about one cent per day per head of population.

Although Canada's undertakings are not accompanied by tropical conditions, the admirable mastery of adversity in the above instance suggests giving more attention to livelihood in our own construction camps. There are many in existence and many more will shortly spring up. In British Columbia there will be the Sooke Lake water supply project, the Burrard Inlet harbour and dock extensions, the tunneling of Roger's Pass, etc. In Manitoba, the construction of the Shoal Lake viaduct will begin early in the spring. In Quebec, there will be the Ottawa water supply project from the Gatineau Lakes, and there are the well-known engineering activities around Montreal and the St. Lawrence. In Ontario, many camps will be active with the opening up of the spring season, chief among them being those on the construction of the Welland Canal. No mention being made of the numerous smaller camps, such as at the many extremities of railway developments, the thousands of men who will be engaged next season in the explicit carrying out of engineers' specifications should be assured immunity from unsanitary and disease-producing conditions in their habitations.

THE VIEWS OF THE PEOPLE ON ROAD IMPROVEMENT.

As announced last week, the Ontario Highway Commission is holding a series of meetings throughout Older Ontario in the interests of the Good Roads movement. The first session was held in Ottawa on October 28th, where representatives of all the municipalities of the Ottawa Valley were present and manifested the intense interest which is being taken in the movement. The sug-

gestions made to the Commission were practical in character, and evidenced a general desire to assist in the bettering of the roads of Eastern Ontario, generally conceded to be seriously in need of improvement.

One point that was particularly emphasized was the belief that it is essential for a permanent and comprehensive good roads policy to substitute for the present statute labor system of maintenance and improvement, a system of municipal or government control and expenditure. It was emphasized that a greater continuity of policy, better men and better supervision of highway construction and maintenance would be secured thereby. It was the general feeling of the session that there is an absolute necessity for a permanent Government Commission to supervise all road construction, and to investigate and apply new and successful methods.

The Commission outlined its aim as being in the interests of rural and urban people alike, and not of any special class of road users. Market roads for the farmers, rather than trunk roads for the automobilists, were the first consideration.

EDITORIAL COMMENT.

The placing under contract of Section II. of the new Welland Ship Canal last week, and the call for tenders for Section V., indicates that there is little delay in getting the project under way. In fact, remarkable speed is being exhibited in disposing of the various sections. Late in July the contract for Section I. was awarded to the Dominion Dredging Company, Ottawa, as announced at an amount approximating $3,500,000. Section III. followed early in September at $9,500,000, to O'Brien and Doheny, Quinlan and Robertson, both Montreal firms. Then, the award of Section II. to the English firm of Baldry, Yerburgh and Hutchinson, at an amount in the neighborhood of $5,500,000 was announced in our issue of last week.

It is understood that, following Section V., Section IV and the remaining four sections will be placed under contract as rapidly as possible.

* * * *

The provincial conference which met in Ottawa last week to discuss the question of pollution of navigable waterways adopted the resolution forwarded by the Canadian Public Health Association, from its Regina convention, asking the Government to consider the desirability of establishing a federal department of public health. Particulars leading up to the framing of this memorial were given in *The Canadian Engineer* for October 16th. The resolution read as follows:—

"Whereas in the past sanitary questions affecting public health have suffered from the non-existence of a federal health department, this conference considers the creation of a federal department of public health might well receive the early attention of the government.

"The conference believes such a department would be of assistance in solving interprovincial problems as to the protection of public health."

A recent number of "The Electrician" states that there are more than 6,000 towns and villages in France at present without a system of distributed public lighting. Of the 4,094 small towns already artificially lighted, 2,673 have adopted electricity, 1,240 gas lighting, and 172 acetylene.

LETTERS TO THE EDITOR.

Discussion of "Bending Moments in Flat Slabs."*

Sir,—The present writer has had occasion recently in his treatise on Flat Slabs† to consider and make application of the general principles of the strength and flexure of flat plates uniformly loaded throughout to the computation of reinforced concrete floor slabs of many panels, especially with reference to the case of those constructed on the mushroom system by Mr. C. A. P. Turner.

While the writer has no fault to find with the method of mathematical analysis adopted by Mr. Elmont, which in fact agrees with his own so far as it goes, he nevertheless feels compelled to say that Mr. Elmont's method of applying that analysis to flat slab design is not, in his estimation, correct, and the conclusions he draws as to the stresses in the steel are not warranted by the analysis.

The reason for this statement lies in the fact that Mr. Elmont has overlooked the effect of the very uneven distribution of the reinforcement in the different parts of the panel area, and the influence which this has in causing a somewhat different distribution of stresses in the slab from what occurs in a uniform plate of metal. In particular he singles out for especial attention the positive bending moments that cause tensions in the material at the upper surface of the slab in directions perpendicular to the sides of the panels at their edges where there are no reinforcing rods to resist such tensions, and argues that ordinary flat slabs are unsafe for that reason.

I deny that such is the fact where the column heads are sufficiently stiff and strong, and say that the capacity of a slab for carrying loads is sot affected to any material extent by cracks in the concrete extending lengthwise of the edges at the top of the slab. Such cracks occurred, for example, in the test of the Deere and Webber Building in this city, which was built by a competitor of Mr. Turner, and the test reported in the Proceedings of the National Association of Cement Users for 1911, page 177, by Mr. A. R. Lord.

The reason why such cracks are unimportant is this: the construction of the slab is such that the important question is not as to just how the moment about the edge is distributed along the edge, but whether there is sufficient steel all told across each edge to resist the total stress. Stress which by plate theory occurs across the central portion of the edge of the panel is ordinarily transferred by twisting moments in the slab to the stiff heads of the columns. The middle portion of the side belts can yield to the positive moments across them to a very limited extent only (usually not enough for the formation of cracks) before resisting stresses in these heads are brought into play. This yielding, however, may and does take place without injury to the slab and without developing any real weakness in it. That such cracks and lack of steel to resist them are matters of no consequence is evidently the opinion of Professor Talbot, to whom Mr. Elmont refers as an authority on slabs, as appears from a passage which I quote from a discussion on flat slab floors, page 191 of the Proceedings previously referred to:

*By V. J. Elmont, B.Sc., in *The Canadian Engineer* of Sept. 25th, 1913.

†Reinforced Concrete Floor Slabs, by H. T. Eddy, published by Rogers & Co., Minneapolis, 1913.

"Mr. W. B. Phillips: In the floor under test, (of the Deere and Webber Building) was reinforcement provided at the centre of the span, at right angles to that connecting two columns at the side of the panel? I believe some reinforcement should be provided between the columns in order to take care of the reverse moment, eliminating cracks to which Mr. Lord refers.

"Mr. A. N. Talbot: In so far as I know, such reinforcement is not used in any of the girderless floors. The cracks referred to are minute hair cracks which, when the load is removed, will close up so as not to be visible. . . . . So far as any one knows, they are not detrimental to a structure."

This is the only point on which Mr. Elmont attempts to substantiate his general sweeping criticism and condemnation of flat slab systems.

But this is not a question that can be settled by quoting opinions or citing authorities. It is a question of fact and experimental verification. There are no observed facts whatever in support of any such stresses as Mr. Elmont computes. It is quite true that systems in which the heads of the columns are not sufficiently large and stiff might be amenable to the objections stated by Mr. Elmont, but when he attempts to excite general distrust of the stability and safety of the pioneer system of flat slab construction by saying that "to-day theoretical and practical experience will veto most of those early systems," he speaks without authority because he is not the possessor of any adequate theory, and is not supported by reference to the facts, which show that not only have such slabs satisfactorily passed the test of carrying twice the live load without failure, but have done this for months at a time without signs of distress; a kind of test to which no other form of structure could be safely subjected.

It may be an open question as to what should be regarded as a sufficient and satisfactory test of a given type of structure. But is would seem as though one which no other type of structure could equal should be so regarded.

There is one peculiarity of flat slab construction which makes it perhaps the safest type of structure which it is possible to erect, but it is a peculiarity not ordinarily recognized, viz., its toughness. It will not collapse, nor give way suddenly under any load that it is possible to place upon it. By sufficient over-load or by too early removal of forms, a flat slab may be made to bag downwards and do almost anything, except actually to fall. A gradual yielding without impairment of strength is the worst that can occur under over-load. Lack of recognition of this fact seems to be the background of the attempt here made to awaken distrust in reinforced flat slabs.

In my treatise on flat slabs, rational formulas have been established that agree closely with a large mass of observations on many different slabs made by various experimenters, the details of which are not there given. But the result of a numerical discussion of half a dozen of the most complete of these tests is now accepted and awaiting publication in the Proceedings of the American Society of Civil Engineers, which will entirely corroborate the statement just made as to the agreement between computed and observed values of both deflections and stresses. Mr. Elmont cannot cite any such agreement of his computations with observations, and until such agreement can be established he is not justified in asserting what will or will not happen to slabs whose entire behavior can be predicted by rational formulas.

My present opinion is that not only has Mr. Elmont drawn incorrect and unwarranted conclusions from the analysis he has offered, but has also seriously misunderstood and misrepresented the position of Professor Talbot when he refers to him as having shown "the insufficiency of reinforcing in flat slabs as ordinarily constructed."

I would respectfully ask Mr. Elmont either to substantiate this statement or to withdraw it. I have been unable to find any such thing in Professor Talbot's publications, but, on the contrary, much to make me think that he is quite unwilling to express the opinion that flat slabs constructed on the lines which Mr. Elmont condemns are necessarily unsafe.

Had Mr. Elmont been willing to point out types or specific instances of the kind of weakness which he depreciates, it would have been possible to agree or disagree with him in better spirit than is now possible, when he apparently intends to bring flat slabs in general into disrepute, and especially in case they are not reinforced across the top at the side belts, a view known to be so erroneous by all constructors of flat slabs, Professor Talbot included, as to detract very greatly from the weight that might otherwise be attached to any other views he might express upon the properties of flat slabs.

H. T. EDDY.

Minneapolis, Minn., Oct. 8th, 1913.

[A copy of Dr. Eddy's criticism was forwarded to Mr. Elmont, who furnishes the following reply.—Ed.]

Sir,—It was certainly not the intention in the writer's paper to bring flat slabs into general disrepute, and the writer has difficulty in understanding how Dr. Eddy could read that out of the paper. The writer considers the reinforced concrete flat slab as being a very economical and suitable structure for many purposes, and thinks that great credit is due to Mr. Grashof for his theoretical investigations, to Mr. Matrai for his reinforcing system leading up to the reinforced concrete flat slab, and Mr. Mensch for being the first—to the writer's knowledge—who employed a flat slab in an actual building.

The aim of the paper was to improve the present design of flat slabs. What the writer expressly directed his efforts against was mentioned in the following words:

"In nearly all flat slabs it is found that the positive bending moments and the negative moments over the columns are provided for . . . but the negative moments perpendicular to the sides of the panels are, as a rule, entirely neglected, although they have about the same numerical value as the maximum positive moments."

Dr. Eddy denies (1) the necessity of reinforcing against these negative moments perpendicular to the sides of the panels; (2) that Prof. Talbot's test loadings tend to prove this necessity.

(1) In his above writings Dr. Eddy refers to his book "Reinforced Concrete Floor Slabs." The writer obtained this book, thinking that it was a pure professional treatise, but found it to be mixed up with advertising matters for Mr. Turner's system. If nothing else, the writer had the surprising satisfaction of finding that Dr. Eddy not only arrived at the result that the above-mentioned negative moments exist, but that they have

far greater values than those given in his paper (though the writer disagrees with the procedure by which Dr. Eddy arrives at these high values).

In spite of this, to state that they do not need to be taken into consideration and resisted by reinforcement is rather strange. It must be granted to Dr. Eddy that so far no flat slab in reinforced concrete has failed on account of lack of this reinforcement, but at the same time, no well-trained structural engineer would consider this circumstance to be a proof that this reinforcement was unnecessary and neither is any proof contained in the fact that flat slabs, designed without this reinforcement, are able "to carry twice the live load without failure, and have done this for months at a time without signs of distress, a kind of test to which no other form of structure could be safely subjected." These last lines, quoted from Dr. Eddy's discussion above, together with the following lines

> "It may be an open question as to what should be regarded as a sufficient and satisfactory test of a given type of structure. But it would seem as though one which no other type of structure could equal should be so regarded."

certainly form the most astonishing engineering statethat the writer has ever seen in print.

First of all, it is not sufficient for an engineer to know that a structure is still standing carrying twice the live load; the important thing to know is how much greater load it would be able to carry without failing. Furthermore, the writer would like to show Dr. Eddy that there is nothing extraordinary when a flat slab carries twice the live load for such a period as "months at a time." That load is only a comparatively small percentage of what it ought to be able to carry before failing. Dr. Eddy might, perhaps, know that numerous very careful experiments have shown that reinforced concrete slabs, reinforced with the usual percentage and kind of steel, are able to carry at least three times the total load (live + dead) for which it has been calculated The load Dr. Eddy is so proud of is

$$P = 2 \times \textit{live load} + 1 \times \textit{dead load};$$
$$\text{or, } P = 2 \times p + 1 \times g;$$

but it should be possible to load these slabs—of course only when properly designed—with,

$$Q = 3 \times p + 3 \times g.$$

Taking $g = \frac{1}{2} p$, we obtain,

$$P = 2.5\ p,$$
$$\text{and, } Q = 4.5\ p;$$

thus P is only about 55% of what a correctly reinforced flat slab should carry before failing.

Dr. Eddy's statement that "no other form of structure could be safely subjected to a test load equal to twice the live load" is, in the writer's knowledge, incorrect; it seems to indicate that Dr. Eddy's design would not be effective beyond that test load. A remedy for this could no doubt be effected if Dr. Eddy were to adopt the reinforcement as advised in the writer's paper, and take the positive bending moment at the centre of the slab, as derived in the paper, to be about $\frac{Wl}{23}$, which is also close to the bending moment, given in the new building regulations for the city of Cleveland. The writer noticed on page 878, Vol. 24, of this paper that Dr. Eddy figures with $\frac{Wl}{50}$. It is also stated "that Mr. Turner's design is extremely light and seems somewhat daring when compared with designs made by other engineers.

(2) The test loading, conducted by Prof. Talbot, that the writer especially had in mind, was that in the Deere and Webber building, described fully in Bulletin 64 of the University of Illinois, published January, 1913, (Tests of Reinforced Concrete Buildings Under Load, page 88 and following). This test loading appears to the writer to have been carried through in a careful way and to be of unusual importance as it has been conducted in an actual building with almost the same exactness in studying the results as can be obtained in a laboratory test.

The floors were calculated for 225 lbs. for sq. ft.; at a test load of 350 lbs. per sq. ft. cracks appeared along the sides of the panels which plainly indicated the negative bending moments. These cracks are plotted in Fig. 75 of the Bulletin.

In conclusion, the writer would quote what Prof. Talbot says with regard to these cracks: "Another set of cracks (besides those about the column heads) which developed only under the maximum load of 350 lbs. per sq. ft. is significant. These cracks ran along the centre line of the cross bands, being easily traced in the portion about half way between columns, growing fainter towards the columns, and disappearing entirely in most cases before reaching the crack over the edge of the capital. Evidently there is negative bending moment at these sections. These cracks, we believe, had not been observed before, probably because other building tests have not been so extensive, and because cracks have not ordinarily been very carefully observed."

V. J. ELMONT.

Montreal, Que., Oct. 17th, 1913.

WIRELESS TELEPHONY IN BRITISH MINE.

An invention of Josef Heinrich Reineke, a system of wireless telephony, which has been installed in the Dinnington colliery, near Rotheram, has been found to give excellent results. The invention is used widely in Germany; and now that the British home office order for the installation of underground telephones in mines has come into force, an English company has been formed to work the patent, and the Postmaster's license to use the patent has been granted to W. Holmes, M.I.E.E. Its chief merit is that signalling can take place through solid rock over a distance of at least one mile. At the Dinnington colliery, stationary instruments are fixed at given points in the mine, and each station can communicate with any other station. In addition, each gang of colliers may be provided with a portable telephone, which can be brought into communication with the stationary telephones in case of need. A further advantage is that communication can be maintained from the pit head or the pit bottom with the moving cage. The apparatus is described as follows:—

"The instruments are exactly like those used in ordinary telephoning, consisting of receiver, transmitter and battery. The battery is of the dry-cell type, and has a life of three years. The portable instrument contains the same parts as the fixed one, and weights about twenty pounds. It is enclosed in a box, and can be carried from one part of the mine to the other. The instruments are fixed up like ordinary telephones, but instead of a wire connection two wires are connected from each instrument to some metallic substance buried in the ground. Connection can be made to the tramway lines in the pit or to water pipes or any convenient metallic substance in the workings."

ENGINEERING AS A PROFESSION

SOME CHARACTERISTICS OF THE ENGINEER AND OF HIS PROFESSION THAT ARE NOT GENERALLY KNOWN—EXTRACTS FROM AN ADDRESS TO THE UNIVERSITY OF TORONTO ENGINEERING SOCIETY, OCTOBER 15TH, 1913

By WALTER J. FRANCIS, C.E.,
Consulting Engineer, Montreal

ENGINEERING is such a material thing, such a practical thing, and such an engrossing thing, that it is very difficult to talk about it in the abstract. Moreover, the engineer is known as a man who does things, and one who is doing things is too busy to talk. You will, therefore, appreciate the greater difficulty experienced by one who is supposed to be an engineer talking in the abstract on such a subject as engineering.

In order that we may have some appreciation of the subject, it is necessary for us to arrive at some definite understanding of the two words "Engineering" and "Profession," although I cannot promise you that these definitions will entirely sweep away the mist.

"Professions."—We all have our ideas what a profession is, yet it might be very difficult for us to name many professions and, having named them, to state the reasons why they are professions. Probably the first of the professions that would come to our mind would be that of law, medicine and theology. Later we would add pedagogy, dentistry, architecture, and surveying. Some might even go so far as to add engineering. The predominating characteristic of all these callings is their protection by law and their recognition as lawfully constituted bodies by the powers that be and by the people themselves. The distinguishing feature of a profession is that it requires its members to have special training and to perform mental rather than physical labor. Custom has decreed that an individual member must earn his livelihood by his chosen profession. The representative society or societies of each profession have a written or an unwritten code of ethics. This code requires, amongst other things, that the remuneration received by a member for his services shall not be in any way contingent upon the result of his work, or, in other words, the professional man may not share in the profits. Thus, a lawyer may not, theoretically at least, accept a case on the understanding that he will be recompensed only in event of a victory over the opposing party, or a doctor may not perform an operation on the understanding that his fee will be greater if his patient should live than it would be if he should die. Further, the law recognizes, more or less, certain fees that must be paid in court for the services of certain professional men, the surveyor, for example. You will doubtless be pleased to learn that the law allows a surveyor six dollars a day for attendance at court, while engineers and other ordinary mortals receive one dollar and a quarter as an emolument for such service.

The standing of the professions in the popular mind is due largely to the character, ability and dignity of the men engaged therein.

The societies representing the professions are the result of the interest that the leaders of the professions have taken in order that the professions may be recognized as such by the world at large.

Generally speaking, a man is no longer considered a member of a profession when he ceases to earn his livelihood by the practice of the profession. A dentist leaving his calling to become a vendor of real estate is no longer considered a dentist, although he has had his training and may still be holding his diploma. A doctor may have received all his degrees and may have practised for decades, but let him devote his energies to commercially exploiting, say, some well-tried prescription, and the medical profession no longer recognizes him as a member. And so we see that the connection of earning that which is needful to purchase food, clothing and the necessities of life is intimately connected with the recognition of a person as a member of a profession.

"Engineering."—It is much more difficult to define engineering. What is an engineer? I confess I have been trying for twenty-five years to find out—and I am still trying. I remember two boys, now both on the list of graduates of this university, arguing about whether a civil engineer should know all about a locomotive or not. He thought he should. I didn't know. The other fellow is now practising surveying. Once I heard a judge of the Supreme Court of the United States struggle with the definition of an engineer in a brilliant twenty-minute speech, and he wound up by concluding that he didn't know anything definite about engineers excepting that they were jolly good fellows. In the daily press we often read of engineers, but before we get through the description we are fully aware that the person referred to drove locomotive No. 522 between two given stations at seventy miles an hour, or that he was the man who turned the throttle valve of the engine in the hold of the excursion boat.

The term "engineer" is very much overworked. It is not surprising that the great public gets confused in the multiplicity of engineers that are sometimes referred to. There are the civil engineer, the mechanical engineer, the military engineer, the electrical engineer, the hydraulic engineer, the sanitary engineer, the municipal engineer, the production engineer, the publicity engineer, the mining engineer, the chemical engineer, the structural engineer, the bridge engineer, the elevator engineer the harbor engineer, the stationary engineer, the government engineer, the city engineer, the town engineer, the tunnel engineer, the county engineer, the marine engineer, the railway engineer and the consulting engineer.

Mr. Dunn, the president of the American Institute of Electrical Engineers, in Boston last year referred to twenty-seven recognized classes of engineers, and I understand that someone of a statistical turn of mind has succeeded in isolating over one hundred and ten separate and distinct varieties of the bacterium *Engineerious Universalis*. Is it any wonder the public gets confused?

Compared with the professional men of law, medicine and theology, the engineer never comes to the at-

tention of the public as a learned man doing things. Let a man be a member of one of the other professions and as soon as he begins to accomplish things he will be heard of. Let a geologist make a speech on his chosen subject and the newspapers of the land will blaze forth with startling headlines that Professor Geologus has unlocked the great secrets which Mother Earth has hidden in her bosom for millions of years. Professor Haultain accounts for this by the fact that the geologist takes time to tell the people what he is doing and what he thinks he has discovered. Let the lawyer defend some celebrity, whether famous or notorious, and before many hours the whole world will know it and will be gazing upon indifferent pictures of that lawyer. It is, probably, safe to say that the engineer may devote his life to the service of the world and die doing his duty, and yet never be heard of during his career, unless he unfortunately make an error in judgment or a slip of some kind. I venture to suggest that Quebec Bridge was more widely known by its failure than it or any other bridge will be in its success. I do not know that the engineer cares particularly about publicity, for he is too busy doing things. I am referring now only to the recognition or non-recognition of his professional existence by the great public. Anyway, he is too busy doing things to stop for the sake of publicity. One of the powers that the engineer under-rates is the power of the press. Summing up, it would appear that the public has, at the best, a very hazy idea of what engineering is. Every engine runner of the country is an engineer, no matter whether he operates a locomotive or a threshing engine. Even the plumbers try to play on the title and have in our own country succeeded in getting an association incorporated under the name of the Canadian Society of Sanitary Engineers. All respect to the man who can wipe joints and collect his bills of world-famous magnitude, but it looks very much like trespassing on the dignity of the name of the great recognized engineering body of Canada, the Canadian Society of Civil Engineers. It is, indeed, a most fortunate thing that the motorman does not term himself a street car engineer, that the chauffeur does not call himself an automobile engineer, and that the aviator does not wish to be known as a monoplane or biplane engineer. I was just wondering, if the analogy were carried on, what the man would call himself who runs a wheelbarrow.

Engineering Societies and Engineering Defined.—There are in every country recognized engineering societies having for their object the betterment of the profession and the uplifting of its members, all of whom are required to have certain pre-requisites of training and experience. In Canada there is the Canadian Society of Civil Engineers, in Great Britain the Institution of Civil Engineers. In the United States the American Society of Civil Engineers takes a corresponding place with, however, the addition of very strong societies known as the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers. We have in Canada also the Mining Institute of Canada. In the constitution of the Canadian Society of Civil Engineers and of the Institution of Civil Engineers the art of engineering is defined, but, so far as I know, no definition is given by the other bodies I have named. The definition used by the Institution is that devised by Tredgold, well nigh a century ago. He calls engineering "the art of directing the great sources of power in nature for the use and convenience of man." The Canadian Society of Civil Engineers has based its definition on the same formulæ in the words "the profession whereby the great sources of power in nature are converted, adapted and applied for the use and convenience of man." With definitions such as these given us by two of the leading English-speaking engineering organizations, it is not surprising that the public has some difficulty in comprehending what an engineer really is; that is, assuming that these definitions ever reached the public. I think it may fairly be said that you could not be considered much of an engineer when you first learned to overcome the law of gravity and stood on end to direct that great source of power in nature to your use and convenience. It has truly been said that the greatest source of power in nature is the tongue of a woman, nevertheless, to your engineering ability could not be applied any other definition than that of "contriving" when you succeeded in getting your mother to persuade your father to buy your first rubber boots. We are told that this definition of Tredgold was primarily intended to distinguish the military engineer from the civil engineer. I think there might be some difficulty in endeavoring to apply Tredgold's definition of a civil engineer to the military engineer, because that military engineer would not find it easy to convince his enemy that the cannon balls were for the use and convenience of said enemy, even if there were any enemy left to argue with. Maybe my lack of soldier enthusiasm prompts the remark. The conflicts for the necessities of life are surely serious enough without adding other struggles blazing with uniforms, glittering with cold steel and reeking with blood. But we must not forget that in the olden days much of what is now known as "public work" was done under the direction of the military authorities who possessed the only complete organization of the time.

Professor Swain has perhaps unconsciously given a definition which, it seems to me, excels all others, where he calls engineering "the application of the laws of nature, the principles of mechanics and materials of construction to the business of the world." It seems to me that we have in these words a definition of engineering in its broadest sense.

Engineering Training.—This definition brings me right up to the present moment speaking to you as a body of young men who have entered one of the great engineering schools to learn something of how to apply "the laws of nature, the principles of mechanics, and the materials of construction to the business of the world." You have come to a great institution. Its graduates are to be found everywhere making good. Go from Tyrrell on the north to Laschinger on the south, start with Lash in Java and encircle the world, and you will find the alumni of Toronto. I myself am proud to be on the same list as Duggan, Stern, Thomson, Wright, Ross, Deacon, Mitchell, Fairbairn, Speller, Angus, Chalmers—I should not have started to name them personally, because they should be named by the hundreds —an honor list of which everyone should be proud. It has been said of Sir Christopher Wren in St. Paul's, "If you would see his monument look around you." I say to you, if you would see the monument of John Galbraith just look around the world at the engineering alumni of Toronto.

The definition necessarily implies broad-mindedness. You cannot be a good engineer and be narrow-minded. So, do not forget that this broad Dominion has other universities, older ones in the Old East and newer ones in the New West. Queen's and McGill are great universities. There are many great universities in the

States. England has a great number of the highest engineering schools in the world. So has France. Germany was well advanced with engineering training before some of the other countries began to be serious about it.

But your university training will not make you an engineer. It will equip you to become an engineer—if the engineering spirit were born in you. By hard work and the application of the training you will here receive you will, I trust, all become engineers.

You are now, doubtless, realizing the difficulties surrounding "engineering as a profession." Eliminating all those engineers who share in the profits of their labors, it will be seen that it reduces the number to a comparatively small number of men—small as compared with the number composing the profession of law or medicine. Yet, it cannot be said that those eliminated are not engineers. On the contrary, they are engineers in every sense of the word, and they are so recognized by all the great national engineering organizations. Many of the leading ship builders, bridge builders and contractors are amongst the best engineers of the world, and they have and are occupying the topmost positions of honor in the engineering world.

The idea of a part of the engineers taking a stand shoulder to shoulder with the other professions is growing fast. Already a powerful movement is taking place in this direction, and it is interesting to note here that the indefatigable secretary of the only really professional organization of engineers was a member of the class of 1884. I refer to Eugene W. Stern, secretary of the American Institute of Consulting Engineers. Let me, in passing, call attention to the pre-requisites of membership with these professional engineers. A member must be at least 35 years of age, he must be actively engaged in the independent practice of the profession, he must be a full member of one of the great recognized engineering bodies, he must have a high character, he must have attained a degree of eminence in the profession, and he must not be engaged in contracting. When you come to realize the requirements for admission to any of the great recognized engineering bodies and add to that all the other stipulations that have been named, you will see that the standard set up by the American Institute of Consulting Engineers is one of which the engineering world should be proud. The membership is jealously guarded and, of course, it is not great in numbers. At present I think there are less than 70. This organization illustrates to some extent the difficulties surrounding "engineering as a profession." One is forced to conclude that "engineering" is too great and too comprehensive to ever be confined within the narrow limits of a "profession" in the same way as law and medicine. As it looks at present, we should associate ourselves with the recognized engineering bodies first and, later, if our choice take us in that direction, the Institute of Consulting Engineers. In the meantime study the work that the Canadian Society of Civil Engineers is doing.

As I look at the whole question that there are in this world two classes of people, the producer and the non-producer. At the bottom of the non-producers I place the real estate men and the speculators. At the top of the producers I place the agriculturist and the engineer. Between these extremes live all the other callings, and I shall leave you, each for himself, to place them according as they may, in your judgment, be producers or non-producers. Under our present social system the agriculturist must come first, because we must have food and clothing. Next in order in the world's progress is the engineer. The Indian in his native state, the Arab with his caravan has no need of the engineer. The farther we get from the primitive the greater the need of those who are able to apply to our use and convenience the great sources of power in nature. The marvelous advances of the last century are engineering advances. The other professions are older than engineering. Art is centuries old, yet it is a question if the art of to-day is on the same plane as that of Greece and Rome centuries ago. The grandest examples of the work of modern architects are based on the ancient orders, and the advances of architecture in modern times are due to the engineer in introducing steel skeletons and reinforced concrete. In surgery wonderful progress has been made within a lifetime, but the skill of noted surgeons was developed only through the medium of the engineer's handiwork in fine instruments and electrical appliances. The physician heals the sick and deals with individuals, while the engineer holds in his hand the health of towns, cities and nations. The preacher has no particular use for the engineer excepting as illustrations in sermons. The lawyer lives on the engineer's quarrels and on the relations which by his ingenuity he has set up between others. The teacher helps to prepare the embryo engineer for his admission into a cold-blooded world and promptly forgets him in the future pursuit of embryology.

It is the engineer who harnesses the Niagaras of the world to transform the night of our cities into noonday and to turn the wheels of commerce. It is the engineer who develops the mining and furnishes the metal with which he builds machines that by their ingenuity compel us to stand in awe and admiration. It is the engineer who produces the steel to form a network of highways over our continents and that makes possible the myriads of floating palaces on our oceans. It is the engineer who has abolished famine and pestilence. It is the engineer who has annihilated distance with his telegraph and his telephone. It is the engineer who has made possible the conquest of the air. It is the engineer who places in the hand of the president of a nation the power whereby he is able with a touch to remove from a point thousands of miles away a barrier of nature separating two oceans. It is the engineer who furnishes the worker in the golden west with the machines whereby millions of bushels of wheat are each year made ready to enter the hopper that the engineer has constructed. It is the engineer who has made Canada of to-day what she is.

In concluding, Mr. Francis referred to the foregoing generalities as being accomplished by the summation of the efforts of individuals, and he impressed upon the members of the society the necessity of upholding the high ideals of the engineering profession.

RAPID DAM CONSTRUCTION.

Near San Antonio, Texas, a concrete dam 164 ft. high, and having a crest length of 1,580 ft., was recently completed in 12 months. It contained 300,000 cubic yards of concrete, and forms part of an irrigation scheme for an area of about 60,000 acres. It has a spillway 1,200 ft. long, which delivers into an adjoining ravine. The delivery of the water involved the use of semi-circular sheet-metal flumes, one of which was supported on towers for a length of 1,500 ft., the greatest height being 95 ft.

THE LEONARD LOCOMOTIVE AND CAR SHOPS OF THE NATIONAL TRANSCONTINENTAL RAILWAY AT QUEBEC, P.Q.

THE general layout of the repair shops of the National Transcontinental Railway at Quebec, P.Q., is such as to show that not only has convenience of operation been the general principle governing the design, but that future needs have also been provided for. Each shop is capable of extension without interfering with any other, and any department can be increased separately as occasion may require.

There are eleven buildings in all, of various dimensions, each suitably designed for the special work to be done in them. These buildings consist of a locomotive, erecting, machine and boiler shop, forge shop, freight car shop, power house, planing mill, dry kiln, lumber shed, forge stores and scrap bins, oil house, stores, and office building for the executive staff. The total area covered is about five and one-half acres. The locomotive, erecting, boiler and machine shops are all under one roof, and arranged as shown in the plan (Fig. 1). The building is 602 ft. 6 in. in length and 152 ft. wide. It is shown in cross-section in Fig. 2.

In the erecting shop there are eighteen pits, placed transversely, and over them a 120-ton crane operates, lifting locomotives into and removing them from, their respective positions. A 20-ton crane operates over the same area at a few feet lower level. It carries small material, and is designed for light and rapid service.

The transverse-pit layout has the advantage of doing away with many side doors in the building for the in-and-out movement of locomotives. There are two doors, conveniently placed, through which engines and material enter and leave. It will be noted that this arrangement is economical in the matter of heating. It dispenses also with the necessity of a transfer-table, with all its inconvenience from snow and ice. The practically unbroken side-wall permits the use of jib cranes, one serving the fronts of two locomotives, being capable of lifting smoke-stacks, main valves, smoke-box doors and rings, etc. The use of these very handy cranes would be most difficult if the wall of the shop had been cut up into a series of doors.

The cross-section of the shop (Fig. 2) shows the position of the cranes. The large crane is carried on a series of built-up columns, so that the heavy load is central over the line of foundations. As one crane does the work of lifting and placing each locomotive, there is no chance of confusion such as might occur when two cranes are used, and where two men do the work. The single powerful crane has also the advantage over the usual twin-crane arrangement in economy of first cost and maintenance.

All the overhead cranes are provided with effective safety appliances. One of the most important of these appliances prevents the load from being "over-wound" by the lifting-drum. It consists of a device which, when the maximum lift has been reached, automatically opens a switch on the hoisting circuit, thereby cutting off the current, and suddenly removing the driving power. The cessation of the current immediately brings into powerful action a gravity-operated brake, which is normally held out of service by the flow of current.

The direction in which the midway crane operates is a new departure in railway shop construction, and substantial advantages are secured. The midway is laid out so as to be alongside of the shops, and not at the ends of the buildings, as is frequently the case. The object

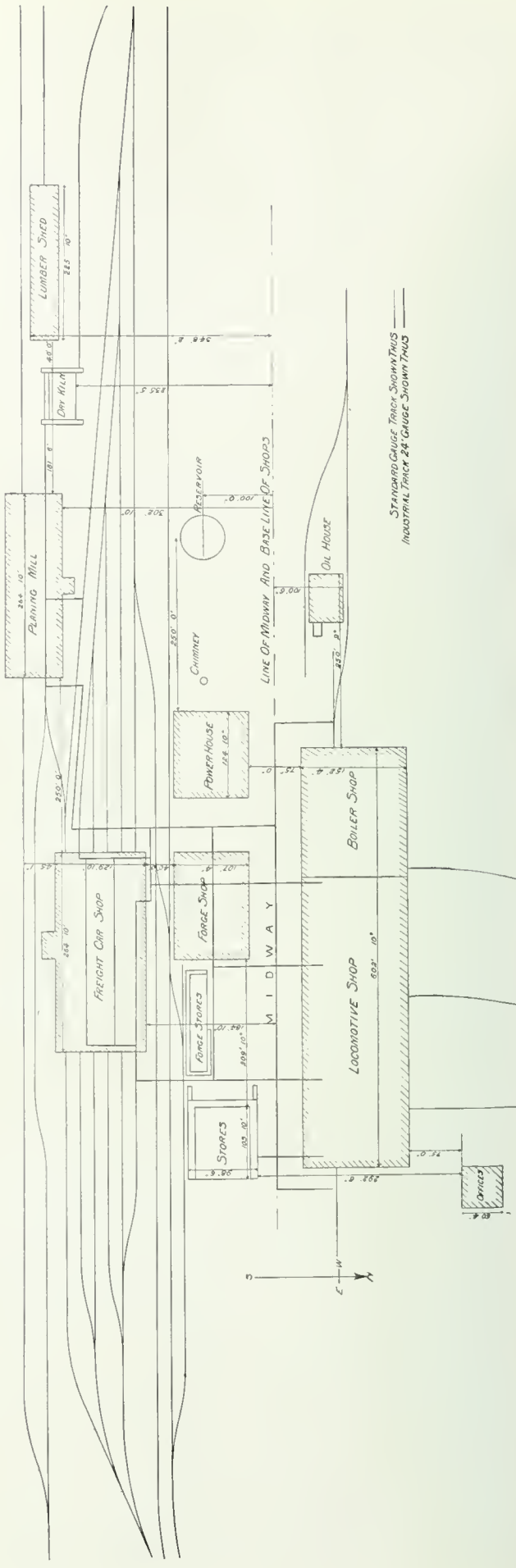

Fig. 1.—General Plan of the Leonard Locomotive and Car Shops, Quebec.

of this arrangement is that when material is brought by the midway crane from the storehouse, forge shop, or foundry to the machine, erecting or boiler shop, it is placed at the door nearest to the machine on which the material will be handled, or to the engine upon which it will be used. In this way the delivery of material is not concentrated at one spot at the extreme end of the building. It avoids distribution from a congested area, and it obviates long haul through the shop. Material is laid down at a point as near as possible to its destination, and economy of time and labor, as well as facility in handling, is thus secured.

The system of placing machines is such that the movement of material will be in one direction, and the distance over which any locomotive part is carried will not be unnecessarily lengthened by journeys forward from one machine and back to another. The continuous one-way movement of material saves time and labor and prevents interference.

The pits in the locomotive shops are supplied with steam, compressed air, hot and cold water. Depressions in the pit walls carry the pipes. By this arrangement the working space in the pits is not restricted, and the pipes are not where they can be easily damaged by workmen dropping material on them; and thus while being quite safe, they are out of the way.

The forge shop and the boiler shop are placed as near as possible to the power house. This is important, for in the case of the forge shop, where hammers are operated by live steam, the short distance between boiler and hammer reduces condensation and delivers steam where it is required with small loss. A similar condition holds good in a sense, for the delivery of compressed air to the boiler shop machinery. The nearer the source of supply, the less the pipe friction involved and the smaller the losses due to the forcing of air through the pipes.

Industrial tracks form convenient means of communication between the various shops. The buildings, cars, engines and supplies are protected by a water-system arranged to be readily put in use in case of fire. A further protection is afforded by reason of the use of concrete and steel in the various structures.

The shops are situated at Quebec, and have been named after Major R. W. Leonard, chairman of the National Transcontinental Railway Commission, under whose administration they were projected. The outlay has been carefully supervised, so that excellent results will be attained and full value received for the money expended. The permanent and substantial character of the shops and the size of the plant will be of material advantage to the city of Quebec, by providing steady employment for

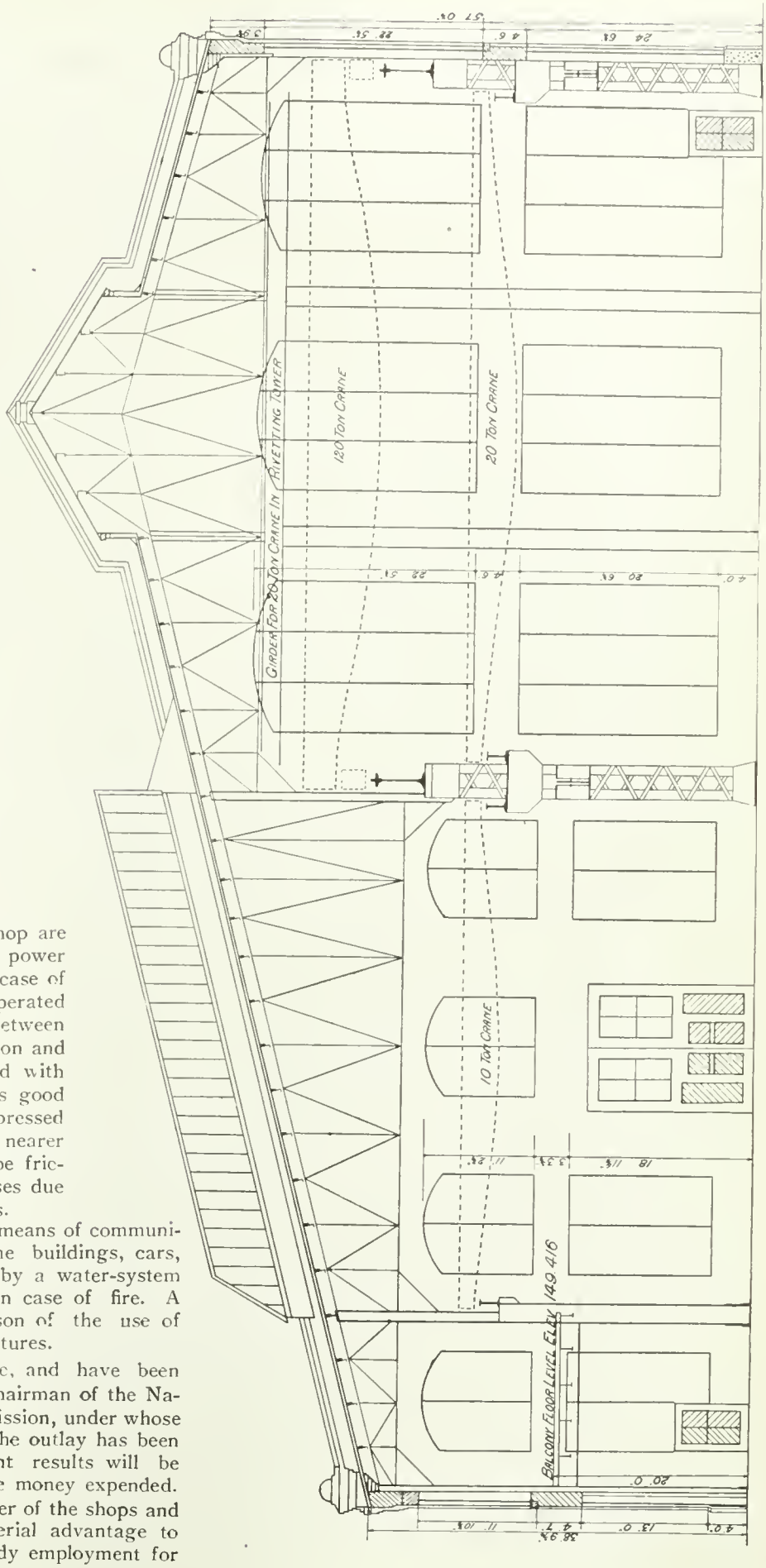

Fig. 2.—Cross-Section of Locomotive Shop—National Transcontinental Railway, Quebec.

a considerable number of men the year round. The whole plant has been laid out in such a way that the latest and most modern railway practice has been provided for, and the design will be second to none in the country.

The plant has been laid out under the supervision of Mr. Gordon Grant, Chief Engineer. The design of the plant, the relative size, arrangement and position of the buildings, together with the selection of the machinery and appliances, has been entrusted to Mr. W. J. Press, Mechanical Engineer, who has had charge of similar work at the Transcona Shops of the National Transcontinental Railway, which are now being operated, and which, in general plan and in kind and quality of equipment, are of the most up-to-date type. The Transcona and the Leonard Shops (when the latter is completed) will embody the latest design and the most modern practice, enabling them to be operated with a very high degree of efficiency. Altogether they will form a most valuable addition to the second of the great National "cross-continent" highways of Canada.

The contract for the construction of the shops was recently awarded to Mr. Joseph Gosselin, of Pt. Levis, Que., and construction work is under way.

A NEW CHEMICAL INVENTION.

While Mr. Henry S. Blackmore, one of the most distinguished chemists of the United States, was in Ottawa, he claimed that he had perfected a process of not only liquefying, but also of solidifying natural gas, and that either the liquid or solid could be used as a motor fuel. The fluid is ethereal in character, like gasoline; and from 8 to 10 gallons are produced from 1,000 cubic feet of gas. This fluid has the advantage over gasoline both in that it can be produced at a first cost of two cents per gallon, and in that it leaves no carbon deposit to clog the cylinder. In the form of a solid, a cubic foot of the fuel weights about 5 pounds, and comprises the condensed product of 2,500 cubic feet of natural gas. It has the appearance of crystallized paraffin, softens to putty-like consistency at 212 degrees, and at 312 degrees turns to gas again. The solid also is superior to gasoline in that a cubic foot of it will carry an automobile 12 to 15 times as far as a cubic foot of gasoline, and in that the solid as well as the liquid is safe to handle. Interests controlling the inventions of Mr. Blackmore have secured large gas fields in the United States and in Canada, and will manufacture this motor fuel at 10 cents per gallon or less; and natural gas in blocks will be shipped from the wells to the consumer.

WIRELESS RESEARCH.

The International Wireless Company has decided on the organization of committees in all the countries adhering to the wireless telegraph treaty, which was signed at London, in July, 1912, to aid the governments in extensive wireless observations and experiments. These will be carried out with the object, first, of determining a way to insure constancy and steadiness of wireless waves; secondly, measuring the variations in the signals and atmosphere disturbances at the different stations; third, comparing the intensity of the signals. These experiments will be conducted simultaneously on three days of each week, beginning in January. Special meteorological observations will also be made once a month. Reports of the work of the committees will be made to the wireless conference at Brussels in 1914 with a view to legislation.

THE MUNICIPAL ENGINEER AND PUBLIC HEALTH.

THE variety of problems that arrange themselves under the heading of "Duties of Municipal Engineers," is constantly being added to, and each unit continues to expand. Those which have to deal with public health were summarized by Mr. J. Antonisen, superintendent, Brandon Municipal Railway, in a paper which was read at the Public Health Congress in Regina some weeks ago. The subject was dealt with without effort toward comprehensiveness, but included those items only that fall within the borders of the engineer's work toward the establishment of a healthy community. According to Mr. Antonisen, they constitute the following lengthy list: A pure, plentiful water supply; proper sewage system; effective drainage system; well-organized system of collecting and destroying the garbage; sanitary lighting, heating and ventilating system for our public buildings and private houses; development of power to operate our public utilities and factories; cheap and safe means of transportation, both by urban and interurban and the larger railroad lines; proper construction of highways, roads, pavements and sidewalks; efficient maintenance and cleaning of our streets; proper city planning; liberal provision for park areas in our congested cities, and for playgrounds, public baths, comfort stations, and a hundred other items, which all come within the scope of the engineer's duties.

Of these, the first several are prominently important, and are dealt with by Mr. Antonisen as follows:—

Water Supply.—When the pioneer goes into unknown regions to find a new home for himself, his first problem is: Where can water be obtained for all kinds of domestic purposes? He locates his house near a lake, a river or a creek, and when other settlers follow, they ask the same question with respect to water supply. It is, therefore, not purely accidental that the majority of villages, towns and cities are located near rivers and lakes.

The pioneer's cabin becomes surrounded by settlers' houses; in course of time a village or small town grows up, and the community is gradually confronted with all the problems which have just been enumerated. At first the so-called practical men try to solve these questions, but sooner or later in the development of each town, the time comes when it becomes apparent to everybody that the state of things bespeak the need of an engineer.

By advertisement or by application to some large city a number of candidates for the position are obtained, and after due consideration the community selects their county or town engineer, who is then expected, for a salary of $75 to $125 per month, to be an expert in all branches of civil engineering. Thus the average town engineer puts up a bold front, commences to lick things into shape and, although he makes many daring leaps into darkness, he generally lands on his feet. By constant hard work and diligent study, seeking advice and information in engineering literature and from more experienced colleagues, he gradually develops into that modern wizard—the city engineer. During his development period he has laid out systems for waterworks, sewerage, built sidewalks, streets, bridges, subways, sewage disposal plants, reservoirs, water towers, dams, incinerators, grandstands, race tracks, and a thousand other things.

As long as the town is small it is contented to pump the water from a river or lake and using it without any

kind of treatment; it is considered all right to discharge raw sewage into the creek or river or lake, as long as the waterworks intake pipe is up-stream and the sewer outlet down-stream; or, in case of a lake supply, a couple of miles apart; but when the death rate rises up to uncomfortable figures, then the first question asked is: Have we got a pure water supply? The overworked, busy city engineer has worried over this question in idle moments, between midnight and sunrise generally, and has, perhaps, formed an opinion of what steps should be taken to safeguard against contamination of an existing pure supply, or procure a better supply than one already contaminated. Sound advice to the city engineer is: Get your council's permission to employ a consulting engineer of known repute; lay all your information, together with your own opinions, before him, and then let him decide what should be done. It is well-spent money to employ the consulting engineer, and when he has worked out the project, and it proves a success, give him the full credit for it, although you have furnished him with some useful information; because, if his scheme does not prove an unconditional success, he gets more than his full share of the blame.

Sewage Disposal.—Once a pure water supply has been secured, the engineer must turn his attention to the sewerage system, as this problem is of equal importance to the public health; not alone in his own town or city, but to all the inhabitants of the drainage area further down the stream or bordering upon the lake into which the sewage is being discharged. It was considered sufficient once upon a time to discharge the sewage raw into a flowing stream or a fairly large lake, and then trust to Nature for the rest; but Nature fails to respond to our trust, and we engineers are obliged to erect sewage disposal plants, a better name for which would, by the way, be sewage treatment plants.

This treatment of sewage in such a manner as to render it harmless is probably the greatest problem of modern engineering authority, and one that should not be tampered with, because a poorly or wrongly designed plant is worse than no plant at all. The province of Saskatchewan is to be congratulated upon the way in which this important problem is being dealt with. The Provincial Government has very strict rules regarding this subject. They employ their own experts, whose advice can always be obtained in designing a system, the plans of which must be approved by the government.

In connection with this matter there is one feature which could possibly be made a subject of recommendation to the government, and that is the operation of these plants after they are installed. No matter how scientifically a plant is designed, nor how properly it has been constructed, if a properly trained and enthusiastic man is not placed in charge of the operation to take proper observations of the results and see that proper results are obtained, the plant will be a dismal failure.

The conviction forced itself upon me, while city engineer in Moose Jaw, that the government ought to place a scientifically trained person in charge at each plant and contribute a portion of the cost of his salary as well as the cost of an experimental station, so that complete and reliable records could be obtained regarding the operation of the different plants.

Garbage Destruction.—Assuming, now, that an ample supply of pure water has been secured, and that there is in operation a plant where the sewage is being treated so successfully, that it ceases to be a menace to the public health. The system of collecting and destroying garbage is another important question. It is not exaggerating to claim that inside the limits of every city in Canada there are always hundreds of tons of garbage lying in a more or less advanced state of decay with the resulting dangers to children and adults. The air is poisoned by the emanating odors, but in spite of all this some cities are very careless and indifferent towards the garbage problem.

Here is a broad field for the engineer to organize a proper system of collecting garbage regularly and then also destroying it properly. When a town has grown to a size of 15,000 inhabitants, it can afford, and should erect, a garbage destructor which, when properly constructed and carefully managed, can be operated at a reasonable cost. The incinerator, which was erected during my stay in Moose Jaw, cost about $45,000, and had a capacity of 50 tons per 24 hours. It was operated without the use of any coal and developed enough steam for 50—75 h.p.

The most essential problem in connection with garbage is, however, to educate the public to co-operate with the authorities by reducing the garbage to a minimum, instead of having an abundance of barrels and boxes in the back yard filled to overflowing. There is no reason why the average household could not dispose of most of the garbage in the ordinary stove and furnace; the ashes can and should be kept separately and used for filling purposes; tin cans, when emptied, should be rinsed with water and then put on the bonfire, where it is permitted to have bonfires.

My attention has lately been called to a water-heating garbage burner, which is manufactured in Kewanee, Ill., and can be installed in ordinary private houses for from $150 to $250. It is claimed for this apparatus that it will destroy all house garbage and develop sufficient heat to provide hot water for domestic purposes. The municipal engineer should investigate such matters, and advocate their introduction in hotels, boarding houses, large private and public institutions, hospitals and asylums.

In smaller cities, which have not reached the stage where they can afford incinerators, the nuisance ground flourishes, and is generally very badly managed or not managed at all, but simply left as a perfect Gehenna. There is no necessity for such a state of affairs, as a nuisance ground, under proper management, can be made a smaller pestilence than at present by the display and use of common sense.

Fires should be maintained; a system of ditches should be dug, into which garbage that can not be destroyed in the fires can be dumped and afterwards covered with the excavated earth. On the average nuisance ground we can generally find enough combustible material, in shape of paper, rags and boxes, to maintain fires which will burn most of the garbage, or at least disinfect it, and in charge of the place are some old fellows who have been given that job because they are old ratepayers.

City Beautification.—But let us turn away from all this and consider the more pleasant tasks of the engineer, through which he promotes the comfort of his fellow-citizens and beautifies the city. These comprise matters such as building sidewalks, curbs, pavements, boulevards, parks and tree-planting. It is of comparatively small importance whether the sidewalks are laid at the property line or at the curb, as far as the public health is concerned; the main thing is to get a network of sidewalks

built so that the citizens can come back and forth from their homes without walking in ankle-deep mud, which is then dragged into the house. Dirt in every shape and form is a menace to health.

The boulevards should be made as wide as possible and trees planted thereon, as grass and trees have a beneficial effect upon the health of the inhabitants. A paved street is easily cleaned, as it can be swept with brooms and flushed with water, so that the dust and dirt can be removed into storm sewers or by street cleaning wagons.

No city can have too many parks and open spaces, as long as these can be provided for, while the land is cheap. The town engineer has to examine all plans of subdivisions, and he can often induce the owner of subdivisions to set aside a parcel of land for public parks and also get them to make some of the streets wider than the usual 66 feet. Provisions like these may seem unnecessary at the time, when the subdivision plans are submitted, but they prove themselves of great value to the public health when these districts become settled.

The roadways in residential sections of cities should be made as narrow as possible, just sufficient for the light traffic, as they produce dust and dirt, which is blown into the houses, whereas boulevards with grass are always clean, healthy and beautiful, when well kept.

As long as the town is small, the transportation problem does, of course, not signify, as the distances between residential and business sections are short, but when the land becomes very valuable, due to the progress of the city, and therefore the working classes must move away from the vicinity of their working places, then arises the necessity for rapid and cheap transit, and we build our electric street railways, which enable the man of moderate means to make his home in the outskirts or suburbs of a city, where land can still be bought or houses rented for a reasonable price.

The man who works in an office, shop or factory the whole day, needs change of air, when he is through with his day of labor, and the street cars, elevated and underground railways, as well as the steam-operated suburban trains, carry the working population back and forth between their places of work and their healthy homes at a small cost. We extend the water and sewer mains, electric light and telephone lines to the farthest limits of a city, so that there should be no excuse for overcrowding in tenement houses.

And when a city has reached the stage where this housing problem becomes an acute question, then we commence to talk of city planning, and we discover all the mistakes which have been made while the city was growing. And why were those mistakes made? Principally because the municipality had no power to control the city planning, and then, also, often because even though the authorities of a city had power to control the city planning, the engineer's advice was not obtained, but private interests dictated the policy of the controlling bodies.

This branch of engineering, the city planning, should be taken up more thoroughly by municipal engineers, because generally the town engineer has to pass all subdivision plans, and if he does not take a look into the future before passing a plan, it is pretty certain that nobody else will; and thus occur many blunders which it afterwards costs enormous sums to rectify.

The proper way is to let the city engineer lay out a city plan and then make property owners conform to this plan. That may appear autocratic to the free citizen of the new world, whose idea of liberty is often that he should have the right to disregard the rights of the community for his own personal advantage, but true liberty exists when law and order is most respected.

NEW DEPARTURES IN TELEPHONE.

An article in the *New York Telephone Review*, entitled "From a Limousine to the Depths of a Coal Mine," describes two types of special telephone equipment—e.g., a chauphone, or telephone for automobiles, and a special portable telephone equipment used in mine rescue work. The chauphone, which consists of a hand transmitter for the passenger connected to a loud speaking receiver at the chauffeur's ear, obviates the difficulties of speaking-tubes for automobile use. The mine rescue equipment has a special type of transmitter known as the "throat transmitter," since a man wearing an oxygen helmet which covers his month cannot use the ordinary type of telephone transmitter. The throat transmitter is light and compact, and is provided with a soft rubber cap, which adapts itself to the curves of the throat. The telephone equipment used by the men outside the mine or at the directing end consists of a chest-type transmitter and head-band receiver. The two are connected by a small wire cable, in 500-foot coils, carried in a leather case and fastened to the helmet man's belt, which pays out as he advances.

CANADA AND HER PAPER MANUFACTURING INDUSTRY.

When the Senate of the United States passed the Tariff Bill and removed the suggested countervailing duty of $2.00 per ton on chemical wood pulp manufactured in Canada, it threw open the gates of the United States to the wood pulp industry of Canada. The United States requires about 4,500 tons of paper daily, New York alone using 600 to 800 tons; and her wood pulp forests are fast disappearing. Her water powers not only are decreasing, due to the bareness of the hills, but are more valuable for other commercial purposes than for driving paper mills, that are very much inferior in supply of material and in limitation of power to competing Canadian establishments. For Canada is extremely fortunate in the possession of those three requisites underlying the manufacture of paper—i.e., cheap and abundant water power, cheap and contiguous wood supply, and ready transportation. And the United States has found that its manufacturers can no longer compete successfully in this business. Since 1911, when not more than 440 tons of paper per day were manutured, there has been an increase in capacity of 1,055 tons per day; so that up to date the total capacity of Canadian mills is 1,495 tons daily. At present the total production of United States mills is about 4,000 tons per day; but the increase of production in 1912 in the United States was 235 tons per day as compared with 430 tons per day in Canada; in 1913 up to date, 110 tons in contrast to 225 tons, which by January 1, 1914, will have been increased further by a capacity of 390 tons per day. Thus, whereas in 1909 and 1910, the capacity of Canadian mills was but 12 per cent. of that of United States mills, in 1914 the Canadian industry is substantially 40 per cent. of the American industry. So, for the interests of the republic, it was not a time to have restrictions placed upon Canadian wood pulp; and as far as Canada is concerned, the new tariff has meant the opening up of new towns in her backwood forests, and the great development of her lumber industry. Canada has taken precedence, because, in the words of Senator Weeks, of the United States Congress, "Canada is in a better situation to make the products which are absolutely necessary in this paper age of the twentieth century."

COAST TO COAST.

Edmonton, Alta.—Premier Sifton made the statement in the Provincial House on October 22nd that the Government will expend next year about $2,000,000 in telephone extensions.

Ottawa, Ont.—A West End Ratepayers' Association has been formed with the prime purpose of securing drainage for the district west of Rosemount Avenue, a matter which has been delayed for some time, much to the disadvantage of this section.

Vancouver, B.C.—The city solicitor has been instructed by Mayor Baxter to bring before the Railway Commissioners the matter of commencement on the C.P.R. tunnel from its west end reserve to the waterfront to obviate the great inconvenience to traffic.

Sutherland, Sask.—The program of civic works for which some time ago the ratepayers approved by-laws amounting to $200,000, will be commenced in its entirety early next season. However, grading operations on the thoroughfares is now in progress.

Vancouver, B.C.—The C.P.R. has presented to the city board of works plans in connection with the proposal to take over the railway reserve, which has become a warehouse district. But action upon these has been deferred until more comprehensive plans are produced by the railway.

Coquitlam, B.C.—A syndicate of Fort William, Minneapolis, and Winnipeg capitalists has selected Coquitlam as a grain elevator site. The head of the syndicate is Mr. J. H. Henderson, of Fort William, formerly head of the Grain Growers' Association elevators of that city.

Lethbridge, Alta.—The inefficiency of the Lethbridge waterworks system is shown in the report of City Engineer Harvey for the month of September. The report says that the city waterworks system sprang a total of 45 leaks, and this is a great increase upon the leakage of previous months.

Hamilton, Ont.—To endeavor to eliminate neglected features in connection with civic works in Hamilton, Alderman Byers is advocating the appointment of a works commissioner, who will closely inspect all works and conduct a cost system in connection therewith, and who will furnish a report weekly, or more frequently, to the city's board of control.

Vancouver, B.C.—Alderman Black, chairman of the civic water committee, has been considering with the water rights commissioner of Victoria the question of securing additional water supply for Vancouver. His desire is to obtain from the water rights and forestry departments of the Government full information in regard to the question of supplying additional water facilities from Seymour Creek.

Montreal, Que.—The firm of investment bankers, Nesbitt, Thompson & Company, of Montreal, have recently purchased $600,000 of the limited preferred stock of the Dominion Power and Transmission Company, Limited. This investment is a recognition of the important position the Power Company has taken and maintains in Hamilton and the surrounding territory.

South Vancouver, B.C.—A deputation from the Main Street Improvement Association has asked the Richmond Municipal Council to assist the association in its campaign to obtain the Main Street bridge across False Creek for the north arm of the Fraser River. The proposal is to remove this bridge from False Creek when it has been filled in, and when a sea wall 300 feet west of the bridge has been completed.

Victoria, B.C.—In connection with the construction and plans of the C.N.P. Railway's bridge across Selkirk water, Alderman Gleason has objected to the proposed pile structure across the beautiful waters of the Arm, and considers that at least a steel bridge should be erected. The council finally adopted a motion made by the alderman to leave the matter with the engineer and solicitor to bring the subject to the attention of the Canadian Northern representatives.

Toronto, Ont.—The new Danforth Avenue civic car line in Toronto has been duly opened with a formal ceremony and with evening illuminations, music, and processions in carnival dress. Those taking part in the official ceremony were Miss Hocken, daughter of the Mayor, the Mayor, and several of the city's aldermen and controllers. A dinner was served later in Playter's Hall; and a meeting was held in Riverdale rink, at which speeches were given by Hon. Dr. R. A. Pyne, Hon. A. E. Kemp, and Geo. S. Henry, M.P.P.

Vancouver, B.C.—The board of works for Vancouver has approved the plans of the southern approach to the Second Narrows bridge, and these have been placed before the Railway Commissioners at their sitting here on October 27th. The site of the approach was moved some sixty feet east, but the general location of the railway line was approved, subject to the bridge company's consent to construct retaining walls, and the necessary subways and bridges. The city engineer was authorized by the board to sign the plans upon these conditions.

Port Arthur, Ont.—The most modern elevator in the entire world, the new government elevator at Port Arthur, is now receiving the finishing touches to its construction. The contractors, the Barnett & McQueen Company, are still in charge of the contract, not having handed the elevator over to be operated under the government's control, nor will it be turned over until completed in every detail, which will perhaps not be for two or three weeks more. Although grain is being unloaded for storage, the full capacity of the big plant will not be called upon until such time as all the last bits of machinery are installed.

Fort William, Ont.—It is reported that the big Stanley Avenue sewer is nearing completion, and under favorable conditions will be finished this year. The open trench work running from the Kaministiquia River to a point 700 feet east of the Canadian Car and Foundry Company's plant was to be completed in October; after which, 300 feet of pipe will be laid under the car works, through which a tunnel will be run if possible. The trench has been built through a heavy loam and blue clay, and the workmen have experienced great trouble with water oozing into the cut when it had been dug to a certain depth. The entire length of the trench had to be shored up with long planks to keep the sides from caving in.

Elmira, Ont.—On October 29th the Hydro-Electric power was turned on in the skating rink at Elmira by Reeve I. Hilborn, and in the evening the current for the street lights was turned on by the Hon. Adam Beck. Delegates were present from all neighboring municipalities, and a band was in attendance to give the event an enthusiastic celebration. Many formal proceedings presided over by Reeve Hilborn, notably a "Made-in-Elmira" exhibition, were conducted by the municipal officials, and were lauded by the congratulatory speeches delivered by the guests of the day. A 250 horse-power current has been thus inaugurated in this enterprising village of a population of 200.

Peterboro', Ont.—At Peterboro', a street lighting system in connection with the Hydro-Electric system has almost been completed. Iron poles and brackets are now in position to support the magnetic arc lamps, which will be assembled in the course of a few days. There is, however, difficulty

arising in connection with the securing of a supply of electrical energy with which to operate the lamps. The present existing contract for the supply of power to the city by the Peterboro' Light and Power Company expires at the close of the present year. In the meantime the Power Committee of the City Council anticipate the successful issue of the expropriation proceedings which have been instituted with a view of obtaining civic control of a stated portion of the company's system in accordance with a special Act enacted by the Ontario Legislature.

Montreal, Que.—President W. G. Ross, of the Harbor Commissioners, in company with Lieutenant-Colonel Labelle and M. P. Fennell, assistant secretary, have made recently an inspection of the grain-handling facilities at Buffalo. As a result, Mr. Ross is advocating strongly that further terminals and grain-handling facilities at Montreal, and the improvement of this city's canal system must be undertaken as a national duty, and the national prestige of handling Canadian business through Canadian seaports, instead of allowing Canada's trade to be taken care of by United States ports, must be preserved. To keep pace with the demands of the development of the Canadian West, and of the increase in trade which will be brought with the completion of the Erie Canal, Buffalo is contemplating the erection at once of several new elevators. For like reasons, improvements are being constructed in connection with the trading port of that city.

Victoria, B.C.—Since the first of the month exceptional progress has been made on the Sooke Lake waterworks scheme, especially on the construction of the dam at Humpback Reservoir and of the dam and head works at the lower end of Sooke Lake. And Engineer Rust expects, that with favorable weather conditions the concreting of both localities will soon be completed. At Sooke Lake, the arrival of the four large metal gates which are to be placed in the gatehouse in such a manner as to permit of the entry of lake water at various levels, is expected daily, and the installation of these will be carried out immediately. Moreover, a start has been made in laying the temporary railway line along the right-of-way from the lake works to the point on the flow line grade above Cooper's Cove, Sooke Harbor, whence the concrete pipe lengths for the flow line will be carried to the pipe line grade by inclined railway and thence distributed by railway along the grade. At Humpback, early in November, the work will be almost completed as far as the city intends to carry it by day labor, and will be ready for the call of tenders for concrete flow line and steel pressure pipe line.

St. John, N.B.—The water distributing system of St. John has undergone a splendid improvement during the past year. The renewals in the water mains covering a very wide area of the city are a necessary supplement to the increased supply and pressure obtained through the new supplying main which was laid to Loch Lomond a few years ago. The great increase in supply and pressure available through the supplying mains was in some sections of the city unavailable owing to the deplorable condition of the distributing mains. These mains have been renewed in the city this past year to the extent of 11,410 feet of 8-inch iron mains; taking the place of mains which ranged in size from 1 inch up to 4 inches. The mains which have been replaced were practically all blocked up to a considerable extent by the corrosion of the pipes. The expenditure on the renewals amounted to $30,000. The department has prepared for a comprehensive scheme of supplying Lancaster and the West side by means of a 20-inch main, which will be laid across the new bridge at the falls. About 2,000 feet of new 12-inch water main has been laid from the Riverview Park out to the bridge. This main will be connected with the Strait Shore main, and both mains will feed the extension across the new bridge. The level of Spruce Lake is only a few feet above the level of Lancaster, and the water supply in this section is hardly adequate, and in view of the rapidity of the growth of that section will become increasingly inadequate. The level of Loch Lomond is sufficiently higher than Lancaster to give an efficient water service there. There will also be the advantage of two sources of supply.

PERSONAL.

DR. FRANK D. ADAMS, Dean of the Faculty of Applied Science, McGill University, Montreal, has been elected an honorary member of the American Institute of Mining Engineers as one of the 20 honorary members of that organization.

A. C. D. BLANCHARD, B.Sc., M.Can.Soc., C.E., formerly city engineer of Lethbridge, Alta., has accepted an appointment to the engineering staff of the Greater Winnipeg Water District. Mr. Blanchard assumed his new duties a few days ago.

T. C. KEEFER, C.M.G., of Ottawa, a past president of the Canadian Society of Civil Engineers, and of the American Society of Civil Engineers, and a member of the Institution of Civil Engineers of Great Britain, was recently elected by the unanimous vote, an honorary member of the American Society of Civil Engineers. When president of that society, Mr. Keefer experienced the distinction of being the first to hold the office, who was not a citizen of the United States, and the society has further extended this honor in the above way. Mr. Keefer is well known among engineers. He has been connected in the past with many of the most important engineering problems of Canada, being as a student the winner of Lord Elgin's prize on "The Railways of Canada," and being one of the first to advocate the construction of the Transcontinental Railway 50 years ago. Mr. Keefer, for a number of years, held a professorship in engineering at McGill University.

OBITUARY.

GEORGE CROFT, contractor, who was putting in the concrete work in connection with the harbor development at Cobourg, Ont., met death on October 29th, by accidental drowning. Mr. Croft was a brother of C. E. Croft of the R. and O. Line, and of Harry Croft, superintendent of government work at Cobourg.

COMING MEETINGS.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

NATIONAL MUNICIPAL LEAGUE.—Annual meeting will be held in Toronto, November 12-15. Secretary, C. R. Woodruff, 705 North American Building, Philadelphia, Pa.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The annual meeting will be held in New York, December 2nd to 5th, 1913.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20648—October 22—Authorizing Twp. Saltfoot, Co. Wentworth, Ont., to construct and maintain highway known as 'Cochrane Road' across T.H.&B. Ry. in Lot 34, Con. 4, Tp. Saltfleet, Ontario, at its own expense. 2. Refusing application to construct highway known as 'Rosseay Road' across said Railway.

20649—October 23—Authorizing C.L.O.&W. Ry. (C.P.R.) to take certain lands for purpose of carrying out diversion of road allowance in Lot 34, Con. 8, Tp. Camden, Co. Lennox and Addington, and removing ground on north side of Co.'s right- of-way, in order to provide a non-obstructive view from said road allowance towards west as far as crossing of Bay of Quinte Ry. by C.L.O.&W. Ry. for a distance of 105 feet from said crossing, in accordance with provisions of Order No. 18696, dated February 13th, 1913.

20650—October 23—Authorizing C.P.R. to change present grade crossing in road allowance between Lots 24 and 25, Con. 3, Tp. Scarborogh, Co. York, Ont.; and construct additional track across said road allowance, at mileage 87.9 on Co.'s main line.

20651—October 23—Authorizing C.P.R. to construct road diversion in Lot 32, Con. 1, Tp. Scarborough, Ont., and to construct its tracks, by means of grade crossing, across said diversion, at mileage 90.4 on its main line, Toronto Subdivision.

20652—October 23—Approving location C.P.R. station at Lonsdale, Lot 23, Con. 2, Tp. Tyendinaga, Ont., at mileage 63.87 from Glen Tay; provided whenever it so develops that traffic on highway is blocked for more than 5 minutes at any one time by reason of location hereby approved, Board shall be at liberty to relocate said station.

20653—October 23—Authorizing C.P.R. to change present grade crossing on road allowance between Lots 34 and 35, Con. 1, Tp. Scarborough; and construct additional track (double track) by means of a grade crossing, across said road allowance, at mileage 91.2, on Con.'s main line, Toronto, Subdivision.

20654—October 23—Authorizing C.N.O.R. to construct across Third Street, town of North Bay, Ontario.

20655—October 22—Refusing application of village of Brechin for an Order directing C.P.R. to move its station from present location (approved by Order No. 15165, dated October 20th, 1912,) to a point nearer said village.

20656—October 22—Authorizing C.N.O.R. to construct, at its own expense, across Eglinton Avenue, between Lot 1, Con. 4, and Lot 5, Con. 3, Tp York, Co. York, Ontario.

20657—October 24—Authorizing C.N.R. to open for traffic that portion of its line from Macrorie to Tichfield, a distance of six (6) miles, and from the junction between Macrorie and Tichfield to Elrose, a distance of fifty (50) miles, in Prov. Sask.; trains operated over said line be limited to a speed not exceeding eighteen (18) miles an hour.

20658—October 24—Extending, until December 31st, 1914, time within which Quebec Oriental Ry. complete work of ballasting its railway from Metapedia to New Carlisle, with a complete lift of six (6) inches of ballast; and of renewing fences, gates, wooden culverts, and all decayed portions of trestles.

20659—October 23—Rescinding Order No. 19702, dated June 27th, 1913. 2. Approving Montreal and Southern Counties Ry. Co.'s Standard Passenger Tariff of Maximum Tolls, C.R.C. No. 4, on basis of 2½ cents a mile, to apply between Co.'s stations south of St. Lawrence River; said Tariff, with a copy of this Order, be published in at least two consecutive weekly issues of "The Canada Gazette."

20660—October 24—Dismissing application of Clifton Sand, Gravel and Construction Co., Limited, for an Order reducing, adjusting and fixing rates on sand, gravel and concrete material between Stamford, Ont., and surrounding points in Ontario, including Niagara Falls, Chippewa, Welland, Port Colborne, Thorold, Merritton, St. Catharines, Hamilton and Toronto and intermediate points.

20661—October 24—Authorizing town of Sarnia, Ont., to construct, at its own expense, highway across right of way and tracks of Pere Marquette Ry. at south limit of said town. 2. R.R. Co., at its own expense, raise its tracks so as to be level with highway, and keep cars 75 feet back from edge of crossing on each side. 3. R.R. Co. install improved automatic electric bell at said crossing, and thereafter maintain bell at its own expense. Town to reimburse R.R. Co. cost of installing said bell.

20662—October 24—Authorizing C.P.R. to construct road diversion in N.W. ¼ Sec. 8-11-9, W. 4 M., Alta.; and to construct tracks of its main line, Alta. Div., Lethbridge Subdivision, across said diversion.

20663—October 24—Amending Order No. 18110, dated November 23rd, 1912, by substituting name, "Robert W. King," for name, "King Constrnction Co.," wherever it occurs in said Order. 2. That words, "of the location of the said branch line, or spurs therefrom," following word "reason," where it appears in operative paragraph of said Order, be stricken out and following words substituted, "of the construction of the said branch line, or spurs therefrom, including damages, if any, occuring by reason of location of said branch line north of centre line of the said Sudbury Street." 3. That, with consent of all parties, Herbert E. Denton, Esquire, Junior Judge of the Co. York, be appointed Referee to ascertain and fix amount of compensation which Robert W. King, Wm. Bretzner, Mary Lyons, John McLean and John O'Neill are severally entitled to receive under terms of said Order No. 18110. 4. That costs of and incidental to said Reference, including those of said Referee shall be in discretion of said Referee. 5. That G.T.R. pay such, if any, snm or sums as said Referee may order to be paid to said claimants, or any of them.

20664—October 21—Directing that cost of installing new diamond, back-up derails, and derails necessitated by construction of double track at crossing by C.P.R. of G.T.R. in W. ½, Lot 14, Con. 2, Tp. Trafalgar, Co. Halton, Ont., at mileage 32.56 from Toronto, be paid by C.P.R. That cost of maintaining additional protection at said crossing be paid one-half by C.P.R., and one-half by G.T.R.

20665—October 27—Amending Order No. 180, dated July 6th, 1904, to provide further protection at crossing of Dundas Street, by G.T.R. and London Street Ry., city of London, Ont.

20666—October 25—Authorizing C.P.R. to open for traffic portion of double track from Pilot Butte, mileage 84.7 to Regina, mileage 92.0, Moose Jaw Subdivision, Prov. Sask.

20667—October 25—Authorizing C.P.R. to operate bridge No. 46.9 on Megantic Subdivision, Eastern Div.

20668—October 24—Recommending to the Governor in Council for sanction agreement entered into in duplicate, June 2nd, 1913, between C.P.R. and Kettle Valley Ry., providing for interchange of traffic between said two companies.

20669—October 24—Authorizing C.P.R. to construct siding for F. T. Proctor, Toronto, Ont., from point on S.W. limit of its main line, in Lot 10, 4th Con. West, Tp. Caledonia, Co. Peel, Ont., at mileage 24.5, Orangeville, Subdivision.

20670—October 23—Authorizing C.P.R. to construct, by means of grade crossing, its Ballast Pit spur across road al-

lowance between Indian Reserve and Tp. Thessalon, Dist. Algoma, Ont., mileage 3.08 of said spur, subject to certain conditions.

20671—October 24—Approving location C.L.O. and W. Ry. (C.P.R.) station at Bowmanville, in Subdivision, Lots 2 and 3, and Lot 13, Con. 1, Tp. Darlington, Co. Durham, Ont., lying west of Scugog Street, town of Bowmanville.

20672—October 25—Directing that New Ontario Farm and Townsites, Limited, and Lieutenant-Colonel Geo. A. Shaw, be declared parties interested and Respondents herein, together with Whitford Vanduson, the registered owner of land above mentioned. And authorizing C.N.O.R. to take, for purposes of efficient construction and operation of its railway, and in order to carry out works approved by Governor in Council on April 27th, 1910, portion Lot 13, Con. 1, Tp. Nepigon, Ont., paying compensation to parties entitled thereto in accordance with provisions of Railway Act.

20673—October 24—Approving revised location C.N.O.R. through Tp. York, and part city of Toronto, Ont., mileage 2.23 to 6.16 from Yonge Street, subject to certain conditions. And refusing Co.'s application for level crossing of C.P.R. main line.

20674—October 27—Authorizing C.N.R. to open for traffic its line from Alsask to Hanna, distance of 93 miles; and from Hanna to Munson, a distance of 40 miles.

20675—October 25—Authorizing C.N.R. to construct across Leitchfield Avenue, Athabasca, Alta., subject to terms of consent.

20676—October 23—Refusing application residents of La Conception, Que., for Order directing C.P.R. to employ an agent at La Conception. 2. C.P.R. provide telephone connection at La Conception Station with agent at Mont Tremlant, also with station at Labelle: That Conductors on Ry. Co.'s trains sell tickets to patrons boarding trains at said flag station or stations, on same basis and advantages as authorized at organized stations.

20677—October 24—Directing that C.N.O.R. forthwith construct livestock pass under its railway on farm of W. R. Kirk, Foresters Falls, Ont., on or beside his farm lane; pass to be 7 feet wide by 7 feet high, properly drained and paved. Co. also construct, at such points as Applicant may desire, grade crossing convenient and proper for farm purposes. Co. shall not block said grade crossing longer than five minutes at any one time when crossing is desired to be used.

20678—October 27—Rescinding Order No. 19468, June 4th, 1913; and Lake Erie and Northern Ry. is declared to have seniority as to trains over Brantford Street Ry., at point of crossing.

20679—October 23—Granting leave to Ottawa Electric Co. to erect poles and wires across C.P.R. on River Road, south of Hurdman's Bridge, Ottawa, Ont.

20680—October 23—Granting leave to Ottawa Electric Co. to erect poles and wires across C.P.R. on private road leading from River Road south, to Convent of Grey Nuns, near Hurdman's Bridge, Ottawa, Ont.

20681—October 27—Directing that, pending extension and operation of C.N.R. to Estevan, C.P.R. publish and file through freight tariff of class rates from Estevan, via Midale, to those points on C.N.R. to which through class rates, via Midale, are published and filed by C.P.R. from Weyburn, Sask., said through rates from Estevan not to exceed sums of published and filed local rates of C.P.R. to Midale and of C.N.R. from Midale to Weyburn destinations: Provided so long as Midale Transfer continues a non-agency, C.P.R. be permitted to consolidate less-than-carload shipments by holding them at Estevan until they approximate a carload of 20,000 lbs. in weight for transfer to C.N.R., without breaking bulk. Said tariff to be made effective not later than November 20th, 1913.

20682—October 27—Approving and authorizing clearances as shown on plan of door openings at factory of Canada Wire and Cable Company, Limited, Leaside, Ont.

20683—October 27—Approving plan showing method of temporarily reinforcing existing piers of New Brunswick Coal and Railway Co.'s Bridge No. 44.7 over Salmon River, near Chipman, New Brunswick.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received:—1105.—A Maritzburg firm of hardware merchants wishes samples and quotations of fencing wire. 1106.—A Natal firm desires quotations and samples of Canadian bolts and nuts. 1116.—A Natal firm of hardware merchants can handle a quantity of splitwood pulleys, small sizes, 6 to 18, and a few 24. 1163.—A South African firm wishes catalogues and quotations on Canadian-made shovels. 1168.—Quotations are requested by a South African firm of commission agents on Canadian lumber. 1175—A Johannesburg firm of lumber dealers requests quotations on best quality pine in the rough. Width, 12 inches and wider. 1176—A Johannesburg firm of lumber dealers desires quotations on best quality poplar lumber in the rough. Width, 12 inches and wider. 1177.—A Transvaal firm of lumber dealers desires quotations on No. 2 quality pine shelving. Width, 12 inches only. 1178.—A Johannesburg firm of lumber dealers request quotations on spruce shelving. Width, 12 inches only. 1179.—Quotations requested by a Johannesburg firm of lumber dealers on deals and timber of various sizes, all in the rough. 1181.—A Johannesburg firm of machinery dealers will take up a Canadian agency for above. 1182.—A Transvaal firm of machinery importers is willing to take up an agency for Canadian esbestos. 1204.—A Johannesburg firm of importers desires catalogues and prices of all kinds of Canadian-made mining tools. 1205.—Catalogues and prices are requested by a Transvaal importing house on all kinds of mining material. 1206.— A Johannesburg firm of mining material importers wishes catalogues and prices of Canadian manufactured mining machinery. 1289.—Wanted by a Bloemfontein firm, an agency for Canadian-made motor delivery waggons and vans. 1301.—An Orange Free State firm of importers requests prices and samples, if possible of Canadian-made leather belting. 1306.—A South African firm of hardware importers desires catalogues and prices of Canadian-made brickmaking machinery. 1308.—An Orange Free State firm of hardware merchants desires catalogues and prices on cranes and elevators of Canadian manufacture. 1309.—A South African firm of general merchants desires catalogues and prices on Canadian-made irrigation machinery. 1310.—An Orange Free State firm of hardware importers would like to communicate with Canadian manufacturers and exporters of milling machinery. Catalogues and prices requested. 1311.—A South African firm of general merchants requires catalogues and prices on sawing machinery of Canadian manufacture. 1312.—A South African firm of general importers wishes to correspond with Canadian manufacturers and exporters of mining machinery. Catalogues and prices required. 1313.—A Bloemfontein firm of hardware dealers would like to be placed in communication with Canadian manufacturers and exporters of windmills. Catalogues and prices requested. 1336.—A Capetown firm of commission agents wishes to be placed in communication with Canadian manufacturers and exporters of forges. 1374.—Samples and prices are requested on bolts and nuts of Canadian manufacture by a Natal firm. 1481.—A Transvaal firm of importers asks for catalogues and prices on mining tools of Canadian manufacture. 1482.—A South African firm of importers requests prices and catalogues on Canadian-made shovels.

The names of the firms making these inquiries may be obtained upon application to:—"The Inquiries Branch the Department of Trade and Commerce, Ottawa, or the Secretary of the Canadian Manufacturers' Association, Toronto; or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary, and Chambre de Commerce du District du Montreal."

The following was among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W. An engineer, in Yorkshire, who has, for many years' past specialized in the manufacture of brickmaking machinery, would like to correspond with manufacturers in Canada who might be disposed to enter into negotiations for the manufacture of machines from his patterns and drawings.

Tarvia

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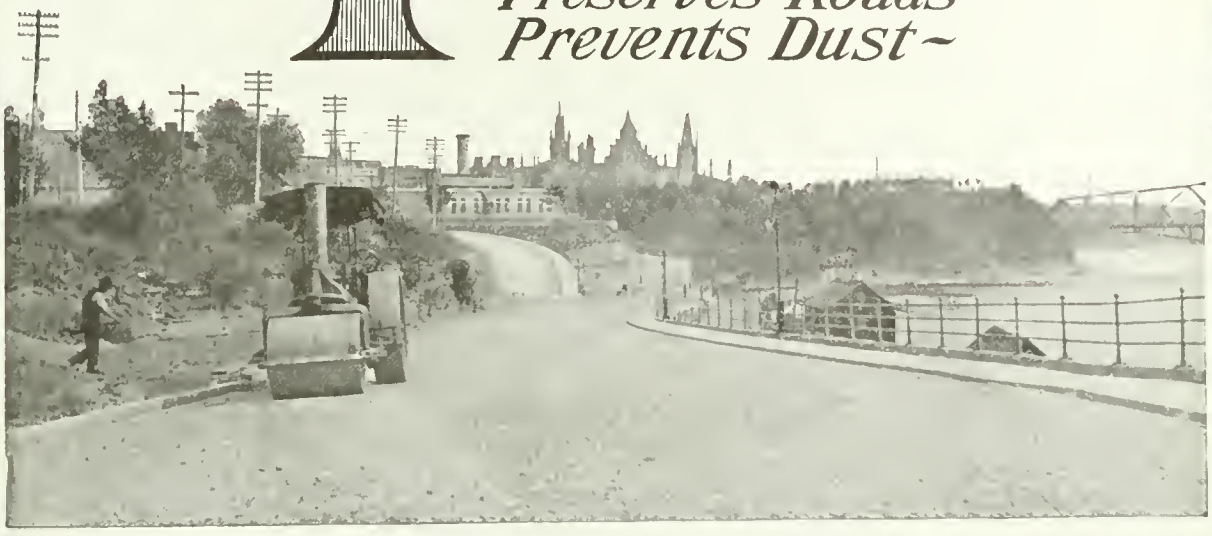

Lady Grey Road, Government Road, Ottawa, Ont. Canada's Mint in foreground. Parliament Buildings in background. Tarvia Modern Pavement finished Aug. 1, 1913.

A New Principle in Road Building

IT has long been recognized by engineers that one of the greatest causes of the destruction of macadam roads by traffic has been the internal movement caused by the passage of heavy loads. The endless shifting and creeping of the lower courses of stone causes a grinding and pulverization which destroys the stone and breaks the bond.

To reduce this internal movement engineers have buried the larger stone under successive layers of finer stone. This fine stone forms dust more rapidly but the dust serves to protect the foundation of the road by acting as a cushion. Modern traffic makes the use of such dust cushions quite impracticable, for the automobiles not only stir up the dust but create entirely new conditions by scouring the surface of the road and breaking the bond with the backward thrust of their driving wheels.

The possibility of making roads automobile-proof by using Tarvia as a binder from top to bottom of the wearing-course during the construction of the road has now been satisfactorily demonstrated. The Tarvia fills the voids and forms a tough, durable matrix in which the stone cannot shift or grind. Consequently it has become possible to use large stone in a much greater proportion of the construction. The fine screenings and stone chips are used only on the surface as a finishing coat.

Traffic wearing away the surface strikes the layer of large stone in the tarvia matrix and makes little or no impression upon it. The large stone pulverizes but slowly and cannot be torn loose by automobile wheels. It does not change contour, sheds water instantly, is free from dust, costs but a trifle more to build than ordinary macadam, costs much less to maintain.

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MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Ainsworth, B.C., wharf	Nov. 17.	Oct. 30.	74d.
Assiniboia, Man., pavement	Nov. 25.	Oct. 30.	86
Calgary, Alta., motor generator, &c.		Oct. 30.	74c.
Fort William, Ont., harbor and river improvements in Mission River	Nov. 21.	Oct. 30.	84
Ottawa, Ont., diversion of line, North Sydney to Leitches Creek	Nov. 10.	Oct. 30.	88
Ottawa, Ont., section 5, Welland Canal	Nov. 18.	Oct. 30.	82
Ottawa, Ont., conveyance of mails	Nov. 14.	Oct. 16.	86
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Port Hope, Ont., harbor improvements	Nov. 17.	Oct. 23.	84
Prescott, Ont., lighthouse lanterns	Nov. 8.	Oct. 30.	74b.
Rainy River, Ont., pile protection work	Nov. 17.	Oct. 23.	82
Rocky Point, P.E.I., wharf	Nov. 12.	Oct. 23.	82
Saskatoon, Sask., sewer and water mains		Oct. 16.	78
Toronto, Ont., steelwork for bridge	Nov. 25.	Oct. 16.	84
Toronto, Ont., pumping engines, &c.	Nov. 25.	Oct. 16.	84
Toronto, Ont., sub-contracts for Methodist Book and Publishing Co.		Oct. 16.	82
Toronto, Ont., steel conduit	Nov. 18.	Oct. 23.	86
Toronto, Ont., casting, pipes, valves, &c.	Nov. 18.	Oct. 23.	86
Toronto, Ont., conveyance of mails	Nov. 14.	Oct. 23.	86
Victoria Harbor, B.C., wharfs	Dec. 9.	Oct. 30.	84
Winnipeg, Man., pumping units, &c.	Nov. 15.	Oct. 30.	74d.
Winnipeg, Man., water supply..		Oct. 16.	86

RAILWAYS—STEAM AND ELECTRIC.

Brantford, Ont.—It has been intimated that the management of the Brantford and Hamilton Radial Company is considering the advisability of double-tracking its line between Brantford and Hamilton. Also from what can be learned, the construction of another track between the points mentioned will be started in the spring.

Hamilton, Ont.—It has been learned that the Toronto, Hamilton and Buffalo Railway Company has in serious contemplation the addition to its services between Hamilton and Waterford, and particularly between Hamilton and Brantford, of steel gas-electric motor cars. It is understood that the company has ordered at least two of its engineers to prepare for the examinations on gas-electric engines, and that the motor cars will be of the latest type and design.

Medicine Hat, Alta.—An arrangement has been completed by which work on the railway spur to the west industrial site will be completed immediately. The financial responsibilities have been arranged for by Mr. A. M. Grace; and the C.P.R. has agreed to supervise the construction work and furnish the necessary motive power for the operation of the spur, which will be completed within the next two or three weeks.

Nelson, B.C.—By an overwhelming majority, the stockholders of the Nelson Street Railway Company voted to sell out to the city for 50 cents on the dollar, payable in 20-year 5 per cent. debentures. A by-law to authorize the issuance of bonds is to be submitted to the people at the same time as the by-law to purchase the gas plant for $50,000.

Ottawa, Ont.—It is stated that the tenders received by the Department of Railways for the Intercolonial terminals at Halifax do not meet with all the requirements, and it is understood that they will not be considered, but that new tenders will be called.

Owen Sound, Ont.—At a recent meeting of the Owen Sound board of trade, a resolution was adopted requesting the town council to appeal to the Ontario Government through the Hydro-Electric Commission to investigate the question of constructing a radial railroad from Owen Sound to Guelph. The government will be asked to furnish estimates of the cost.

Toronto, Ont.—Mr. T. J. Glover, promoter of the Forest Hill Railway, has announced that the company will spend $50,000 within a year on active construction work. Until the plans have been settled finally, the company will not declare the route of the road.

Vancouver, B.C.—It is reported that Sir Richard McBride, Premier of British Columbia, has concluded a deal with the Standard Oil Company to give them a charter at the coming session of the Provincial Legislature for a railroad to be built through to Alaska. The line is to run in connection with the Chicago, Milwaukee and St. Paul Railway, with headquarters at Seattle, linking the Pacific Great Eastern with Fort George.

Vancouver, B.C.—A reciprocity arrangement has been suggested by the Board of Railway Commissioners to deal with the respective applications from the Wellington Colliery Company to cross the tracks of the E. and N. Railway and vice versa.

Victoria, B.C.—The officials of the C.N.P. Railway Company are engaged in the preparation of plans for continuing the road towards the north of the Island. The announcement that no further contracts will be awarded until the Saanich work, now in progress and due to be finished by the end of January is concluded, does not mean that a line as far as Alberni, or even as far as Nootka Sound, shall be the extent of the company's operations. It has been announced that several survey parties have been employed in the country north of Alberni canal, and the impression is given that, as soon as the enterprise now in hand is completed, the company will undertake the penetration of the Island's extreme north. A definite survey has been prepared for a road connecting with the Canadian Northern Pacific at Alberni and running through to Nootka Sound, reaching the latter harbor by a route which, in its final stages, skirts the banks of the Muchalat Arm. En route, a branch has been run to Duncan Bay. This survey, except in some minor particulars, has been adopted, and, when the contractors are relieved of the work now in hand between this city and Alberni, it is probable that tenders will be called for this section. No actual line has been surveyed north of Nootka, but the report of a reconnaissance party, which has been in the field for some months, is said to have been of a very favorable character as to the practicability of continuing the road through

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in Great Britain in varying quantities up to 15 miles; in Canada, to 17 miles.

Seven hundred miles of weldless steel spigot and faucet tubes—quite apart from flanged tubes and lapwelded spigot and faucet tubes—are in use in the United Kingdom, as well as large quantities in Canada, Australia, South Africa, South America, India, China, New Zealand and Europe.

We are constantly adding new customers to our list, and, what is of even greater significance, more frequently still receiving repeat orders.

Solid drawn tubes are used in places where it is impossible to use cast-iron pipes or lapwelded tubes, as well as in places where the conditions are more normal.

In the past five years the sale of Mannesmann weldless steel spigot and faucet tubes (home trade alone) increased one thousand per cent., and during the last financial year reached the figure of about 5,000 tons, equal to 15,000 tons of cast-iron, in addition to a large export business.

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BOOKLETS ON REQUEST

to Quatsino and the north end of the Island. It is said that it has been found that the summit in the Kla-Anch River country is not as formidable as has been thought, and that it will be possible to pick a first-class route into the most northerly regions of the Island.

Winnipeg, Man.—A spur line to serve the premises of the Midland railway industrial site has been approved by the Winnipeg works and property committee.

Winnipeg, Man.—The city light and power company has been granted permission by the public utilities commission to extend a line into the Grand Trunk Pacific shops, with the understanding that proper safety precautions be taken.

Winnipeg, Man.—Sir Thomas Shaughnessy, president of the C.P.R. Company, has assured Mr. Geo. H. Bradbury, M.P. for Selkirk constituency, that the extension of the Selkirk line to Icelandic River will be completed next summer without fail. This stretch of 20 miles is already graded and awaiting steel.

GARBAGE, SEWAGE AND WATER.

Fredericton, N.B.—As an endeavor towards securing a better quality of water than that reported by Mr. H. H. Hagerman, the analyst, the Board of Health has decided to address a letter to the city council, asking that steps be taken to remedy conditions at the filtration plant in connection with the Municipal Water Department, and also to forward to Alderman Everett, chairman of the water committee, a copy of the analyst's report. Immediate action by the council will be requested.

Medicine Hat, Alta.—Chief Provincial Engineer Owen is investigating the protest of Medicine Hat against sewerage from the town of Redcliff being drained into the Saskatchewan River above the water intake of Medicine Hat's waterworks system.

Medicine Hat, Alta.—Among other by-laws passed by the city council of Medicine Hat to be submitted to the people, in the event of the assent of the burgesses, upon the 29th of November, are one providing for borrowing $175,000 upon debentures to pay for extending and improving the waterworks system, and one for $60,000 to pay for the construction of surface and storm sewers throughout the city.

Montreal, Que.—The program of sewers to be undertaken next year will include the finishing of the trunk sewers from Notre Dame de Grace and from St. Denis wards to the Back River, and the construction of a new trunk sewer through the east end to Bout de l'Isle. The laying of miner sewers only where most needed will also form a small part of the program of sewer construction. The cost of the sewer from St. Denis ward alone will be in the neighborhood of $1,000,000.

Ottawa, Ont.—Tenders will be received up till November 6th for the construction of the West End intercepting sewer. Plans and specifications may be obtained from Arch. Currie, City Engineer, City Hall, Ottawa, Ont

+—Port Arthur, Ont.—The city of Port Arthur is installing a complete new waterworks system, comprising a duplicate pipe line of welded steel pipe of 24-inch diameter. This pipe line will be about five miles long, totalling 10 miles of pipe. The pipe is being delivered now, a considerable amount having already arrived by the boat-load manufactured in Coatbridge, Scotland, all subjected to test of 500 lbs, to the square inch. MESSRS. DRUMMOND McCALL of Montreal are the contractors for the delivery of this pipe and special parts. Six miles of pipe are already on hand, and it is hoped to have the balance by the close of navigation. A complete and up-to-date pumping station is being erected at the shore end of the intake, and the entire system will be completed and in operation by the summer of 1914.

Toronto, Ont.—The works department of Toronto will likely call for tenders within two weeks for one or two 20-million gallon pumps, 110 pounds pressure, for the main pumping station. Tenders will be asked on both high duty and centrifugal pumps. These two proposed pumps will bring the capacity of the main pumping station up to 106,000,000 gallons daily, or sufficient to handle the city's needs even after the installation of the filter plant.

▲—Toronto, Ont.—Tenders will be received up till November 15th for the construction of a sewer on Bathurst Street, in the Township of York. Plans and specifications may be obtained from Frank Barber, C.E., Township Engineer, 57 Adelaide Street East, Toronto, Ont.

Vancouver, B.C.—Early in November, the Burrard Peninsular sewerage commission will meet to consider calling for tenders for this winter's program of sewerage construction. This winter's work on the construction of the Greater Vancouver sewerage system will involve an expenditure of approximately $400,000; and in the spring $2,500,000 will be raised by the sale of bonds guaranteed by the Provincial Government to continue the work.

+—Victoria, B.C.—The city council has approved the letting of the contract for the construction of the concrete flow line to the GRAFF CONSTRUCTION COMPANY, providing the company satisfies the water commissioners on or before November 10 concerning certain phases of their tender for the Sooke Waterworks pipe-line.

Welland, Ont.—Hon. Frank Cochrane, in a letter to Mayor Goodwin, announces that the Government will not pay for all the loss Welland will suffer by reason of the demoralization of the waterworks system and sewage system when the canal is enlarged. He does not say just what proportion the Government will pay, but leaves the inference that the town will not be forced to assume the entire burden.

Winnipeg, Man.—The Northwest Ratepayers' Association are endeavoring to draw the attention of the Board of Control to the necessity of constructing a culvert across McPhillips Street at some convenient point to take away the surface water in the spring, and also a water main in Magnus Avenue, near the Stonewall branch of the C.P.R. to do away with the dead end in the vicinity.

Winnipeg, Man.—Mayor Deacon of Winnipeg has been requested to further the interests of Canadian contractors in the awarding of contracts for the Shoal Lake water scheme.

LIGHT, HEAT AND POWER.

Ayr, Ont.—A by-law is to be submitted to the municipality of Ayr on December 1st, concerning the making of a contract with the Hydro-Electric Power Commission for the supply of power to Ayr at an approximate cost of $38 per horsepower.

Halifax, N.S.—The result of the meeting of the Halifax Medical Council in connection with the typhoid epidemic raging in the city, was to adopt the following resolution and send it to the city Board of Health:—"Resolved that this society represent to the city Board of Health, its belief that the entire watershed of the lakes from which the city water supply is obtained, should become the property of the city, and that no person should be permitted to reside or trespass upon the watershed."

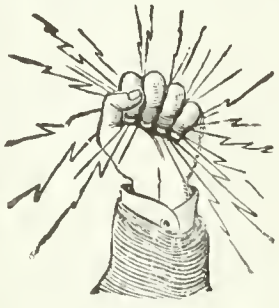
Kildonan, Man.—The municipal council has instructed Engineer Parr to negotiate with the solicitors the matter of by-laws for paving Main Street and East Kildonan road on the east and west sides of the river, the width to be 20 feet, and to be constructed adjacent to the proposed car line in the centre of the street. The engineer is also to furnish at once complete plans and estimates.

London, Ont.—The Ontario Hydro-Electric Power Commission are considering the estimates which are now in their hands for the proposed contract for hydro power between the London street railway and the local water commission. The estimates include the street railway company's revision.

London, Ont.—The London Street Railway and Water Commission has completed to all practical purposes the agreement by which the street railway will use the hydro-electric power. The company is to take a minimum of 1,000 horsepower, direct current; and in order to convert the power to alternating current a rotary generator will be installed at a cost of $20,000. It is expected that the agreement will be finally signed within a couple of days, and this agreement will run for 12 years—e.g., to the end of the present franchise of the street railway.

Medicine Hat, Alta.—Two by-laws will be voted upon at Medicine Hat on November 20th in connection with the city's light and power department, the first to provide for borrowing $150,000 upon debentures to pay for increasing and extending the electric light and power plant and for extending and improving the electric light and power systems; the second, to provide for borrowing $50,000 upon deben-

PHILLIPS



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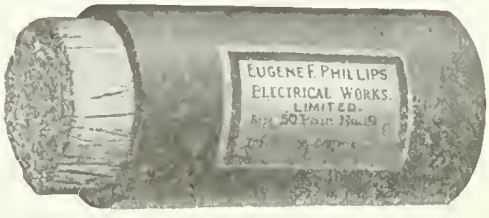

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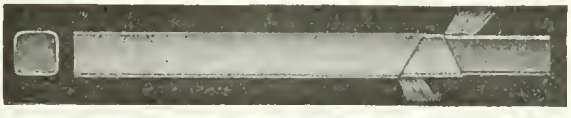

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tures for extending the city's gas system, and for drilling, boring, and constructing gas wells for any purpose authorized by the Medicine Hat charter.

New Glasgow, N.S.—The Pictou County Electric Company are enlarging the capacity of their power plant at Stellarton. An outfit that will double the present equipment, consisting of boilers, generators, engines, etc., has been purchased and will be completely installed within a month's time.

Ottawa, Ont.—The control of the Great Falls on the Winnipeg River has passed into the hands of the Winnipeg Electric Railway. The lease runs for a period of 21 years, renewable for three further similar periods, or altogether for 84 years. The Government will control the rates to be charged to the consumer, and the rental will be considered at every renewal. The Government further reserve the right at the end of each period or at the conclusion of the 84 years to buy back the development. According to the new agreement the development must be carried out as a component part of a comprehensive scheme of power development comprising all the falls on the river between Lac du Bonnet and Lake Winnipeg. This scheme contemplates the concentration at the various falls of the river at three points where 75,000 horsepower can be developed. These three points are Pine Falls, Great Falls and McArthur Falls. Surveys and investigations leading up to the extensive power scheme have been under way for the past three years and have just been completed. Work has been carried on by expert engineers under the advice of consulting engineers prominent in hydro-electric practice. A full report of this investigation is under preparation and will be published at an early date. J. T. Johnston, hydraulic engineer of the waterpower branch, is now on his way to Winnipeg to confer with the engineer retained by Sir William Whyte and to satisfy the department that the Great Falls development will not be inimical to the more comprehensive scheme of development proposed.

Ottawa, Ont.—City Bacteriologist Race reported rather favorably on the present condition of the Ottawa River water at a Board of Health meeting recently. Only in one ward, Capital Ward, were the marked signs of contamination most prevalent. This he attributed to the number of dead ends of pipes in that section and advocated more frequent flushing. He regarded, however, the Gatineau lakes as the solution of Ottawa's water problem.

Regina, Sask.—The city commissioners have opened tenders for a 3,000 k.w. turbo-alternator, which it is estimated will be required about a year from now. They have also referred to the decision of the Fire, Light and Power Committee a recommendation for a contract for the supply of a travelling crane for the new power house based upon the tenders which have been received.

St. Catharines, Ont.—The Hydro-Electric by-laws, which were voted upon at St. Catharines on October 30th, met with very slight opposition. The city will now be enabled to sign the contract with the Hydro-Electric Commission, and to issue $116,000 debentures for the establishment of a distributing system and stepping-down plant to use the Hydro power, which is to be sold to the city at $14 per horsepower.

+—Toronto, Ont.—An agreement of contract has been signed between the TORONTO HYDRO-ELECTRIC COMMISSION and the T. Eaton Co., Limited, for the supply of 2,000 kilowatts, or about 2,500 horsepower, of electrical energy from the commission. This additional amount of energy is required by the T. Eaton Company as a supplement to the supply generated by its own plant, and will cost the company about $50,000 per year. This contract is the largest yet obtained by the commission with the possible exception of the agreement for the supply for the dredging operations in Toronto Bay; and the commission will have to increase its supply from the provincial commission to meet the requirements of the new contract.

Welland, Ont.—The report of the provincial analyst received by Dr. Howell, M.O.H., on samples of water recently sent to be tested, has shown the spring water at the east end of the canal to be badly contaminated, and the well has been closed to the public.

Winnipeg, Man.—Tenders will be received up till December 1st, 1913, for the supply of d.c. and a.c. meters as may be required by the city Light and Power Department during one year from the date of contract. Plans and specifications may be obtained from the city Light and Power Department, 54 King Street, Winnipeg, Man. Signed, M. Peterson, Secretary, Board of Control, Winnipeg.

Winnipeg, Man.—Public Utilities Commissioner Robson announced recently that, in accordance with the policy outlined at the last session of the Manitoba Legislature, he is now prepared to go to outside points in the province to hear representations in regard to water power, this with a view to the establishment of a hydro-electric commission for Manitoba.

BRIDGES, ROADS AND PAVEMENTS.

Assiniboia, Man.—Tenders will be received up till November 25th for the construction of an asphalt pavement on the north side of Portage Road, for approximately 7¼ miles. Plans and specifications may be obtained from Frank Ness, Clerk, Rural Municipality of Assiniboia, Man.

Edmonton, Alta.—A petition signed by all the wholesalers in the district on 103rd and 10th Streets has been presented to the city commissioners, asking for the opening of a subway under the Canadian Northern yards on 104th Street, and has been referred to the city council.

Guelph, Ont.—Though the time limit set for the contractors who are building the Heffernan Street bridge has expired, the bridge is far from being completed.

Kamloops, B.C.—The Canadian Northern Pacific Railway Company are commencing the construction of the second bridge across the North Thompson River above Kamloops. The structure is to be a seven 80-foot deck girder span bridge.

Kildonan, Man.—In a recent meeting of council, it was suggested that a bridge should be built over the Red River to give better communication between the communities on the two sides of the river. A committee was appointed, also, to wait upon the provincial minister of public works to see what grants the department would allow for improvements to the roads of the municipality.

Le Pas, Man.—It is announced that work on the steel bridge across the Narrows at Cormorant Lake, on the Hudson Bay Railway is to be commenced soon, and that the two abutments for the cantilever bridge across the Nelson River will be built this winter. The necessary cement is to be hauled from Whiskey Jack Portage on Cross Lake, at the head of Lake Winnipeg.

Medicine Hat, Alta.—The city council has passed a by-law to be submitted to the people on November 29th for the borrowing of $50,000 upon debentures for grading and gravelling of streets and for purchasing road construction plant and machinery.

Ottawa, Ont.—Ex-Mayor Charles Hopewell appeared on behalf of the Ottawa Valley Motor Car Association before the Public Roads and Highways Commission, which met in Ottawa recently, and advanced reasons for the construction of an adequate highway between Ottawa and Prescott.

Toronto, Ont.—Mr. Frank Barber, engineer for York Township, has completed, in accordance with the order of the council, some weeks ago, plans for a high-level bridge over the West Don River, alongside the C.P.R. viaduct No. 3, and approximately at the corner of Leslie Street and Eglinton Avenue. The construction of this bridge will mean that Eglinton Avenue will be made a through road on high level.

▲—Toronto, Ont.—Tenders will be received up till November 8th for the construction of Rocmac Pavement on Spadina Road, in the Township of York. Plans and specifications may be obtained from Frank Barber, C.E., 57 Adelaide Street East, Toronto, Ont.

▲—Toronto, Ont.—Tenders will be received up till November 14th for the construction of pavement on King and Guelph Streets, Preston, Ont. Plans and specifications may be obtained from Frank Barber, C.E., 57 Adelaide Street East, Toronto, Ont.

Vancouver, B.C.—Mr. O. S. Bowen, Seattle, the assistant chief engineer of the Great Northern Railway, stated recently in Vancouver that the railway corporation propose to commence in the near future work on the permanent bridge over the Grandview cut at Broadway. The structure will be of 4-plate girder spans, and of the best type of construction.

Vancouver, B.C.—The Ward Four Ratepayers' Association has endorsed the extension of Venables Street along the British Columbia Electric Railway Company's right-of-way.

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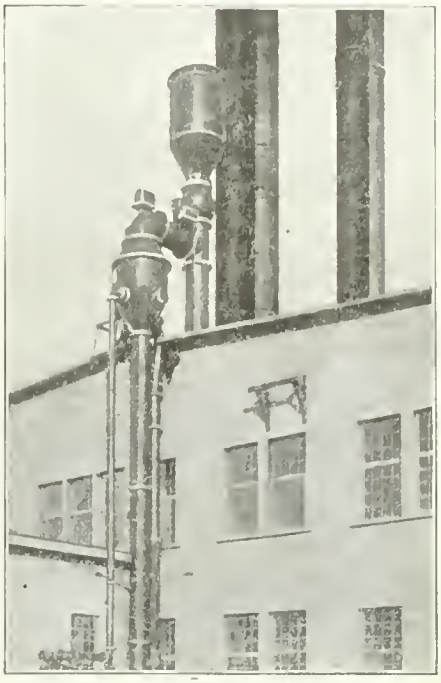

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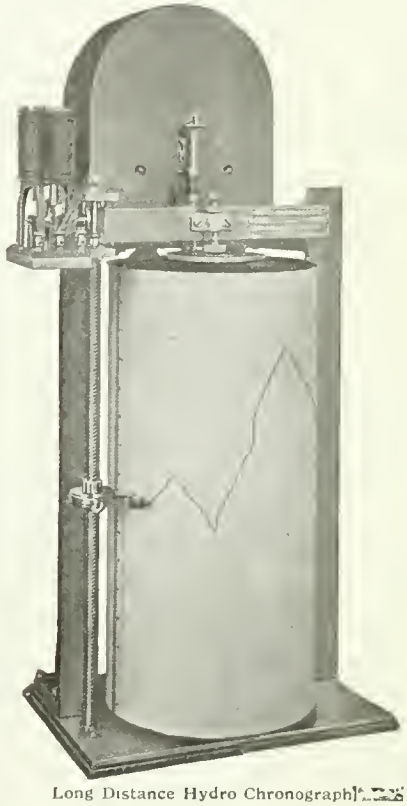

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Estimates of that scheme and of the alternate plan of a route by Prior Street were submitted to the association, but a resolution was passed approving the former; and coupled with it was a condition requiring the British Columbia Electric Railway Company to lay double tracks on Prior Street from Campbell Avenue to Main Street, when requested to do so by the city council.

Vancouver, B.C.—The civic board of works and the C.P.R. officials have come to an agreement concerning the taking over, by the city, of Hamilton and Mainland Streets, which lie in the C.P.R. warehouse reserve. The railway company is to pay for half the paving of the streets on which their tracks run, including the 6-foot sidewalk, and will, moreover, arrange with the property owners as to the building of the concrete platform at the side of the portion of the street to be taken over by the city.

Vancouver, B.C.—The Board of Railway Commissioners has decided with respect to the application made by the V.V. and E. Railway for the purpose of diverting Gunn Road and Brunette Road and a protest from the municipality of Coquitlam on the same question, that a previous order issued by the Board covered the situation. Chairman Drayton directed that a conference be held between the railway engineers and the city of New Westminster to settle other debated points.

Vancouver, B.C.—The Great Northern Railway has been given a peremptory notice by the Railway Board of Commissioners to reach an agreement with the city of Vancouver within 30 days respecting plans for the proposed overhead bridges at Hastings, Pender, Keefer and Harris streets. And seven days, after the expiration of the 30-day limit set for the railway company, were allotted the company and the city to forward the result of their conferences on the viaduct question to the Board of Commissioners for approval.

+—Victoria, B.C.—The contract for the erection of Taghun Bridge, near Nelson, B.C., involving an expenditure of about $75,000, has been awarded by the Department of Public Works. The CANADIAN NORTHWESTERN STEEL COMPANY will supply the steelwork at approximately $4.45 per 100 pounds of metal. HUDSON KING AND PHELAN BROTHERS were awarded the contract for concrete substructure and the work of erection, at a cost of about $55,000. The work is to be commenced at once, so as to have the bridge completed for the early summer traffic next year.

Victoria, B.C.—The Inner Harbor Association has added its objection to that of the city council made recently, to the erection of a trestle viaduct by the C.N.P. Railway Company over the Victoria Arm. The association object for several reasons, its first one endorsing that of the city council, e.g., that a pile viaduct and bank would be the ugliest form by which the beautiful stretch of water, the Victoria Arm, could be crossed.

Victoria, B.C.—A proposal is being made before the Federal Government for a resolution to set aside a large sum for the construction and maintenance of highways, the money to be divided among the provinces upon a subsidy basis.

INDUSTRIAL WORKS.

Fredericton, N.B.—The survey being conducted by the Dominion Government Department of Public Works to make the final estimates of the dredging work done in the St. John River last summer was completed last week.

Le Pas, Man.—As much work as weather will permit is to be done on the Hudson Bay Railway terminals east of Le Pas this fall, and next spring work will be commenced on the roundhouse and machine shops, plans for which have been prepared. The site of the $75,000 station has not yet been determined; but this building is to be completed by January 1st, 1915.

Ottawa, Ont.—Tenders will be received up till December 1, 1913, for the construction of a wharf at Heustis Landing, Queen's Co. N.B. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Montreal, Que.—The Harbor Commissioners have completed the purchase of a block of east end land for $163,312, which has been secured for harbor extension down the river.

New Westminster, B.C.—At the recent meeting of the Board of Railway Commissioners held in Vancouver, it was agreed that an arrangement should be made later to decide on an application made by the city of New Westminster for an order to apportion the cost of a concrete retaining wall to replace wooden crib work in front of the Penitentiary Grounds.

▲—Ottawa, Ont.—Tenders will be received up till November 18th for the construction of Section No. 5, Welland Ship Canal. Plans and specifications may be obtained from the office of the Chief Engineer, Department of Railways and Canals, Ottawa. Signed, L. K. Jones, Esq., Assistant Deputy-Minister and Secretary, Department of Railways and Canals.

▲—Ottawa, Ont.—Tenders will be received up till November 20th, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging and filling of reclaimed areas. Plans and specifications may be obtained from L. K. Jones, Esq., Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, Ont.

▲—Ottawa, Ont.—Tenders will be received up till December 2nd, 1913, for the construction of a wharf and warehouse at Richard's Landing, St. Joseph Island, Algoma District, Ont. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—The award of contract for Section 3, Welland Ship Canal, to Baldry, Yerburgh, and Hutchinson, at $5,377,185, has been formally confirmed by the Cabinet of the Dominion Government; and tenders for the 5th division are called. This divison is 3 miles in length, extending from a point in Port Robinson to a point in about the centre of Allenburg. Comparatively little rock-cutting will have to be done on this section, and the cost is not expected to exceed three million dollars.

Ottawa, Ont.—Tenders will be received up till December 9th for the construction of wharves at Victoria Harbor, B.C. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—Tenders will be received up till November 24th for the construction of East Breakwater Pier at Seal Cove, Grand Manan Island, Charlotte Co., N.B. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—Tenders will be received up till November 12th, 1913, for improving the lower entrance to Lock No. 20. Plans and specifications may be obtained from the Department of Railways and Canals, Ottawa, Ont. L. K. Jones, Esq., Assistant Deputy Minister and Secretary.

Ottawa, Ont.—Tenders will be received up till December 1st, 1913, for the construction of an extension to the wharf at Callendar, Ont. Plans and specifications may be obtained from the Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

Saskatoon, Sask.—The commissioners have recommended to the city council the construction this year of a concrete tunnel at the pumping station between the intake well and the low water pump well; and that James Priel, contractor for the tunnel now in course of construction at the pumping station, be allowed to undertake this additional work for $6,013 plus extras incurred on account of the lateness of the season.

St. John, N.B.—A committee from the board of trade is to be appointed to sit with the Common Council in a joint meeting with the Minister of Public Works. The committee will ask for the immediate letting of contracts for the construction of two new concrete docks on the West side, and that these new berths be rushed to completion to be ready in plenty of time for next season. The committee will urge also the construction of a new grain elevator with the new conveyers and general equipment necessary to provide grain facilities for the new berths desired. Finally, the completion of the entire contract in connection with the development at Courtenay Bay will be urged within a time limit of two and a half years instead of three and a half years as the contract now stands.

Toronto, Ont.—It is understood that the Canadian Stewart Company, Limited, C.P.R. Building, Toronto, desire to sub-let to other contractors considerable sea wall, ship channel and crib work in connection with its Toronto Harbor contracts.

(Continued on page 88a.)

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2

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned and endorsed "Tender for Construction of Wharfs at Victoria Harbor, B.C.," will be received at this office until 4 p.m., on Tuesday, December 9, 1913, for the construction of Wharfs at Victoria Harbor, B.C.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the District Engineers' offices at New Westminster, B.C.; Victoria, B.C.; Confederation Life Building, Toronto, Ont.; Post Office Building, Montreal, P.Q.; and on application to the Postmaster at Vancouver, B.C.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to five per cent. (5 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 27, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—45197.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Harbor and River Improvements in the Mission River, Fort William, Ont.," will be received at this office until 4 p.m., on Friday, November 21, 1913, for the construction of the Harbor and River Improvements.

Plans, specifications and form of contract can be seen and forms of tender obtained at this Department and at the offices of W. P. Merrick, Esq., District Engineer, Fort William, Ont.; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; J. L. Michaud, Esq., District Engineer, Post Office, Montreal, P.Q.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank payable to the order of the Honorable the Minister of Public Works, equal to ten per cent (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 22, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—46879.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

ONTARIO—ST. LAWRENCE CANALS, CORNWALL CANAL.

Sealed tenders addressed to the undersigned and endorsed "Tender for Improving Lower Entrance to Lock No. 20," will be received at this office till 16 o'clock on Wednesday, November 12th, 1913.

Plans, specification and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer of the Ontario-St. Lawrence, Cornwall, at which places Forms for Tender may be obtained.

An accepted bank cheque on a chartered bank of Canada for the sum of $2,000 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By Order,
L. K. JONES,
Assistant Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 31st October, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—50153.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

CANADIAN GOVERNMENT RAILWAYS.

HALIFAX OCEAN TERMINALS RAILWAY, HALIFAX, N.S.

CALL FOR NEW TENDERS.

Sealed tenders addressed to the undersigned and endorsed "Tender for Docks, First Unit, Contract No. 3," will be received at this office until 12 o'clock noon, Thursday, November 20, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor to a depth of 45 feet at low water and filling reclaimed areas.

Plans and specifications and form of tender may be seen and full information obtained at the office of the General Manager, Moncton, N.B., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Halifax, N.S.

The right is reserved to reject any or all tenders.

By Order.
L. K. JONES,
Assistant Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 30th October, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—50200.

(For further Tenders see pages 86 and 88.)

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We offer our services as consultants to engineers and architects who have charge of industrial construction. We have a thorough knowledge of fire protection and the many matters which govern insurance rating.

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Insurance may be placed through our firm in the same manner as it would be through other insurance brokerage firms. The service rendered—in most cases without cost to our clients—by our staff of inspectors and engineers makes it profitable for owners who are placing insurance on industrial undertakings to place the insurance through our firm.

E. M. SELLON & CO.
LIMITED
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and Insurance Brokers

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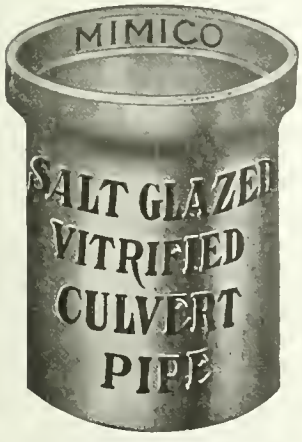
MEANS
TYPHOID



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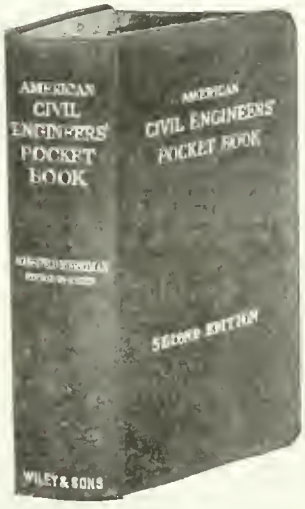

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TENDERS CALLED FOR

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

WELLAND SHIP CANAL.

SECTION No. 5.

NOTICE TO CONTRACTORS.

Sealed Tenders, addressed to the undersigned and marked "Tender for Section No. 5, Welland Ship Canal," will be received at this office until 12 o'clock noon on **Tuesday, November 18th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, St. Catharines, Ontario.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered bank of Canada for the sum of $100,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Assistant Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 29th October, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—50010.

PROPOSED GOVERNMENT BUILDINGS, OTTAWA, ONT.

EXTENSION OF TIME.

Notice is hereby given that the time for the reception of designs in the first competition for the erection of Departmental and Courts Buildings, is extended for three months to Thursday, April 2nd, 1914.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
—49657. Ottawa, October 23, 1913.

Sealed tenders addressed to the undersigned and endorsed "Tender for Wharf and Warehouse at Richard's Landing, Ont.," will be received at this office until 4 p.m., on Tuesday, December 2, 1913, for the construction of a Wharf and Warehouse at Richard's Landing, St. Joseph Island, Algoma District, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the District Engineer's offices, Sault Ste. Marie, Ont.; Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Richard's Landing, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 p. c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By Order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 31, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—48268.

SPECIAL NOTICE TO CONTRACTORS.

RE GREATER WINNIPEG WATER SUPPLY.

(Estimated Cost $13,500,000.)

Notice is hereby given to Contractors that tenders will be invited early in the year 1914 for the construction of works necessary for the delivery of water from Shoal Lake to the Greater Winnipeg Water District. The following is a brief description of the proposed works:—

1. A dyke and channel for the diversion of the Falcon River into Snowshoe Bay.
2. 85 miles concrete aqueduct.
3. 10 miles pipe line (probably 1916 work).
4. 900 lineal feet tunnel under Red River.
5. 85 miles of construction railway.
6. Telephone line.
7. Clearing and ditching.

The fall season of the year affords the best opportunity for inspection of proposed route of the aqueduct, and it is recommended that contractors having a view to tendering on the work should send their inspectors over the line at as early a date as possible.

Particulars as to estimated cost of the work and map of approximate location and profile of aqueduct may be obtained from the undersigned.

M. PETERSON,
Acting Secretary of the
Administration Board,
Greater Winnipeg Water
District.

City Hall,
Winnipeg, Canada,
October 6th, 1913.

Note.—Copy of report of the Consulting Engineers, plan and profile of work and typical details of design may be seen at the office of *The Canadian Engineer*, 62 Church Street, Toronto.

(For further Tenders see pages 84 and 88.)

MEXICAN EAGLE ASPHALT

TRADE MARK

Delivered to meet the specifications of the American Society for Municipal Improvements, the Association for Standardizing Paving Specifications or any other standard specifications

Purchase MEXICAN EAGLE ASPHALT because:

1—It is more cementitious than other asphalts.

2—Water will not readily injure it.

3—Exposure to sun and air will not cause its deterioration.

4—It has great cohesive strength.

5—It is more ductile and flexible than other asphalts.

6—Shocks will not crack it. It is very malleable.

7—We will supply asphalt having the proper penetration for your needs.

8—It is best adapted to Canada's climate—will not mark in hot weather—nor are snow or ice likely to crack it.

9—It has over 99 per cent. bitumen. Purest on the market—therefore free from deleterious matter.

10—It is so constituted that it will not be injured by the heat necessarily applied to melt it for paving operations.

Samples, prices, analyses, etc., on request.

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

TENDERS CALLED FOR

CANADIAN GOVERNMENT RAILWAYS.

TENDER.

Sealed tenders addressed to the undersigned and marked on the outside, "Tender, Diversion of Line, North Sydney to Leitches Creek," will be received up to and including

Monday, November 10th, 1913,

for the construction of a line of railway from North Sydney to Leitches Creek, N.S.

Plans and specification may be seen at the office of the undersigned at Ottawa, Ont., at the Station Master's Office, North Sydney, N.S., at the office of the Resident Engineer, at New Glasgow, N.S., and at the office of the Chief Engineer, Moncton, N.B., where forms of tender may be obtained.

All the conditions of the specification must be complied with.

L. K. JONES,

Assistant Deputy Minister and Secretary, Department of Railways and Canals.

Ottawa, Ont., October 24th, 1913.

RURAL MUNICIPALITY OF ASSINIBOIA.

NOTICE.

Sealed tenders, marked "Tenders for pavement," will be received by the undersigned up to 4 o'clock p.m., on Tuesday, the 25th day of November, 1913, for the construction of an asphalt pavement, on the north side of Portage Road, from the westerly limit of Lot 113, St. Charles, to the westerly limit of the Municipality—an approximate length of 7¼ miles—the first 1¼ miles to be 24 feet in width, and the balance 16 feet in width.

Plans and specifications may be seen at the office of the Municipal Engineer, Municipal Hall, St. Charles.

A marked cheque for 5 per cent. of the amount of tender must accompany each tender, which will be forfeited, should the successful tenderer refuse or neglect to enter into a contract, or to proceed with the work, as required in the specifications.

Tenders will also be accepted for pavements other than asphalt, in which case persons tendering must furnish plans, specifications and details of same.

The lowest or any tender not necessarily accepted.

By order of the Council.

FRANK NESS, Clerk,
Rural Municipality of Assiniboia.

Kirkfield Park P.O., Man., October 24th, 1913.

TENDERS FOR ROCMAC PAVEMENT.

Sealed Tenders plainly marked as to contents will be received at the office of the undersigned up to **Six o'clock of Saturday, November 8th, 1913,** for the construction of Rocmac Pavement on Spadina Road in the Township of York.

Plans, specifications and all information may be obtained at the office of Frank Barber, C.E., 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer.

Toronto, November 4th, 1913.

TENDERS FOR IRON POSTS.

Sealed tenders addressed to the undersigned and endorsed "Tenders for Iron Posts," will be received at the Department of the Interior, up to noon of the 1st day of December, 1913, for the furnishing of fifteen thousand small and five hundred large iron posts for use on the survey of Dominion Lands, to be delivered at Edmonton on or before the 31st day of January, 1914.

Forms of tender and detailed information may be obtained from the Surveyor-General of Dominion Lands, Ottawa.

The tender must be accompanied by an accepted cheque on a chartered Canadian bank for the sum of two hundred dollars, payable to the order of the Deputy Minister of the Interior. This cheque will be forfeited if the party whose tender is accepted declines to enter into a contract to deliver the posts or fails to carry out the contract. If the tender is not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

Newspapers copying this advertisement without authority from the Department will not be paid.

L. PEREIRA,
Secretary.

Department of the Interior,
Ottawa, October 31st, 1913.

TENDERS FOR CONSTRUCTION OF SEWER.

Sealed Tenders plainly marked as to contents will be received at the office of the undersigned up to **Noon of Saturday, November 15th, 1913,** for the construction of a Sewer on Bathurst Street in the Township of York.

Plans, specifications and all information may be obtained at the office of Frank Barber, C.E., 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer.

Toronto, November 4th, 1913.

TENDERS FOR PAVEMENT.

Sealed Tenders plainly marked as to contents will be received at the office of the undersigned, up to **Noon of Friday, November 14th, 1913,** for the construction of pavement on King and Guelph Streets, Preston, Ont.

Plans, specifications and all information may be obtained at the office of Frank Barber, C.E., 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
Engineer.

Toronto, November 5th, 1913.

(For further Tenders see pages 84 and 86.)

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE CANADIAN ENGINEER OFFICES—IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

We desire proposals

from

Experienced Contractors

on

PILE DRIVING AND CAPPING
CRIB WORK, SHIP CHANNEL
AND CONCRETE WALLS

for

We are in the market

for

TUGS
BARGES
DERRICK BOATS
FLOATING PILE DRIVERS

and other floating equipment

for use on

Toronto Harbor Contracts

CANADIAN STEWART CO., LIMITED

C. P. R. BUILDING, TORONTO

INDUSTRIAL WORKS.

(Continued from page 82.)

Victoria, B.C.—The city council has authorized the construction of a concrete retaining wall on the west side of Gorge Park at a cost of $1,000.

Victoria, B.C.—Mr. J. S. MacLachlan, Dominion District Engineer, has been devising methods for the improvements to be carried out at the Canadian Collieries wharf at Union Bay, and also for river and navigation improvements at Courtenay. In addition, Mr. MacLachlan has located a site for the new wharf at Roy's Beach.

Victoria, B.C.—The city council will advertise for new tenders for the telephone pole line for the waterworks, the city engineer to put in an estimate on the whole of the work in the event of Mr. F. H. Folsom declining to accept the work at the price quoted by him last July. The tenders will be invited on the whole or part basis.

Victoria, B.C.—The council has decided by a majority vote to call again for tenders for rivetted steel pipe, the new tenders to be in by November 10, so as to give local contractors an opportunity to bid again on the specifications.

Weston, Ont.—The Weston, Water, Power, and Light Commission has decided to lay a 4-inch water main on the north side of St. John's Road at the request of the York Colonization Company. The pipe will be laid for 600 feet westerly on the road from the Weston Road.

Weston, Ont.—Water mains are being extended on several of the municipality's streets, and the contractor, G. B. Moogk, expects to have the work completed before winter frosts set in.

West Vancouver, B.C.—Tenders will be received for the construction of a breakwater at the wharf at Fourteenth Street, D.L., 237, West Vancouver, B.C. Plans and specifications may be obtained from T. F. Merrick, Esq., Manager, West Vancouver Ferry Co., Limited, West Vancouver, B.C.

West Vancouver, B.C.—The by-law to provide a wharf at the foot of Twenty-Fifth Street in Dundarave at a cost of $40,000 has been carried.

+—Winnipeg, Man.—Contracts have been awarded for the installation of water mains in St. Vital, by the city council to the GUILBAULT COMPANY, LIMITED, the contract price being $58,000. It is hoped that the first unit for 1½ miles along St. Mary's road from the boundary of St. Boniface, will be completed by next spring, when it is expected that tenders for further work, entailing an expenditure of $100,000, will be called.

MISCELLANEOUS.

Fort William, Ont.—The city council has made final arrangements for appointing an electrical inspector, and also passed a by-law such as is authorized by the hydro-electric commission for appointing its inspectors.

Lethbridge, Alta.—An agreement has been made with the city by the P. H. Rice Malting Company, of Winnipeg, by which the company will construct a malting plant and elevator at Lethbridge. The plant will cost $200,000, and will include a 100,000 bushel concrete storage elevator. The new industry has been incorporated under the name of the Lethbridge Alberta Malting Company, and will have a capital stock of $350,000.

Medicine Hat, Alta.—On the 29th of November, the people of Medicine Hat will vote upon a by-law to provide for borrowing $12,000 upon debentures to purchase additional fire apparatus for the city fire department.

▲—Ottawa, Ont.—Tenders will be received up till December 1st, 1913, for the furnishing of 15,000 small and 500 large iron posts for use on the survey of Dominion Lands, to be delivered at Edmonton on or before January 31st, 1914. Plans and specifications may be obtained from the Surveyor-General of Dominion Lands, Ottawa, Ont. Signed, L. Pereira, Secretary, Department of the Interior.

Saskatoon, Sask.—At present, local contractors are experiencing a somewhat serious cement shortage, not 100 bags being in the city. Mr. F. J. O'Leary, a prominent contractor, is engaged in the construction of a large block in the

city; and in connection with that, in the pouring of a concrete slab 17,000 square feet and 8½ inches thick, which will support 1,000 pounds to the square foot. This is the largest slab yet undertaken in Saskatoon.

Toronto, Ont.—The city has decided to build this winter a $15,000 scow, and this construction will be supervised by Mr. Charles Margerison, the new superintendent of the city's marine plant.

Toronto, Ont.—The Hydro-Electric Power Commission of Ontario will likely call for tenders within the next couple of months for impulse or special design reaction water turbines, 500-foot head, for about 2,600 feet of lapwelded or rivetted steel pipe, 30-inch diameter, from approximately 100 to approximately 500 pounds per square inch pressure; and for from 4,000 to 6,000 feet of wood stave pipe, 36-inch to 54-inch diameter, 50 pounds per square inch pressure. It is understood that this equipment will be needed in connection with the proposed development at Eugenia Falls, Ont. The Hydraulic Engineer for the Commission is H. G. Acres, Continental Life Building, Bay and Richmond Streets, Toronto, Ont.

+—**Toronto, Ont.**—The contract has been awarded by Mr. Geo. W. Gouinlock, Temple Building, Toronto, to MESSRS. T. CANNON AND SON, for the erection of a storage tank and other works for Messrs. Lever Brothers.

Toronto, Ont.—Tugs, barges, derricks, hoisting machinery, pile driving outfits, etc., will be purchased by the Canadian Stewart Company, Limited, C.P.R. Building, Toronto, in connection with its contracts for Toronto Harbor. It is understood that they are ready to receive proposals on this equipment.

+—**Vancouver, B.C.**—The contract has been awarded MESSRS. CAMPBELL BROS., for the construction of the new passenger station which the British Columbia Electric Railway Company is erecting at the south end of the Granville Street bridge as a terminal for its Lulu Island line. The substructure, consisting of heavy pile and timber work supporting the platform on the level of the bridge, was constructed last summer and work on the station proper is to be commenced by Campbell Bros. immediately, and be completed so as to allow the company to start operation into the new terminal about the first of the year. The total expenditure on the new terminal will be in the neighborhood of $40,000.

Vancouver, B.C.—The Board of Railway Commissioners, in its session held at Vancouver recently, reserved decision on the Coquitlam station site controversy, in order to give the members of the Commission an opportunity to review the previous evidence and to give the question further consideration.

Vancouver, B.C.—Tenders will be received up till November 10th, 1913, for the construction of a Sanatorium at Tranquille, B.C., of reinforced concrete. Plans and specifications may be obtained from Dr. Fagan, Provincial Board of Health Office, Victoria, B.C. Signed, S. B. Barron, Assistant Secretary, B.C. Anti-Tuberculosis Society, Vancouver, B.C.

Winnipeg, Man.—Mr. C. F. Roland, Industrial Commissioner, has left for Great Britain to take up the question of financing the proposed industrial scheme in Winnipeg. The scheme is to erect in units, buildings which will cost ultimately $10,000,000, and which are to be used by small manufacturers.

CURRENT NEWS.

Calgary, Alta.—The report of the city commissioners of Calgary shows a saving to the city of $35,000 during the past year made by the city paving plant as compared with the cost of paving by contract done in previous years. The municipal plant has laid this year 52 miles, or 140,000 square yards of pavement at an average cost of $2.15 per yard.

Drummondville, Que.—Effective proof of the commencement of construction on the St. Francis Valley Railway, formerly known as the L'Avenir and Melbourne, is furnished by the fact that engineers are surveying the line between Melbourne and Drummondville. The charter of the company was amended at the last session of the legislature extending the line so as to reach the St. Lawrence River, and it is expected that ultimately it will be built to the city of Sorel. Subsidies have been voted by both the provincial and federal governments for the 28 miles between Drummondville and Melbourne, and it is fully expected that the part of the grading on this section of the line will be made this fall.

Fredericton, N.B.—The contractors, Messrs. McLaggan, McBean and Bell have commenced operations on the construction of the new Intercolonial Railway freight sheds at Fredericton.

Galt, Ont.—The electric pumps at the waterworks station, which are being driven by a 150 h.p. auto-synchronous motor, have been found to operate satisfactorily, but until official test has been made of the pumps, they will not be taken over formally by the Water Commission.

London, Ont.—The departmentally constructed pavements in South London have been completed, and are so satisfactorily to the engineering department and Board of Works, that more concrete pavements will be constructed next year on the civic engineering plan.

Nelson, B.C.—Good progress is reported by Mr. A. J. Becker, contractor in charge of the crosscut tunnel which is being driven at the Apex mine, near New Denver. The tunnel will tap the ore at a depth of 275 feet, and it will be 417 feet in length. Already 100 feet have been driven, and it is expected to reach the vein about February 1st.

Ottawa, Ont.—The Dundonald Park well is now yielding 250 gallons of water per hour, or 6,360 gallons per day. However, boring operations will be continued for a few more feet in order to locate a greater flow.

Ottawa, Ont.—Early in October there were but eight miles of rails to be laid before the Transcontinental Railway would be connected from Moncton without intermission to the Rockies; and this gap was at a point about 200 miles east of Cochrane.

Port Arthur, Ont.—Nine new siding tracks of the C.N.R. in the south section of the yards, between the first river and the coal docks, have been completed and now furnish the company with ample storage.

Queen Charlotte, B.C.—Excellent progress is reported on the telegraph line for Graham Island, which soon will have reached Queenstown. The route of the line has been changed, and it will now run to Gold Creek, and thence to Myre Lake. It is intended eventually to connect Sandspit with Skidegate by cable across the inlet.

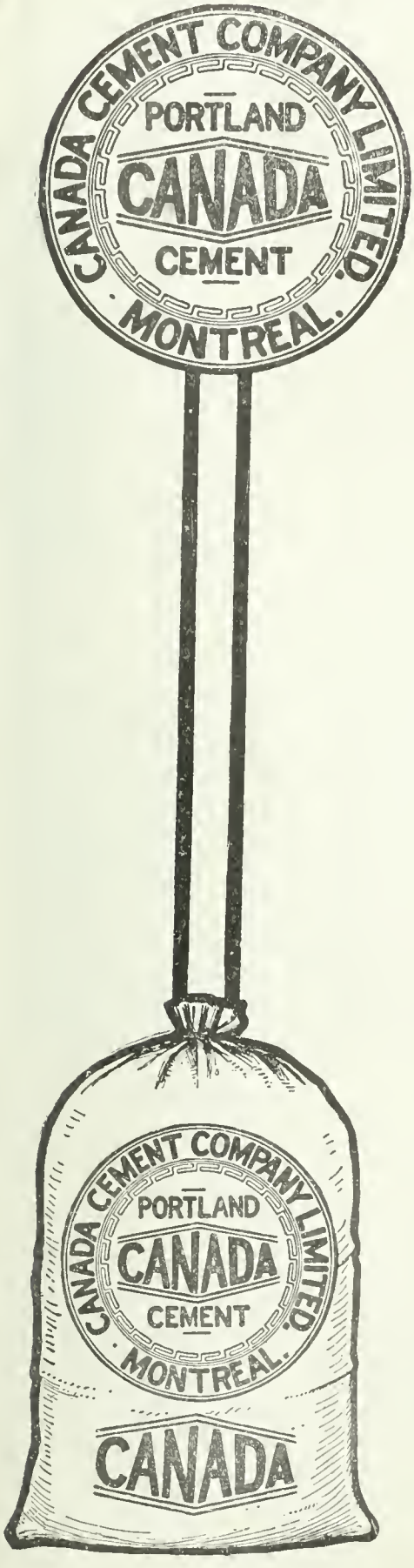
MONTREAL MARKET LETTER

Montreal, November 4.

Iron and steel men are not feeling any more cheerful as the days go by. For a long time past there has been a feeling that possibly the depression in the United States might extend across into Canada and at the moment there is fear that such a development is imminent. Car companies are beginning to feel the effects of the financial stringency—or of the lack of orders from the railway companies, whatever the reason may be for this lack. At the last annual meeting of the C.P.R., Sir Thomas Shaughnessy made a statement which is subject to the interpretation that the C.P.R. will not spend as much money in new construction and new cars in the near future as it has spent in the immediate past. This tendency in the case of the C.P.R. is hardly because of lack of money, inasmuch as the railway is exceptionally well supplied in that particular. In the case of the C.N.R., it is likely that the demands for new cars in the coming few years will be much greater than in the past, and this in all probability is the case also with the G.T.R. or G.T.P. It is thought, however, that these roads, also, will go light in the matter of ordering cars, just now, owing to the difficulty of obtaining money. Some of the car companies have been urging the Government, lately, to place orders for the I.C.R. in order to keep the car works operating. All this has a significance. Up to the present the iron and steel works have not complained of lack of orders, but there is a feeling of uncertainty over the possible effect of the lowering of the tariff in the United States. Structural steel works, including bridge companies, are all well supplied with orders, so far, and some are working overtime.

No changes in price are reported this week. The movement in pig iron is probably more active, owing to the approach of the end of the season.

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Second-Hand Machinery

SIMPLE DURABLE CHEAP

THOR AIR TOOLS

Used by the most progressive Railroads, Bridge, Ship and Dock builders.

Send for Catalogue

Exclusive Canadian Agents

H. W. Petrie, Limited

General Machinery Dealers

TORONTO, ONT.

PANAMA CANAL EQUIPMENT FOR SALE.—The Isthmian Canal Commission will offer for sale in the near future the equipment used in building the Panama Canal, such as rolling stock, excavating machinery, floating equipment, miscellaneous plants, and miscellaneous equipment, including locomotives, cars, steam shovels, cranes, unloaders, earth spreaders, track shifters, rock drills, well drills, dredges, barges, tugs, launches, pile drivers, concrete handling plants, pumps, rock crushers, etc. Inquiries from users of such equipment are invited for its purchase. Catalogues listing the equipment offered for sale and other information may be obtained upon application to the General Purchasing Officer, Isthmian Canal Commission, Washington, D.C. F. C. Boggs, Major, Corps of Engineers, U.S.A., General Purchasing Officer.

FOR SALE.—One model 41 Marion steam shovel, less than a year old; one Porter locomotive; ten 4-yard Western cars; one 40 H.P. boiler. Please address Box 154, *The Canadian Engineer*, Toronto.

FOR SALE.—One 35 h.p. gas engine, in good condition, suitable for city or natural gas. Apply Box 1505, General Post Office, Winnipeg.

WANTED.—Duplex Steam Pump, size 17 by 10 by 12. Slight variation in dimensions not detrimental. J. L. Millard, Aylmer, Ontario.

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.—Assistant Engineers, Transitmen, Levellers, Rodmen, Chainmen, Inspectors and Draftsmen for all branches of engineering work. We make no charge to enroll you on our books. Send for application form. Civil Engineer's Employment Bureau, P.O. Box 62 Station "B.," Montreal.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

AN ELECTRICAL ENGINEER; ten years' experience in Western Canada, head office, Winnipeg, is desirous of getting in touch with firms wishing Western Representative. Have managed sales office of one of the largest manufacturing concerns in Canada for the past five years, so am in close touch with conditions. 482½ Main Street, Winnipeg, Man.

CIVIL ENGINEER, 26, college graduate, 5 years' experience in surveying, reinforced concrete structures and waterworks, field and office, desires position. Familiar with water power investigations. Excellent references, thoroughness. Box 170, *The Canadian Engineer*, Toronto.

STENOGRAPHER.—Experienced in engineering correspondence, estimating and accounting, desires position, preferably as secretary. Gilt-edged references. Please address, Box 168, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

FOUNDRY AND SHOP WANTED.—United States manufacturer desires to lease Canadian foundry and machine shop. Please give full particulars of equipment and state terms desired. All letters confidential. Address Box 156, *The Canadian Engineer*, Toronto.

WE MANUFACTURE for Sale and are prepared to fill orders for Cork Cutting Machines and Liquid Bottling Machines under Canadian Letters Patent No. 136613 and No. 143161 of the Crown Cork and Seal Company of Baltimore, Maryland. Aluminum and Crown Stopper Company, Toronto, Canada.

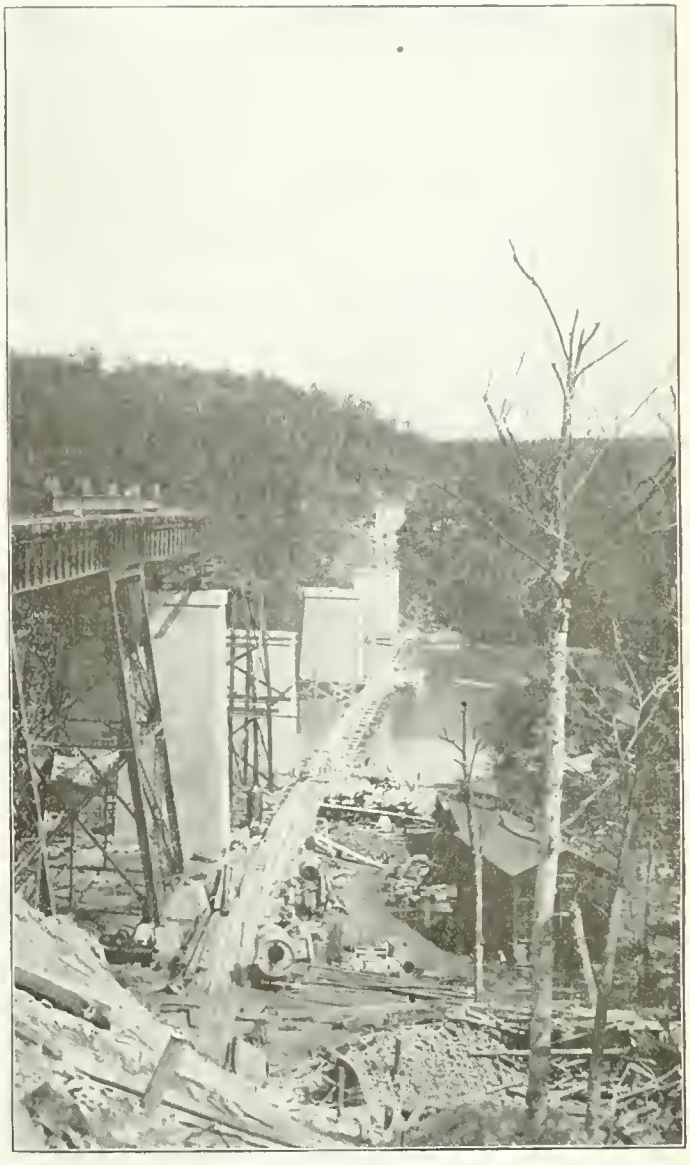
YOU KNOW the best investment is to buy a Patent that will give a good return and be in good demand. I have such for Sale. 206 Hamilton Street, Toronto. Phone, Gerrard 2559.

NEW INVENTION IN ELECTRIC SIGN OPERATION.

Hitherto, the operation of electric signs has been effected by the flash system; and, though now many beautiful and wonderful works of art emblazon the streets of all large cities, the amount required annually to maintain these is a matter of important consideration, and has been engaging the attention of electricians for years in efforts to invent some device or new method that will reduce the cost of operation. Mr. F. C. Brodie, of 282 Ninth Avenue, Moose Jaw, Sask., has perfected an electric sign which can be operated not only at a great decrease in expense, but also with great economy in labor. By means of slight changes in the interior mechanism of his invention, a corresponding change of letters, words, mottoes, names, or phrases can be produced in the electrical sign. Additional features of the machine are that foreign languages can be produced as easily as the English language, that pictures may be shown as readily as letters, that bulletins can also be produced effectively, since the message to be given can be changed to what is desired in a very few minutes, and, by placing a new cylinder in the machine, it may be kept in operation while the change of bulletin is being set on another cylinder; and that the controller for the sign apparatus can be placed anywhere within a building, while the sign itself might be placed upon the roof.

ONE OF OUR RECENT BRIDGE CONTRACTS

FEBRUARY, 1913



AUGUST, 1913

CONSTRUCTED IN SIX MONTHS

Substructure of 965 ft. BRIDGE—Some of these piers were carried to a depth of over 100 ft. below water level, by pneumatic caissons.

THE FOUNDATION COMPANY LIMITED

MONTREAL VANCOUVER

MARKET CONDITIONS

Montreal, November 3rd, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron, $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21.25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 56 to 55c. each. Telegraph poles; seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2 10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, November 5th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¾-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 5½c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 5½c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3 55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40 60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot.....	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long ...	1.00	1.60	2.60	4.00	13.00
Double junctions.....	1.25	2.00	3.25	5.00	16.25
Increasers and reducers.....	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3,40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, November 4th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7.16, $4.75; ½, $4.50; 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18, $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.20; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5 15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3-35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch $1 per cwt.

Steel Plates, Rolled—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe caulk, $4.50 base tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Nov. 13, 1913

Contents of this issue on page 711

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

STRESSES IN CIRCULAR PIPES.

WITH SOME NOTES ON THE DESIGN OF LARGE WATER CONDUITS—A CALCULATION OF STRESSES DUE TO INTERNAL WATER PRESSURE, WEIGHT OF THE SHELL, AND BACK-FILL—CIRCULAR PIPE UNSUITED FOR CASES OF LARGE DIAMETER PIPE AND LOW PRESSURE HEAD, OWING TO THE RESULTING BENDING MOMENTS

By T. H. HOGG, B.A.Sc., A.M. Can. Soc. C.E.,

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The analysis of the stresses in circular pipes due to the weight of the material in the pipes themselves, to internal and external water pressures, and to different kinds of loading, is a subject to which little attention has been devoted in engineering literature.

When the pipes are relatively small in diameter, the conditions are such as yield to simple approximate methods of investigation. With the larger sizes of conduits and pipes now being used so extensively in water supply and water power systems, however, the question of the weight of the shell itself, and the differences in pressure at the top and bottom of the pipe when conveying water in a horizontal position, become exceedingly important.

This paper is presented in the hope that it will afford some aid to the engineer in the design of such conduits. The results of the analyses contained in it were arrived at while the writer was working under the direction of Mr. R. D. Johnson, of Niagara Falls. The system followed in the development of the theory of the stresses due to water pressure is along similar lines to the work of C. W. Filkins and E. J. Fort, who developed the stresses in circular rings due to the weight of the rings themselves, and due to external water pressure. Their work is published in the "Transactions of the Association of Civil Engineers of Cornell University," for 1896.

The following discussion takes up the analysis of the stresses in circular conduits due to internal water pressure. The method of combining the stresses due to the weight of the shell and to the water pressure is reviewed; the question of the design of large conduits for the carrying of water is dealt with, and the equilibrium shape as the logical one, in preference to the circular, is described.

Stresses Due to Internal Water Pressure.—It is usually assumed in figuring the stresses due to internal water pressure in circular pipes or conduits, lying horizontally, that it is quite sufficient to take into account only the tension induced in the shell, and that the bending moment may be neglected. This is only true when the pressure head is infinite and may be grossly in error when the pressure head is small, and the diameter of the pipe relatively large. When the latter condition exists there is a greater pressure at the bottom than at the top, and this causes large bending moments in the shell.

Throughout this discussion the ring is assumed supported on a knife edge, and water pressure is assumed level with the crown of the pipe. The analysis also assumes a thin ring of homogeneous material, having a constant modulus of elasticity, and that the changes from

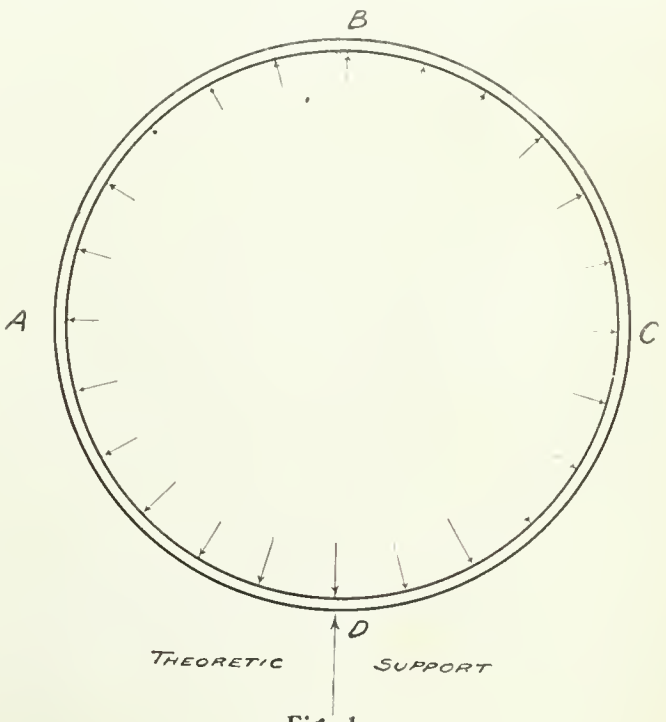


Fig. 1.

a circular form will have little effect upon the dimensions of the ring.

These assumptions are merely to facilitate the application of theory. When the results have been obtained, practical considerations which affect these considerations will be discussed.

The following nomenclature will be used throughout the paper:

H = head of water above top of pipe.
r = radius of circular pipe.
M = bending moment in pipe.
M_B = bending moment in pipe at top.
M_D = bending moment in pipe at bottom.
M_{max} = bending moment in pipe at maximum point on side.
T = tension in pipe.
T_B = tension in pipe at top.
T_D = tension in pipe at bottom.
ϕ = angle to different points (expressed in radians).
ϕ_{max} = angle to maximum bending moment point on side.
ϕ_U = angle to upper node point (point of no bending moment).
ϕ_L = angle to lower node point (point of no bending moment).
γ = weight of cubic foot of water.
J = shear at any point.
J_B = shear at top.
J_D = shear at bottom.
d_ρ = arm of bending moment.
d_o = arm of the bending moment at top of pipe.

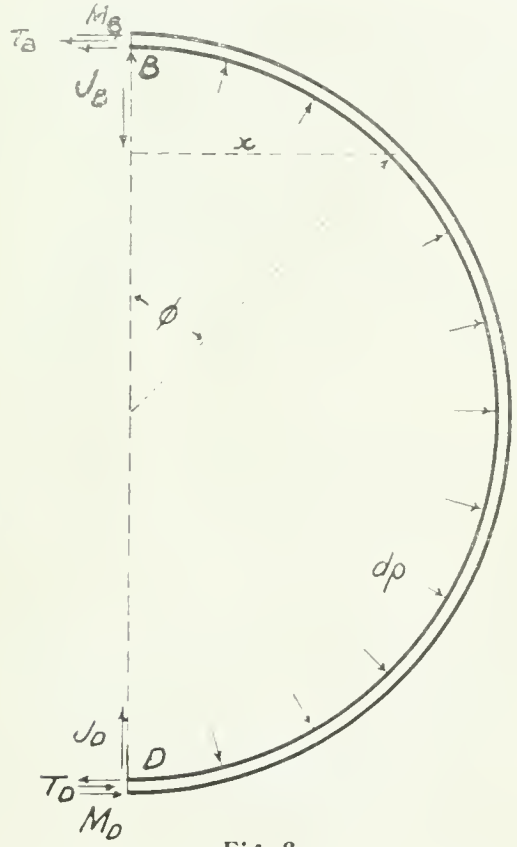


Fig. 2.

We will assume that the reader is familiar with the three general formulae for arch ribs, viz.,

$$\int_D^B \frac{Mds}{EI} = \int_D^B d\phi; \qquad \int_D^B \frac{Myds}{EI} = \int_D^B dx;$$

$$\int_D^B \frac{Mxds}{EI} = \int_D^B dy.$$

The ring is a continuous curved beam to which these situations will apply.

The forces acting upon the pipe may be appreciated by looking at Fig. 1. If we cut the pipe at B and D and consider the forces acting on the section to the right, we obtain the system of forces shown in Fig. 2.

Taking the centre of moments at the neutral axis at D, we obtain:

$$M_D = M_B - 2T_B r + \int_o^\pi r(1 - \cos\phi)\, dp \sin\phi$$

Now,

$dp = \gamma r^2 (1-\cos\phi)\, d\phi$; and,

$\sin\phi\, dp = \gamma r^2 (1-\cos\phi) \sin\phi\, d\phi$.

Therefore,

$$M_D = M_B - 2T_B r + \int_o^\pi \gamma r^3 (1-\cos\phi) \sin\phi\, d\phi.$$

Integrating, we obtain:

$$M_D = M_B - 2T_B r + 2\gamma r^3.$$

Now, consider as a free body that portion of pipe shown in Fig. 3.

$$EI\Delta y = \int Mxds; \; ds = rd\phi = rd\theta;$$

$$-M = M_B - T_B y + \int_o^B pdsx;$$

$$pds = \gamma r^2 (1-\cos\theta)\, d\theta;$$

$$x = r \sin(\phi - \theta);$$

$$y = r(1-\cos\phi).$$

Therefore,

$$-M = M_B - T_B r (1-\cos\phi) + \int_o^\phi \gamma r^3 (1-\cos\theta) \sin(\phi-\theta)\, d\theta;$$

$$= M_B - T_B r + T_B r \cos\phi + \gamma r^3 \int_o^\phi (1-\cos\theta) \sin(\phi-\theta)\, d\theta,$$

$$= M_B - T_B r + T_B r \cos\phi + \gamma r^3 (1-\cos\phi - \tfrac{1}{2}\phi \sin\phi).$$

Therefore,

$$EI\Delta y = \int Mxds = \int Mr^2 \sin\phi\, d\phi,$$

$$= \int_o^\pi \left[(M_B r^2 - T_B r^3 + \gamma r^5) \sin\phi\, d\phi + (T_B r^3 - \gamma r^5) \sin\phi \cos\phi\, d\phi - \tfrac{1}{2}\gamma r^5 \phi \sin^2\phi\, d\phi \right]$$

Solving the above equation we obtain:

$$EI\Delta y = -2(M_B r^2 - T_B r^3 + \gamma r^5) + \frac{\gamma r^5 \pi^2}{8};$$

also, $EI\Delta x = \int_D^B M(ds)y = 0$, since B has not moved horizontally, and since its tangent is horizontal.

Now, $y = r(1-\cos\phi)$; $ds = rd\phi$.

Therefore, $EI\Delta x = r\int_o^{\pi r} Mds - r^2 \int_o^\pi M \cos\phi\, d\phi$

i.e., $0 = r\int_o^{\pi r} Mds - r^2 \int_o^\pi M \cos\phi\, d\phi$.

Substitute value of M found above and solve.

Therefore, $-\int_o^\pi M \cos\phi\, d\phi = \int_o^\pi \left[(M_B - T_B r + \gamma r^3) \cos\phi\, d\phi + (T_B r - \gamma r^3) \cos^2\phi d\phi - \tfrac{1}{2}\gamma r^3 \phi \sin\phi \cos\phi\, d\phi \right]$.

Therefore, $-\int_o^\pi M \cos\phi\, d\phi = \frac{\pi}{2}\left\{ T_B r - \gamma r^3 \right\} + \frac{\gamma r^3 \pi}{8}$;

or, $\int_D^B Myds = \frac{\pi r^3}{2}\left\{ T_B - \frac{3\gamma r^2}{8} \right\} = 0$;

and, therefore, $T_B = \frac{3}{4}\gamma r^2$.

Now, $\int_D^B M ds = 0 = \int_0^{\pi} \left[M_B r d\phi - T_B r^2 (d\phi - \cos\phi\, d\phi) + \gamma r^3 (d\phi - \cos\phi\, d\phi - \frac{1}{2}\phi \sin\phi\, d\phi) \right]$;

Whence, solving the above,

$$M_B = T_B r - \frac{1}{2}\gamma r^3.$$

Therefore, $M_B = \frac{\gamma r^3}{4}$

Now, $M_D = M_B + 2\gamma r^3 - 2T_B r$

$$= \frac{\gamma r^3}{4} + 2\gamma r^3 - \frac{3\gamma r^3}{2}$$

$$= \frac{3}{4}\gamma r^3$$

Now, $-M = M_B - T_B r + T_B r \cos\phi + \gamma r^3 \left(1 - \cos\phi - \frac{1}{2}\phi\sin\phi\right) = \gamma r^3 \left(\frac{1}{2} - \frac{1}{4}\cos\phi - \frac{1}{2}\phi\sin\phi\right)$,

which is the general expression for the bending moment.

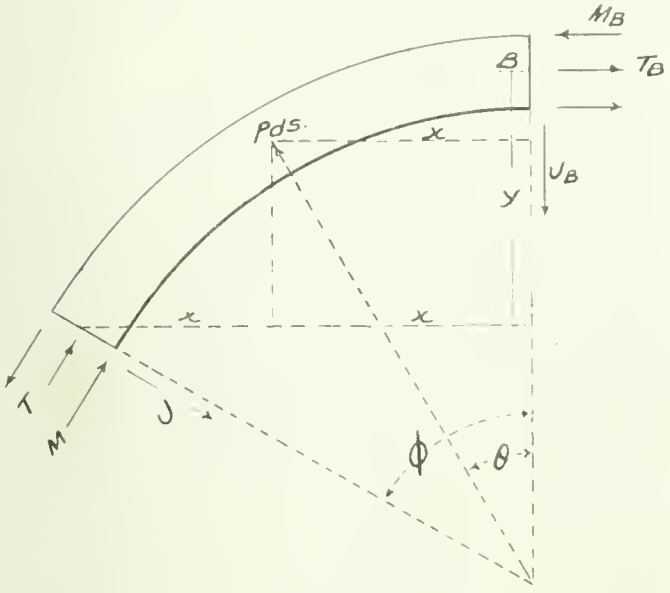


Fig. 3.

To find the shortening of the vertical diameter, substitute the values of M_B and T_B in the equation:

$$EI\Delta y = -2\,(M_B r^2 - T_B r^3 + \gamma r^5) + \frac{\gamma r^5 \pi^2}{8}.$$

We obtain, $EI\Delta y = -\gamma r^5 + \frac{\gamma r^5 \pi^2}{8}$,

$$\Delta y = \frac{\gamma r^5}{EI}\left(\frac{\pi^2}{8} - 1\right) = +.2337\,\frac{\gamma r^5}{EI}.$$

To find the lengthening of the horizontal diameter,

$$EI\Delta x = \int_A^B M\,(ds)\,y.$$

$$\therefore -EI\Delta x = \int_0^{\frac{\pi}{2}} \left[(M_B - T_B r + \gamma r^3) r^2\,(1 - \cos\phi)\,d\phi + (T_B r - \gamma r^3)\, r^2 (\cos\phi - \cos^2\phi)\,d\phi - \frac{1}{2}\gamma r^5\,(1\text{-}\cos\phi)\,\phi\sin\phi\,d\phi \right].$$

Solving, $-EI\Delta x = \frac{\gamma r^5}{4}(1.5\pi - 5)$,

$$= -.0719\,\gamma r^5,$$

Therefore, $\Delta x = .0719\,\frac{\gamma r^5}{EI}$.

The whole change in horizontal diameter,

$$= 2\Delta x = .1438\,\frac{\gamma r^5}{EI}.$$

In order to find the value of ϕ where the moment is a maximum, place $\frac{dM}{d\phi} = 0$.

Therefore, $T_B r\, d\cos\phi - \gamma r^3 d\cos\phi - \frac{1}{2}\gamma r^3\, d\phi \sin\phi = 0$.

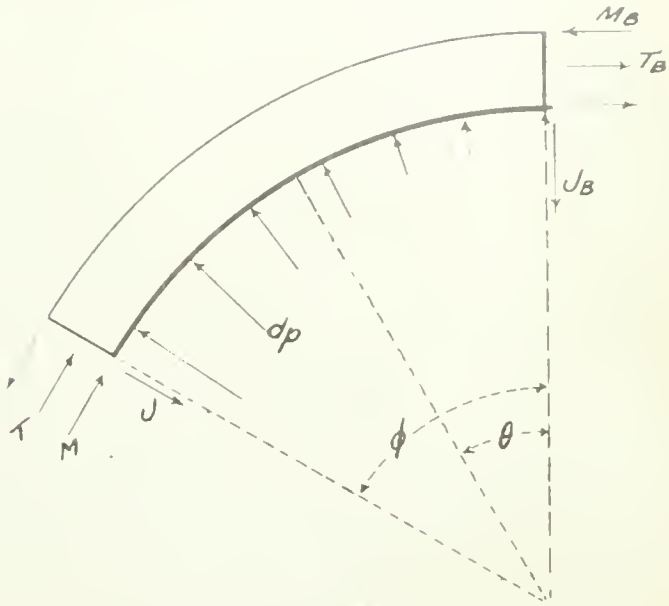


Fig. 4.

Differentiating and simplifying, we obtain:

$$\phi\cot\phi = -\frac{1}{2},$$

$$-2\phi = \tan\phi.$$

By trial we find $\phi = 105° - 13' - 45.4''$; also $\phi = 0$.

Now when $\phi = 0$, the maximum moment $M_B = \frac{\gamma r^3}{4}$.

When $\phi = 105° - 13' - 45.4''$ substitute in the expression for the moment,

$$-M = M_B - T_B r + T_B r \cos\phi + \gamma r_3 (1 - \cos\phi - \frac{1}{2}\phi\sin\phi),$$

and we obtain,

$$M = -.3203\,\gamma r^3 .$$

Assembling and comparing the values of the moments found, we see that $M_B = +\frac{\gamma r^3}{4}$; $M_D = +\frac{3\gamma r^3}{4}$,

and $M_{max} = -.3203\,\gamma r^3$.

Therefore, we see that the moment of the stress couple changes sign (i.e., passes through zero) between M_B and M_{max}, and between M_{max} and M_D.

Place M in the general equation, equal to zero, and solve for ϕ.

$$\gamma r^3 \left(\frac{1}{2} - \frac{1}{4}\cos\phi - \frac{1}{2}\phi\sin\phi\right) = M = 0.$$

Therefore, $\phi \sin\phi + \frac{1}{2}\cos\phi = 1$,

or, $\phi = 50° - 36' - 45''$,
also, $\phi = 146° - 19' - 25''$.

Now, considering Fig. 4, we see that the value of $dp = \gamma r^2 (1\text{-}\cos\theta)\, d\theta$.

Therefore, the sum of the vertical components of all the dp's between o and ϕ

$$= \int_0^{\phi} dp \cos\theta = \int_0^{\phi} \gamma r^2 (1\text{-}\cos\theta)\cos\theta\, d\theta,$$

$$= \gamma r^2 \left(\sin\phi - \frac{1}{2}\phi - \frac{1}{4}\sin 2\phi\right).$$

And the sum of the horizontal components of all the dp's between o and ϕ

$$= \int_0^{\phi} dp \sin\theta = \int_0^{\phi} \gamma r^2 (1\text{-}\cos\theta)\sin\theta\, d\theta,$$

$$= -\gamma r^2 \left(\cos\phi - 1 + \frac{\sin^2\phi}{2}\right)$$

In Fig. 4 place the vertical components of the acting forces equal to zero.

Therefore,

$$J\cos\phi + T\sin\phi = \gamma r^2 \left(\sin\phi - \frac{1}{2}\phi - \frac{1}{2}\sin\phi\cos\phi\right).$$

Placing the horizontal components equal to zero,

$$J\sin\phi - T\cos\phi = \frac{3}{4}\gamma r^2 - \gamma r^2\cos\phi + \gamma r^2 - \frac{1}{2}\gamma r^2 \sin^2\phi$$

Solving these equations for T and J, we obtain:

$$T = \gamma r^2 \left(1 - \frac{1}{2}\phi\sin\phi - \frac{1}{4}\cos\phi\right).$$

$$J = \gamma r^2 \left(\frac{1}{2}\phi\cos\phi + \frac{1}{4}\sin\phi\right).$$

The above discussion has assumed that the pipe is just filled to the top with water. It is easy to see that the bending moments are not affected by the water pressure after the top is passed. In other words, the bending moments induced in the shell are caused by the difference in pressure between the top and any point on the shell chosen; and this difference remains constant for any head above the top. The tension in the shell, however, varies directly with the head, and is equal to $H\gamma r$, where H is the head on the top of the pipe.

This amount must be added to the above obtained value of the tension to obtain the general expression.

Formulae for Stresses Due to Internal Water Pressure

$$M = -\gamma r^3 \left(\frac{1}{2} - \frac{1}{4}\cos\phi - \frac{1}{2}\phi\sin\phi\right),$$

$$T = H\gamma r + \gamma r^2 \left(1 - \frac{1}{4}\cos\phi - \frac{1}{2}\phi\sin\phi\right),$$

$$J = \gamma r^2 \left(\frac{1}{2}\phi\cos\phi + \frac{1}{4}\sin\phi\right),$$

$$M_B = \frac{1}{4}\gamma r^3,$$

$$M_D = \frac{3}{4}\gamma r^3,$$

$$M_{max} = -.3203\ \gamma r^3,$$

$$T_B = H\gamma r + \frac{3}{4}\gamma r^2,$$

$$T_D = H\gamma r + \frac{5}{4}\gamma r^2,$$

$$\phi_{max} = 105° - 13' - 45''.4,$$

$$\phi_U = 50° - 36' - 45'',$$

$$\phi_L = 146° - 19' - 25'',$$

$$\triangle_x = .0719\ \frac{\gamma r^5}{EI},$$

$$\triangle_y = .2337\ \frac{\gamma r^5}{EI};$$

To show the results clearly, let us plot a bending moment diagram. We can always express the bending moment in terms of the tension multiplied by the arm of the moment. Therefore, if we divide the bending moment at any point by the tension at the same point, we obtain the arm of the bending moment at that point.

Let $d\rho = \frac{M}{T}$ = arm of the bending moment,

$$= \frac{-\gamma r^3 \left(\frac{1}{2} - \frac{1}{4}\cos\phi - \frac{1}{2}\phi\sin\phi\right)}{\gamma r \left\{H + r\left(1 - \frac{1}{4}\cos\phi - \frac{1}{2}\phi\sin\phi\right)\right\}},$$

$$= \frac{-r\left(\frac{1}{2} + k\right)}{\frac{H}{r} + r + k}, \text{ where } k = -\frac{1}{4}\cos\phi - \frac{1}{2}\phi\sin\phi.$$

Plotting the values of $d\rho$ readily, for different values of ϕ, we can represent the bending moments as shown in Fig. 5. This curve is the equilibrium polygon for the assumed conditions.

The arm of the bending moment at the top of the pipe, $d_o = \frac{M_T}{T_T} = \frac{\frac{1}{4}\gamma r^3}{H\gamma r + \frac{3}{4}\gamma r^2}$,

$$= \frac{\frac{1}{4}r^2}{H + \frac{3}{4}r},$$

Stresses due to the Weight of the Shell.—The analysis of the stresses due to the weight of the material in the shell of the pipe is similar to the method we have just employed. As this case has been developed in the paper by Mr. C. W. Filkins and Mr. E. J. Fort, referred to in the introduction to this discussion, we will not repeat the discussion here. The following are the formulae deduced by them for the stresses due to the weight of the shell.

$$M = pr^2 \left(\phi\sin\phi + \frac{1}{2}\cos\phi - 1\right),$$

$$T = pr \left(\phi\sin\phi - \frac{1}{2}\cos\phi\right),$$

$$J = pr \left(\phi\cos\phi + \frac{1}{2}\sin\phi\right),$$

$$M_B = \frac{1}{2}\, pr^2,$$

$$M_D = \frac{3}{2}\, pr^2,$$

$$M_{max} = -.64076\ pr^2,$$

$$T_B = \frac{1}{2}\, pr = T_D,$$

$$\phi_{max} = 105° - 13' - 45.4'',$$

$$\phi_U = 50° - 36' - 45'',$$

$$\phi_L = 146° - 19' - 25'',$$

$$\triangle x = .1438\, \frac{pr^4}{EI},$$

$$\triangle y = .4674\, \frac{pr^4}{EI}.$$

The only new symbol here is, p, which represents the weight of a unit length of the pipe.

Stresses due to Back Fill.—The stresses due to an external concentrated vertical load on the crown of a circular pipe whose thickness is small as compared to its diameter, have been investigated by several writers.

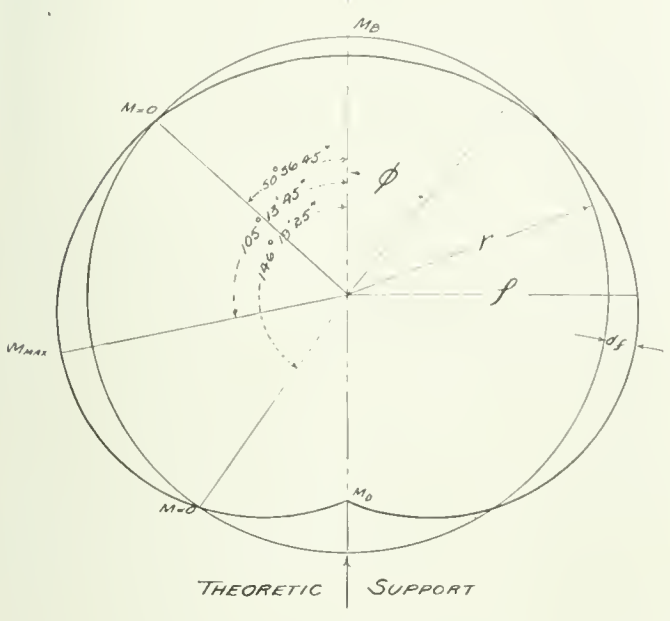


Fig. 5.

Probably the clearest exposition of this case together with the cases of a distributed vertical load, and distributed vertical and horizontal loads is given in Bulletin No. 22, University of Illinois Engineering Experiment Station. "Tests of Cast Iron and Reinforced Concrete Culvert Pipe," by A. N. Talbot. The reader is referred to this discussion.

The bending moment at the crown due to a concentrated vertical load P is equal to $M_B = .159\ Pd$, where d is the mean diameter of the pipe.

The bending moment at the crown due to a vertical load distributed uniformly over the horizontal projection of the ring is equal to $M_B = \frac{1}{16}\, wd.$, where d is the mean diameter of the ring and w is the total load on a ring of unit length.

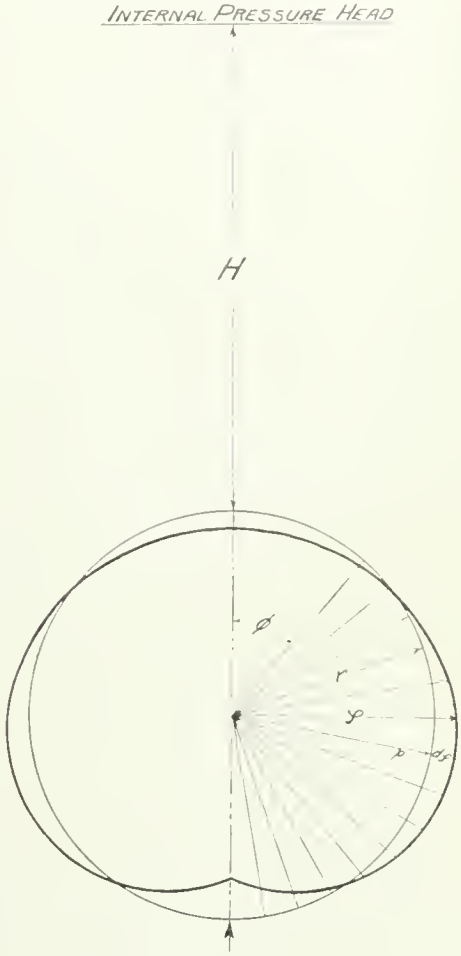
The bending moment at the crown due to a vertical load distributed over the horizontal section of the pipe as before and to a horizontal pressure uniformly distributed vertically against the pipe is equal to

$$M_B = \frac{1}{16}\left(1 - q\right) wd,$$

where w is the total vertical load on the ring, and q is the ratio of the horizontal to the vertical intensity of pressure.

The bending moments, it will be noted, are only given for the crown of the pipe. The reason for this will be clear on following the remainder of the discussion.

The reader is also referred to a paper by B. Haukelid in the June 14, 1913, issue of the ENGINEERING RECORD, on the "Stress Analysis of Circular Tubes." In this paper, Mr. Haukelid takes up the analytical and graphical determination of the stresses in circular tubes under various conditions of loading, and his analysis will be of assistance in connection with the results obtained in this article.



Theoretic Support.

Fig. 6.—Illustration of Equilibrium Curve.

A comparison of the formulae for the stresses due to internal water pressure, with the formulae for the stresses due to the weight of the shell, shows that they can be easily combined. It will be noted that angles from the vertical to the four nodes, or points of contra-flexure, are the same for both cases, and that the bending moments due to both causes are proportional at all points on the circle.

The analysis of the stresses in circular conduits due to internal water pressure has demonstrated the bending moments induced when such conduits are in a horizontal position. Where the diameter of the conduit, in an individual case, is large and the pressure head is comparatively low, these bending moments become very important,

so important that it is usually better to use a shape more nearly conforming to the equilibrium polygon. Mr. R. D. Johnson, in a paper before the American Society of Mechanical Engineers, printed in the May, 1910, Journal of the Society, on "The Hydrostatic Chord," presents very clearly the reasons against the use of the circular shape for such conditions. In this paper he also describes the hydrostatic chord, a curve which is eminently satisfactory for use under the conditions.

The hydrostatic chord is the curve which results when a flexible inextensible substance is loaded by fluid pressure which varies according to the head or depth of water at any point. For purposes of illustration, let us assume we have a large soft hose. If this is laid on a horizontal surface, it immediately flattens out. When it is filled with water gradually, it rounds out, but

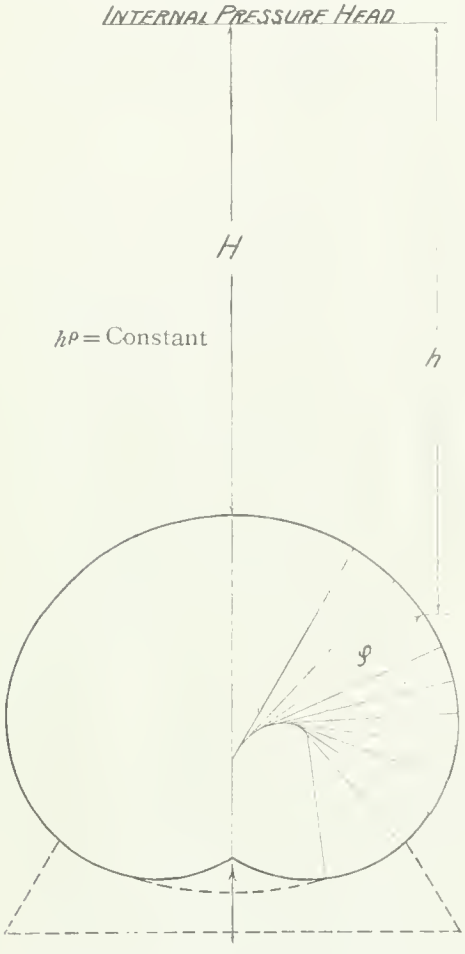


Fig. 7.—Illustration of Hydrostatic Chord.

with a flattened oblate form. As the pressure is increased it becomes more nearly a circle. As this flexible material cannot take any forces due to bending, it is easy to see that the shell is in a condition of pure tension, that this tension is equal throughout, and of finite value. If, on the other hand, this hose were hung in a vertical position and filled with water, it immediately takes the shape of a circle, as the pressure at any horizontal plane is uniform at all points on the shell.

The hydrostatic chord is the same as the hydrostatic arch with the stresses all reversed. The only investigation of this arch the writer has seen is that found in Rankine's "Applied Mechanics."

Since the tension in the hydrostatic chord is constant at all points in the shell, and this tension is measured by the product of the radius of curvature, and the head at that point, it is an easy matter to construct the shape for any desired condition. The equation of the curve will be $h\rho$ = a constant, where h is the head to any point on the curve, and ρ the radius of curvature at that point.

With the practical elimination of the bending moments in large conduits by the use of this shape, a very considerable saving in the material of the shell will result, and its use under certain conditions is almost a necessity.

The conditions to be met with in the design of large conduits under relatively low-water pressures, are: water pressure, back fill, and the constant weight of the shell. The water pressure will in all probability vary between certain defined limits, also the back fill. By choosing an equilibrium shape midway between the shapes for the limits of the water pressure, the stresses due to the various loads may be reduced to a minimum, and the material of the shell thus will be greatly lessened.

Reverting to Figure 5, the equilibrium polygon for a circular pipe under water pressure, the method of obtaining this polygon shows that any number of these curves may be plotted, as different values of H may be taken, and it is clear that these polygons will all pass through the same node points.

The question may arise in the reader's mind whether the equilibrium polygons shown in Fig. 5 and Fig. 6, and the hydrostatic chord shown in Fig. 7 are not identical for the same head and radius. They are not identical because the water pressures on the hydrostatic curve are normal to the curve itself, while the water pressures used in obtaining the equilibrium polygon are normal to the circle. There is very little difference, however, between the curves, for the conditions under which these shapes would be used in actual practice.

The assumptions, made in the early part of this paper, on which the mathematical analyses of the stresses were developed, were that the pipe was supported on a knife edge, and that the shell of the pipe was a thin ring of homogeneous material, having a constant modulus of elasticity. These conditions are not strictly true for pipes made of cast iron, steel, concrete or reinforced concrete, with regard to the later assumptions; but there will be little error in practical design. In practice, the conduit will probably be laid on a continuous bed or saddle of concrete, and in this case, the bending moments in the shell will be materially reduced. Investigation will usually show that the maximum moment, in the case of a conduit supported on a continuous saddle, is at the top of the pipe, and therefore the strength need be considered only at that point, if the shell is of uniform thickness and uniform material.

If in the judgment of the designer, the size of the conduit, and the water pressures to which it is subjected, are such as to justify the use of the hydrostatic chord for the intermediate pressure head; the bending moment induced in the shell for any head may be computed at any point, by noting the intercept between the equilibrium curves for the intermediate pressure head and the head under consideration. The bending moment will then be equal to the tension at that point multiplied by this intercept.

The tension for any point is obtained from the formula previously derived, viz.,

$$T = \gamma r \left\{ H + r\,(1 + k), \right\}$$

and the value thus obtained for the particular point under investigation is multiplied by the intercept.

The total stress is obtained by combining algebraically the bending stresses due to the weight of the shell, the back fill, and the weight of water, and adding to this amount the tensile stress due to the water pressure.

SOME PHASES OF THE CHANNEL TUNNEL CONTROVERSY.

THE question of a tunnel under the English Channel was referred to in *The Canadian Engineer*, Sept. 11th issue. At the Franco-British Travel Congress, held in London Sept. 23rd, the enterprise was given thorough discussion. The tunnel, viewed as an engineering problem, was dealt with by Sir Francis Fox, whose remarks were, in part, as follows:—

"The grey chalk through which the tunnels would be bored is 87 ft. thick at Dover and 70 ft. thick at Sangatte. It possesses the peculiar property of gradually 'puddling' itself and becoming impervious. Containing no flints, it is, as far as can be ascertained, free from fissures and slides; but should a fissure be encountered, it may be easily and satisfactorily dealt with by means of the system of high-pressure grouting which has been introduced within the last five or six years. A drainage heading would be driven from each side of the Channel, rising towards the centre, and connected at Dover and Sangatte with shafts for pumping and winding.

"The main tunnels would consist of two single-track circular tunnels, each of 18 ft. net internal diameter, and thus large enough to accommodate the rolling stock of the British and French lines, except only their locomotives, for which would be substituted electrical locomotives of ample power to deal with the heaviest trains running upon the main lines. Including the junctions with the main lines of railway in England and France, the total length of each tunnel would be 31 miles, the actual length under water being 24 miles. The tunnels would be placed 36 ft. apart, and lined throughout by cast-iron segments, of ample strength to resist any possible pressure, and grouted on the outside so as to secure a covering of cement which would not only prevent leakage into the tunnels, but also preserve the plates from corrosion. Assuming that 17 yards per day could be maintained for six days per week, the annual progress would be about three miles at each face, so that the driving of the drainage heading would occupy four years.

"Ventilation of the tunnels would be established by blowing air in the direction in which each train was travelling. The traffic being electrically operated, the volume of air required is very largely reduced. To keep the tunnels pure and fresh it would be necessary to supply 45,000 cubic feet per minute on each line of way, travelling at a velocity of 6 ft. per second, which was equivalent to a very light breeze. The prevention of fire in the trains is also one to which much attention has been devoted. In the case of specially built rolling stock for the London and Paris and other expresses no inflammable material should be used, and as the motors of the electric locomotive would be 'armored' against fire in case of short circuiting no danger would arise as regards the electrical working even from the employment of ordinary rolling stock. Assuming, however, that in spite of precautions any stoppage should occur in the tunnels, the passengers would readily pass along the tunnels in the rear of the train, where ample space would be available, as a footpath, clear of the electrical conductors. The tunnels would be lighted throughout by electricity. A separate and special circuit would be provided, so that in the event of the main traction current failing the lights in the tunnels would not be extinguished. Plans and sections for the proposed approach railways on the British side provide sorting sidings and a station near Maxton, just within the borough of Dover. These railways are well laid out to accommodate the traffic, and, in conjunction with the station where the exchange of steam for electric locomotives and all necessary sorting of traffic would take place, would provide full and complete means of communication with both the existing main lines between Dover, London, and the rest of England."

Dealing with the protection of the tunnel in time of war, Sir Francis Fox said there would be no question of the destruction of the tunnel. There was a dip at the Dover end. All that would be necessary would be to open a valve and let in a certain quantity of water. Then nothing could pass through, and the water could not be got out before the declaration of peace.

While dealing with this subject, it is interesting to call to mind some of the other schemes that have been advanced. Those of Henry Fairburn, in 1833, were decidedly clever. The main idea was to take down a considerable portion of the cliff between Dover and Folkestone and fill up the sea for an area of several miles with the material thus obtained. A huge harbor was to be formed at the extremity of the new piece of land, and similar works were to be undertaken at a corresponding point on the French coast. The two harbors were then to be connected by an enormous causeway, about ten miles in length. Further suggestions were that after the harbors had been made and protected by huge sea-walls, communication was to be continued by the construction of a chain bridge, a tunnel, a floating bridge, a bridge of ships, or a great steam ferry. Details of these and many other novel schemes, including one for a marine railway to carry ships across the Isthmus of Suez, occupy some 250 pages of a now rare treatise.

In 1856 Mr. Charles Boyd published his plans for a "Marine Viaduct or Continental Railway Bridge" between Dover cliffs and Cape Gris-nez, at a proper altitude for the safe passage of ships of the largest dimensions. The bridge was to be supported by towers rising from the bed of the Channel. The towers themselves, about 500 feet apart, were to have fog-gongs and lighthouses.

Perhaps the most ingenious scheme was that humorously propounded by the late Angus B. Reach in 1847. This was to take the form of a line of rails on a timber foundation carried by a bridge of boats, "the rails to work on hinges on board each boat, so as to yield freely to the action of the sea." Trains were shown in a sketch running up and down the inclines formed by the trough of the sea. A further joke by the same author was a Channel Balloon Line, in which a train was shown on an aerial platform supported by three balloons.

All these schemes are but marks of the general thought and effort to solve the problem of communication between England and the Continent, which, in spite of the great progress made in maritime navigation, has remained difficult on account of the obstacle of the channel, an obstacle of comparatively recent origin, the result of an erosion produced in a soil which was once continuous.

The study of the channel tunnel has brought to light one interesting fact, and that is the proportion of travellers between England, on the one hand, and France, Belgium, Holland and Germany, on the other, is slightly less than one per cent. of the united populations of these countries. But between France and Germany the proportion is two per cent.; and between France, Belgium, and Holland, eight per cent. M. A. Sartiaux, chief engineer of the French Northern Railway, and an administrator of a French society for the building of a channel

tunnel which was constituted in 1875, and which still exists, commented recently upon these proportions in travelling communication thus: "The proportion is remarkably low between England and the Continent, and we should have reason to be astonished at this if we did not know how much the changing of carriages, etc., complicates a voyage, and if we did not know the repugnance of many people to the smallest voyage on the sea.

"On the Continent, and even in England, there are business men who, although lacking nothing in activity, give way before the loss of time and the fatigues of the double crossing. It is necessary, whether going or coming, to resign oneself either to passing a night without sleep or sacrificing a day or half-day. Either of these alternatives is not encouraging. When, in addition, one is a victim to mal-demer, the voyage becomes really formidable. It is easy to understand, then, why many business men only undertake it on rare occasions, and why many tourists hesitate, with all the more reason, to undertake it when their sole pursuit is that of pleasure. . . . With the tunnel the journey between London and Paris would be five to five and a half hours by the most rapid route. But it would do more than take two hours off the present time necessary. It would make it possible, and here is the essential progress, to leave one of the capitals towards eight or nine in the morning, to be in the other at one or two o'clock in the afternoon, to leave it at six or seven in the evening, and to be back home again between eleven o'clock and midnight. Thanks to such a service, the movement of travellers between London and Paris would be doubled, perhaps trebled, at the end of a few years, and the current of business affairs between the two countries would follow a similar progression." M. Sartiaux then goes on to show how the growth of commerce between France and England is very much inferior to the growth between France and other Continental countries. The growth of general commerce between France and England for the years 1904 to 1911 was, on an average, 4.2 per cent. annually. But in the same period the commerce between France and Germany increased by 8½ per cent. annually, climbing up in that time from 1,117 millions of francs to 2,035 millions. "These figures have their eloquence. They show clearly the influence that is exerted by easy communication on commercial development."

Early Tunnel Schemes.—From figures, M. Sartiaux passes on to a short history of the various projects that have been made for the construction of a Channel tunnel, and it is interesting to note that such ideas have always originated on the other side of that important strip of water. As early as 1802 a French engineer named Mathieu had the idea of making a tunnel for a service of diligences, but he could certainly never have carried out his idea. A little later there was an idea, more weird than useful, for laying on the bed of the ocean an enormous iron tube. But it was not until 1867 that there was a serious proposal, based on geological studies of the bed of the Channel. This was made by Thomé de Gamond, and his careful borings in the Channel bed have been of great use to engineers interested since in the project. "In order to complete his scientific efforts Thomé de Gamond formed, in 1869, a Franco-British committee, whose aim was to work on both sides of the Channel towards a concession for the construction of the line. And here was commenced the diplomatic phase of the project, about which negotiations were opened between London and Paris. Far from opposing the idea, the British Government received the first communications favorably, and the reply that our Ambassador then received enabled pourparlers to go on with the greatest hopes of arriving at an entente. The conversation was, in fact, pursued between successive governments, and ended in 1874 in so complete an understanding that a Franco-British commission was formed to fix the conditions in a protocol, which was signed on May 30, 1876."

From then work went forward on both sides, although the most important was done by the French at Sangatte—the spot, by the way, from which Latham made his attempts to fly the Channel. There a long shaft was sunk and a gallery run under the sea to a length of over a mile. The works at Sangatte have never been abandoned definitely, and work could be restarted there again tomorrow if necessary. At Folkestone also a preliminary gallery was made. But work on both sides was stopped by an agitation which arose in England, the end of it being that no more was heard of the Channel tunnel scheme for many years; then, as now, the great objection being the possibility of military invasion.

CEMENT MANUFACTURE IN CANADA.

Concerning the manufacture of cement in Canada, Mr. J. McLeish, of the Division of Mineral Resources and Statistics, has issued the following data in his report on Economic Minerals and Mining Industries:—"Materials used in the manufacture of cement in Canada include marls, limestones, clays and blast furnace slag. The occurrence of cement materials is so widespread and abundant in all parts of the country that the question of their utilization is largely economic, being dependent upon the market for the product, the comparative availibility of suitable raw materials in different localities, the cost of fuel, and the transportation facilities. There are at present 24 completed cement plants in Canada, with a total daily capacity of about 28,800 barrels, besides several plants in course of construction. The total production in 1912 was 7,132,732 barrels, valued at $9,106,556, and in addition, 1,434,413 barrels were imported. The operating plants are distributed as follows:—One at Sydney, Nova Scotia, using blast furnace slag, three in the province of Quebec, two of which are near Montreal, and one near Hull, adjacent to the city of Ottawa, each using local limestone and clay. In the province of Ontario there are 15 plants with a total daily capacity of nearly 16,000 barrels. Of these 11 use marl and four limestone. The marl plants are located at Marlbank, Durham, Owen Sound, Lakefield, Hanover, Blue Lake, Raven Lake, Orangeville and Ottawa. The limestone plants are located at Belleville and Port Colborne. Formerly considerable quantities of 'Natural Rock' cement were made from a suitable calcareous limestone found in the Niagara peninsula, but this has now been entirely superseded in Ontario by the production of Portland cement. In the province of Manitoba, a 'Natural Portland' cement is made at Babcock, south-west of Winnipeg. Alberta has three limestone plants, located respectively at Calgary, Exshaw and Blairmore. A second limestone plant is being constructed at Blairmore, while a marl plant is being constructed near Marlboro about 145 miles west of Edmonton. British Columbia has one rock plant at Tod Inlet, near Victoria, and a second under construction at the same place, while another rock plant is nearing completion at Princeton."

The dock department of New York has decided upon building a drydock big enough to accommodate the "forthcoming 1,000-foot ship." The project will cost about $2,500,000.

VALUE OF THE FIXED CARBON TEST

By H. B. PULLAR,
Pullar & Enzenroth, Engineering Chemists, Detroit, Mich.

NOTE: On account of a bitter discussion regarding the propriety of limiting the maximum amount of fixed carbon, the City of Toronto was delayed six months in awarding its contract for supply of asphalt for 1913. The city bought in the open market during the first half of the year, as the Works Department did not seem able to convince the Board of Control that fixed carbon should be limited to 15%. Some of the controllers thought the specification unfair. Moreover, many chemists, paving contractors and city engineers differed in their opinions as to whether the specification was fair or unfair.

The city engineers of Canada will, within the next two or three months, write their specifications for asphalt supply. THE CANADIAN ENGINEER believes that a discussion of the desirability or undesirability of the "Fixed Carbon Test" would therefore be particularly valuable at this time.

During the next couple of months THE CANADIAN ENGINEER hopes to publish a number of articles from prominent chemists expressing their opinions regarding Fixed Carbon; and letters from city engineers and others who may have well-defined views on this subject are invited. Of seven well-known chemists whose opinions have been obtained by THE CANADIAN ENGINEER, two strongly favored limiting fixed carbon to 15%, four favored disregarding the test entirely, while one—Mr. Pullar—suggested a classification of asphalts with a different limit for fixed carbon for each class.

Mr. Pullar's suggestion is novel and has many points in its favor. In the following article he explains his claim that the maximum limit of fixed carbon for a gilsonite asphalt—for example—must be much lower than the limit of fixed carbon for, say, a Texas asphalt, in order that the gilsonite asphalt be in every way as good a paving material as the Texas asphalt.—EDITOR.

THE question of the value of the fixed carbon test as applied to bituminous materials and the advisability of eliminating this test from specifications, has been the topic of much discussion during recent years, and especially has this been true since the advent of certain asphalts which are good paving materials, even though they may have a high percentage of fixed carbon. Authorities disagree widely as to the value of this test, some advocating its total elimination from specifications, while others advocate a more strict observance of it. The writer, while agreeing with many of the objections to this test, believes that it is too important to totally eliminate from specifications, and when properly used is of the utmost value in helping to determine the quality of a bituminous material.

A particular objection to the fixed carbon test is, of course, the fact that different laboratories use different methods for running it. Such things as different sizes and different kinds of burners, different gas pressures, different crucibles and other details, make the results unreliable. Even in view of these possible varying conditions which might take place, the fixed carbon test is no more "liable to error" than a number of other tests which are applied to bituminous materials, and the elimination of the test for this reason should not be seriously considered.

The ductility test, which has been so strongly advocated by a number of authorities, has never reached the stage of perfection where any one chemist can exactly agree with the results obtained by other chemists. There are a number of ductility machines on the market, all of which are based upon the same principles, but which vary in detail, and which may cause varying results. Some are run by hand, some by motor, and the ductility as taken by different chemists on the same sample has varied as much as 20 cms. on a material having a ductility of less than 90 cms. This apparent inconsistency in tests is not only true of the ductility test, but of other tests which are used for determining the quality of bituminous materials. There is a personal equation in nearly all tests but their value is not eliminated, because of the fact that there is a personal equation and because chemists in different sections of the country cannot accurately check with each other.

The statement made in a recent publication regarding the fixed carbon test in which the writer states "The insertion of this test in any city, county, state or other specifications is purposely or unconsciously done, or caused to be done, by copying or otherwise from one or more persons or agents, who thereby seek to include some and exclude other brands of asphalts and road materials which compete and are perfectly good for use," is both unfair and unjust to a large number of engineers and chemists who believe in this test and who, from practical experience, know that this test, properly applied, is of value.

In order to show that this fixed carbon test is of considerable value and importance, a few results obtained on different samples and a discussion of the samples may prove interesting. A sample of asphalt made from Ohio oil, obtained in 1894, showed a fixed carbon of over 26%, while a sample of asphalt made from Ohio oil from the same field during the past year and which was treated by the same method, showed a fixed carbon of only 4.61%. While it is true this last product was not treated to the same extent as the first one, yet had it been treated to a greater extent it would have under no circumstance given over 10% of fixed carbon. This is proved by the fact that Ohio oil obtained in 1907 and mixed with a high per cent. of gilsonite, only showed a fixed carbon of 9.46%. The high fixed carbon in the first sample mentioned can, without question, be attributed to the fact

that in 1894 residuum oil was carelessly produced and a considerable amount of cracking occurred during the process of distillation. The asphalt produced from this oil was very poor in quality and proved a failure when used for paving purposes. There is no other test which so clearly and decisively showed the poor quality of this asphalt as that of fixed carbon.

In 1910 the value of the fixed carbon test was very clearly brought to the writer's attention. Two samples of asphalt obtained by the treatment of residuum oil (the oil being taken from the same district but produced by different refineries) showed a fixed carbon of 9.88% and 12.32% respectively. The quality of the asphalt showing the fixed carbon of 12.32% was very poor and not suitable for bituminous work, while the sample which showed a fixed carbon of 9.88% was good quality and equal to the standard for that class of material. Upon investigation it was found that the oil from which the poor sample was made was a mixture of poor, heavy-grade residuum oil which had been badly cracked during distillation and a lighter gravity residuum oil. There was no other test which so decisively showed the true value of these different materials (which all belonged to the same general class of asphalts) as that of fixed carbon. For the class of product to which this asphalt belonged, a limit of not over 11% of fixed carbon would always fully protect a city against any poor quality of oil. Likewise another bituminous material obtained by the same method, but from oil from a different field, showed a fixed carbon varying from 10 to 14%. Those asphalts which showed the high per cent. of fixed carbon did not prove a success; seemed "dead," and after a few months showed a separation and exudation of oil. They were poor quality and were not suitable for bituminous work. The fixed carbon test more clearly indicated this than any other test known.

The asphalts which have been mentioned above, have all been produced by the treatment of residuum oil with air. However, the value of the fixed carbon test not only applies to this class of asphalts but also to other asphalts produced from different oils and by different methods.

One of the well-known brands of California asphalts which was active on the market a few years ago, showed a fixed carbon of 18.06%. This asphalt was produced by distillation and treatment with air at high temperatures, which resulted in a "cracked" product of poor quality. It is to-day almost unknown, and is not considered by authorities to be a suitable material for road and paving purposes.

Another sample of California asphalt which proved a failure and which was carelessly prepared, showed a fixed carbon of 16.29%, and still another which was a failure showed a fixed carbon of 15.43%. The California asphalts which have given the most successful results, which are produced by the largest and most reliable companies, and which are recommended as standard material by leading engineers throughout the country, vary in their per cent. of fixed carbon from 11 to 14%. There has during the past year, however, appeared upon the market a new brand of California asphalt which seems to be of good quality and which ought to give successful results—the average fixed carbon for this particular brand being 9½%.

It appears from the foregoing facts that the fixed carbon test is therefore a very important test, if not the most important one for determining the quality of the California asphalts. Certain authorities believe that this cracking can be better shown by the solubility in carbon tetrachloride, but the writer has found that the carbon tetrachloride test requires more attention to details and greater care. At the same time it is more "liable to error" than the test for fixed carbon, and also it is more difficult to obtain from it satisfactory results and definite conclusions.

The fixed carbon test is of considerable importance when testing the so-called natural asphalts after they have been fluxed with residuum oil. A poor quality of oil will show up by high fixed carbon; and if properly applied and careful records are kept, this test will probably indicate as much as any other the amount of oil which is being used to flux the "native asphalts."

The probable reason for the recent interest aroused in the fixed carbon test is the advent of the Mexican asphalts. Owing to the peculiar characteristics of the oil obtained from Mexico and the asphalt product resulting from the distillation of this oil, a much higher fixed carbon is properly obtained than would naturally be supposed, averaging between 14% and 18% for the well-known brands. As a maximum of 15% is incorporated in several specifications throughout Canada, therefore making it difficult for the Mexican asphalts always to comply with them, it is only natural that this question be given considerable attention. From other tests and from the practical results which have been obtained, it is apparent that asphalts carefully prepared from the Mexican oils will give satisfactory results, despite comparatively high fixed carbon, and that for this class of materials a higher per cent. of fixed carbon could reasonably be allowed. However, the writer is very much of the opinion that it would be unwise to entirely eliminate this test or not state a definite limit, for, without question, Mexican oils can be as easily cracked as other oils, and the resulting products obtained from cracked Mexican oil will not be of good quality any more than that obtained from cracked oils from other fields. As the fixed carbon test is one of the best indicators for cracked oil, it is of the utmost importance that this test be very carefully considered.

From the foregoing statements it is apparent that there are many different conditions under which the fixed carbon test may prove of value. The writer does not advocate the arbitrary setting of the same per cent. limit on all bituminous materials, nor does he by any means advocate the elimination of this test, but he advocates a more systematic and proper use of it. At the present time a large majority of specifications are drawn up in order to admit a number of asphalts in competition. They are usually so open to the various asphalts which are admitted under them that the producing companies may practically ignore their requirements, and so far as keeping any particular material uniform and of the highest quality, they are of little value. For this kind of a specification a fixed carbon limit of 15% or any per cent. is useless and unjust.

In order to eliminate all undesirable features it would be advisable to draw up specifications dividing the bituminous materials into various classes and to draw strict requirements for each class.

By doing this the fixed carbon, as well as a number of other tests, would prove of very material value. Chemists could then use the fixed carbon test, not only as a help to identification, but as an important test in deciding the qualities of the material under examination.

CONCRETE ROADS.*

By Hon. Frank F. Rogers,
State Highway Commissioner of Michigan.

MUCH of value has been written in the past two years on concrete roads and pavements, but a great deal is in the nature of theoretical discussions quite largely based on laboratory experiments, hence when an opportunity is offered to make a field study of many miles of concrete roads, some of which have seen four years of service, it should not be lost.

The writer makes no claim to being a concrete expert but simply has been fortunate in having the opportunity to study at first hand, and in some detail, the behavior of a large mileage of concrete roadways in Wayne county, Michigan. This county, without doubt, has a larger mileage of concrete roadways than any other county in the United States, or than is possessed by any equivalent area under a single local government in any foreign country. There are now completed in Wayne county about 65 miles of concrete highways outside the corporate limits of cities and villages.

For the reasons above stated the writer desired to spend the time allotted to him in a somewhat detailed study of the local concrete roads which most of you will visit before leaving the city rather than to treat the subject in a more general way. All of the main highways leading out of this city have been concreted to the outermost boundaries of Wayne county and several cross-roads have already been concreted. The principal roads are the extensions of Woodward, Grand River, Gratiot and Michigan avenues, while River Road and the extension of Fort Street running southerly are concrete roadways that should not be overlooked.

The State Highway Department, with the co-operation of the road officials of Wayne county, and assisted by Prof. John J. Cox, instructor in highway engineering at the University of Michigan, has just taken up some detailed and rather minute observations of these roads which will extend over a period of years in the hope that after a while a safe estimate can be made of the probable life and cost of maintenance of such pavements as the county is now building, and under such traffic, soil and climatic conditions as prevail in this locality.

The first work in this study will be careful traffic records covering enough time and at such frequent intervals as will give a reliable estimate of the average daily traffic for one year. The first records were taken for one continuous week beginning August 21, and a part of this record, which is given in the accompanying table, will be used for the purpose of the present discussion.

The next step was to start a permanent record showing the present condition of each 25-foot section (the distance between expansion joints) of all the different roads. The observations for this record were made September 2nd, 3rd and 4th and cover 6,384 sections and a little over 30 miles of road. Several pieces of road have not been taken at this time. The oldest roads were built in 1909 and the newest that were taken were built in 1912, having been down one year.

For the purpose of this record the defects in the slabs or sections have been classified as longitudinal, transverse and diagonal cracks and holes. The records were taken in ordinary field books, the left hand column of the left hand page having been previously numbered with an automatic numbering stamp to designate the record number of each slab, while the four columns to the right were headed L—T—D—H, respectively, being the first letters of the words indicating the defects named. Opposite each number and in the proper column vertical, horizontal or diagonal marks were used for symbols to indicate the form of the crack, while small ovals were used to indicate such holes as seemed worthy of note. Tar had been spilled on many spots that were not defective.

The first mile of this road was built in May and June, and opened to traffic in July of 1909, thus giving it full four years of wear. The traffic record of this road shows a daily average of 2,160 vehicles, of which 88.1% were motor-driven.

The soil is clay loam, inclining a little more to sand at the northerly end. A double-track electric railway occupies the westerly side of the street. Between the railway and the concrete roadway is a very shallow gutter under which was laid a tile drain from 2 to 3 feet in depth. On the opposite side is an open ditch, the bottom of which is from 2 to 4 feet below the crown of the roadway.

The pavement is 18 feet wide, has a crown of 3″ and a blind curb 8″ wide and 4″ deep under the outer edges which were somewhat bevelled. The concrete was composed of Portland cement, crushed field stone or cobbles and sand mixed in the proportion of 1:2½:5 for the base, which was 4″ thick. The top layer was made of the same materials, using a 1:2:3 mix and was 2½″ thick.

No very definite data can be secured to determine the wear, which seems to be slightly greater on the side opposite the railway, but measuring from some of the harder pieces of the coarse aggregate which have been worn but little, if any, we have estimated the general wear at about ¼″, which would be an average of 1/16″ per year.

This mile was divided into sections of about 25 feet, separated by expansion joints, there being 209 sections to the mile. The most of the sections were separated by four thicknesses of tar paper separated by thin boards which it was planned to remove as the work progressed, though many of the boards are still in the pavement. Four of the joints were protected by pairs of steel angle bars, separated with tar paper and placed with one leg of each angle back to back so that the other leg of each bar was flush with the surface of the concrete, thus covering a space of about 4½″ at the joints. The concrete wears slowly on each side of the angles, leaving a raised joint that is slightly noticeable when driving over the pavement. This was an experiment which has not been repeated.

Of the 209 sections constituting the first mile on Woodward Avenue, 80 showed longitudinal cracks, 32 transverse cracks and 2 diagonal cracks, while 46 sections were recorded as having holes, making a total of 160 sections which are more or less imperfect, or 76.5 plus % of the entire mile.

The remaining portion of Woodward Avenue, 252 sections, was built in 1910 using the same materials and the same mix. No blind curb was used and the crown was reduced to 2″. The soil on this section is considerably more sandy, especially toward the north end.

On this portion of Woodward Avenue, 29 sections have longitudinal, 22 sections transverse, and 6 sections diagonal cracks. Eleven sections have holes, making a total of 68 defective sections or 27 plus % as compared with 76 plus % in the first mile.

*Read at American Road Congress, held at Detroit, Mich., Sept. 29 to Oct. 4, 1913.

On Gratiot Avenue, in the season of 1910, 9,000 feet of 16-ft. concrete roadway was built. On this pavement gravel and sand were used for the aggregate and a one-layer concrete having a 1:2:4 mix was laid. The soil is a clay loam and rather heavy. This road was not completed until late in the season and was opened to travel in November. It immediately pitted and looked rough and has been covered with a surface treatment of refined tar and fine gravel. It was re-covered this season, using a rather light grade of tar (Tarvia A) but is already shows some tendency to scale off. The experience in some other places leads the Commission to believe that a heavier grade of tar gives better results.

Beyond this portion of the roadway 326 sections of the same width concrete were laid in 1911, reaching the county line. Washed pebbles and sand were used for the aggregate in a 1:1½:3 mix, one course concrete 7″ deep being laid. The records for this piece are as follows: Longitudinal cracks, 11; transverse cracks, 10; diagonal cracks, 3; holes, 6; showing a total of only 30 defective slabs, or 9.2 plus %. The traffic count on this road, taken at the county line, shows 507 vehicles daily, 65.8% of which are motor-driven.

On the Grand River Road 61 sections of two-course concrete, the same as laid in the first mile of Woodward Avenue, were built in 1909. The soil is a clay loam. The records show 11 longitudinal cracks, 2 transverse cracks, 1 diagonal crack and 3 holes, a total of 17 defective slabs, or 27.9 minus %. The traffic count showed 1,064 vehicles, 56.5% of which were motor cars.

In 1910, 341 more sections were added to Grand River Avenue under contract, the specifications being the same as for the north end of Woodward Avenue. Thirty-three of these slabs became more or less pitted, some having quite large holes. They have been repaired by covering with refined tar and stone chips so that no defects could be observed at the time of the count, hence only 308 are shown in the table. The defects noted are as follows: 59 longitudinal, 20 transverse, 29 diagonal cracks and 46 holes, a total of 154 defective slabs or 50%.

In 1911, 515 additional sections of one-course concrete were placed on the Grand River Road. Washed pebbles and sand were used for the aggregate with a 1:1½:3 mix. The Baker steel joint was used in all of this work except the first six sections. The defects noted are as follows: Longitudinal cracks, 8; transverse, 26; diagonal, 3; and holes, 5; making a total of 42 defective sections, or 8.2 plus %.

In 1912, 1,208 more sections were added to Grand River Avenue, reaching to the line between Wayne and Oakland counties. The count on these sections shows as follows: 66 longitudinal cracks, 37 transverse cracks, 6 diagonal cracks and 5 holes, making a total of 114 defective sections, or 9.4 plus %. The soil grew more sandy as the road extended westerly, considerable stretches being almost free from clay or loam.

On Michigan Avenue 481 sections of concrete, 17 ft. 8 in. wide were laid, using washed pebbles and sand for the aggregate in a 1:2:4 mix. The soil for the most part is a sandy loam, but a little heavy. The count shows as follows: 219 longitudinal cracks, 48 transverse cracks, 23 diagonal cracks, 21 holes, making a total of 311 defective sections, or 64.6 plus %. The traffic count shows 1,009 vehicles, 67.5% of which were motor-driven.

In 1911, 1,570 sections were added to this piece of road, using washed pebbles and sand for the aggregate and a 1:1½:3 mix. The soil over which this pavement was laid is a sandy loam running into light sand at the west end. The count shows the following: 219 longitudinal cracks, 80 transverse cracks, 42 diagonal cracks, 14 holes, making a total of 355 defective sections, or 22.6 plus %. In 1912 this road was paved to within 1¼ miles of the county line, and this year completed to the county line, but no record was taken farther west than the east limits of the village of Wayne.

In 1910, 149 sections of concrete 15 ft. wide and 6½″ deep were laid on the River Road, using gravel and sand for the aggregate and a 1:2:4 mix. The soil over which this road runs is for the most part heavy clay. The count shows as follows: 49 longitudinal cracks, 5 transverse cracks, 6 diagonal cracks and 2 holes, making a total of 62 defective sections, or 41.6 plus %. The traffic count shows 538 vehicles daily, of which 78.9% were motor-driven.

In 1911, 434 sections were added to this road some distance below the village of Trenton. The pavement was 15 ft. wide, 7″ thick, built of washed pebbles and sand for the aggregate, using a 1:1½:3 mix. The count for this stretch of road shows as follows: 165 longitudinal cracks, 17 transverse cracks, 13 diagonal cracks and no holes, a total of 195 defective sections, or 44.9 plus %.

In 1912, the gap between this piece of road and the southerly limits of the village of Trenton was closed in with a similar pavement to that just described, comprising 213 sections. The count of this piece shows defects as follows: 14 longitudinal cracks, 8 transverse cracks, 4 diagonal cracks and no holes, making a total of 26 sections, or 12.2 plus %.

The same year there was added to the south end of the work done in 1911 something over two miles of concrete roadway, but of this only 208 sections were counted. Of the sections counted, 17 show longitudinal cracks, 9 transverse cracks, no diagonal cracks and no holes, a total of 21 defective sections or approximately 10%. The soil of the entire road was heavy clay.

In 1910, one-half mile of gravel concrete of a 1:2:4 mix, 12 ft. wide and 6½″ deep was built on Fort Street. This concrete, like that already referred to on Gratiot Avenue, was built rather late in the season, and was opened to traffic in November. It immediately pitted to such an extent that it has since been coated with refined tar and fine washed gravel, about ¼″ in size. This covering makes an excellent surface and wears fairly well. Of course it was impossible to observe any further defects in the concrete at this time. Continuing south, in 1912 450 sections of concrete 12 ft. wide, 7″ deep, and of 1:1½:3 mix were added. The count on this piece of road follows: Longitudinal cracks, none, although another observer has reported there are 2; transverse cracks, 19; diagonal cracks, 9; and holes, 1. Total defective sections, 29, or 6.5 minus %.

From the foregoing, it is strikingly apparent that the percentage of defects varied greatly in the different roads. A careful study of this variation in connection with the age of the pavement will soon convince one that mere age has not produced the defects noted. For example, 252 sections built on Woodward Avenue in 1910 show but 27% defective slabs, while 308 sections built on Grand River Avenue, the same year and under the same specifications, show 50% of defective slabs. There are two noticeable differences. Grand River Avenue was built by contract on a clay loam soil while the portion of Woodward Avenue named was built by day labor under the direct supervision of the engineers of the County Road Commission, on a soil more sandy and, presumably with a little better sub-drainage. Again, 481 sections built on

Michigan Avenue the same year with sand and pebbles for the aggregate and a 1:2:4 mix show 64.6% of defective slabs. This was on clay loam soil. We might also mention 149 sections built on the River Road in 1910 on heavy clay soil, under the specifications last named, which show but 41.6% of defective slabs.

The most noticeable feature concerning these defects is that the longitudinal cracks almost always appear in groups, seldom singly. This indicates that there must be some local conditions in the foundation, due to insufficient drainage, soil conditions, newly made fills or uncompacted sub-grades that cause these defects. Longitudinal cracks almost invariably appear on fills and on cuts, apparently with as much frequency in the latter as in the former. It would seem that cracks on the fills are due to the settlement of the embankment, and in the cuts the presence of water and frost in the sub-grade. Briefly, the writer's opinion is that these cracks are due, first, to the settlement of the newly made fills, and second, to water that has not been completely removed from the sub-grade, plus frost. If these causes could be thoroughly eliminated it would seem possible to build concrete roadways to the width of 15 or 16 feet, where sufficient expansion joints are used, without fear of trouble from longitudinal cracks.

It has been argued by the Morse-Warren Engineering Company, in a recent publication, that it is impossible to build concrete pavements (wider than 12 ft.) which will remain free from longitudinal cracks without using longitudinal joints, unless the pavement is so thick as to make the price practically prohibitive. The table accompanying this report, which shows 450 sections of 12-ft. roadway on the Fort Street road, would seem to bear out this assertion, but a mile of concrete on the Eureka Road, which the writer did not get time to inspect, shows a great number of longitudinal and transverse cracks in a 12-ft. concrete roadway, where the soil conditions are the same as on the Fort Street road referred to. The only apparent difference is that the former is a 1:2:4 mix and the latter a 1:1½:3 mix, washed pebbles and sand being used for the aggregate in both cases.

But long stretches of pavement, 16 ft. wide and now two years old, on Grand River and Michigan Avenues, which show no longitudinal cracks, would seem to prove that this statement is not necessarily true, and that a sufficient amount of money spent in compacting and draining the foundation or in reinforcing the concrete over newly made fills, would produce pavements free from the objectionable longitudinal crease, whether natural or artificial. Most persons are agreed that transverse cracks are almost always due to defective expansion joints. It has been thoroughly demonstrated, both theoretically and practically, that 25 feet is frequent enough for the expansion joints, and it is quite possible that they might be placed farther apart with safety—probably not less than three to 100 feet.

The diagonal cracks are doubtless due to causes which are a combination of those noted under longitudinal and transverse cracks. Many diagonal cracks were noted where the corners only were broken off, frequently on adjoining corners of adjacent slabs, indicating that the slabs were united through the expansion joints with a bond stronger than the tensile strength of the concrete on either side of the joint.

The holes noted are perhaps of less importance than the different kinds of cracks. In a few instances they are rather large, sometimes a square yard or more in area, but such places are very rare and most of the holes noted are due simply to some foreign substances getting into the concrete, like clay, wood or some fragment of an inferior rock that might chance to be a part of the aggregate. This was more noticeable where crushed cobbles were used for the coarse aggregate than where washed pebbles were used.

Any one familiar with the quality of rocks which constitute Michigan cobbles will understand that the principal objection to this material for an aggregate on concrete roads is the varying qualities of these rocks, ranging from soft to hard granite, quartzite and trap. A study of the roads where these materials have been used shows much more wear in the spots where the softer rocks happen to be at the surface.

Up to the present time the defects noted, except the pitted conditions of the concrete roads which have been re-surfaced in the manner already described, are not serious and are not causing any additional expense for up-keep. In the past two years the expansion joints on all the old work, whether reinforced or not, have been coated with refined tar and sand once a year. Thus far, the cost has ranged between $50 and $100 per mile, depending on the distance of the work from the base of supplies. These repairs are proving adequate and satisfactory, and while the defects noted are something of a reflection on the present method of building concrete roadways, they are really no reflection on the use of concrete as a suitable material for making hard and durable surfaces over our country highways wherever traffic conditions warrant, and the community has the ability to pay the cost of high-class road surfaces. There is no question as to the necessity of some form of very permanent roadway near the city of Detroit, neither is there any question as to the ability of Wayne county to pay for a roadway that is good enough and permanent enough to meet the requirements of its traffic. In the writer's opinion, Wayne county has made no mistake in choosing concrete as a paving material for its main roads.

DISCUSSION ON "CONCRETE ROADS."

By A. N. Johnson.*

It is evident that if one portion of a concrete road surface exhibits a special weakness it must be due to non-uniformity of the concrete. This will happen if soft pieces of material are in the aggregate. Many gravel banks contain enough soft pebbles to render the gravel useless for concrete-road work, though frequently these soft pebbles have somewhat the general appearance of the sound material and, unless a careful examination is made, will not be detected.

Another cause for local weakness in concrete is the non-uniform distribution of the mortar and the aggregate. It frequently happens, particularly with very wet mixtures, that the coarser aggregate will not be thoroughly distributed but will occasionally be separated into small collections or nests of the larger pieces, which contain a very small amount of mortar. There is no mixer that has come under the writer's observation which will mix and deposit a batch so uniformly that all portions will contain the proper amount of coarse aggregate and mortar. It is necessary, therefore, in the construction of a concrete road to have one or two men constantly at hand to correct such uneven distribution by shoveling out the

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pockets of coarser aggregate to be found in the centre of nearly every batch that is deposited on the road and replacing these pockets with mortar, which usually runs to the bottom and edges of the batch.

The causes of the other three defects noted by Mr. Rogers (see Engineering Record, Oct. 11, 1913, page 409)—longitudinal cracks, transverse cracks and diagonal cracks—are perhaps more difficult to ascertain in a given instance. The data presented have been rearranged according to the age of the various pieces of road in the table following. In order to have a proper basis of comparison the number of cracks per mile has been computed for the roads built in 1909, 1910, 1911 and 1912 respectively.

At once one is struck with the increase in the number of cracks with each succeeding year. This increase is particularly marked during the first three years, but apparently falls off sharply during the fourth year.

A notable coincidence is that the curve showing the total number of cracks per mile of all kinds is approximately a straight line for the first three years, or, in other words, the increase in the number of cracks was approximately the same for each of these years.

There is also considerable agreement of the curves for the longitudinal, transverse and diagonal cracks during the first three years, but no such agreement for the fourth year. It is to be borne in mind, however, that for the fourth year data are given for only two pieces of road about 1.3 miles in length. However, as these pieces were laid with a leaner mixture than much of the other work and constitute the first concrete work done by the Wayne County Commissioners, all the evidence would point to the conclusion that this stretch of road would show at least as many defects as will appear later in the other roads.

The value of future observations to be made at intervals of not less than three months will be evident. These observations should note carefully all the cracks that are found, both as to their character and, particularly, as to their distribution, so that in the future the location of new cracks as they appear may be known, as well as the approximate time of the year when they occur.

It can be fairly assumed that the slabs of concrete are approximately of the same strength, offering practically the same resistance to all exterior forces to which they are subjected.

Among the forces which would cause the slabs to crack are variations in temperature, extraordinarily heavy traffic loads and unequal settlement of the foundations. It is more than probable that the cracks are due to no one of these causes alone, but rather to their accidental combination. If the changes in temperature were the prime cause, it could be expected that all slabs would show approximately the same number of cracks, for the reason that all portions of the road are subjected approximately to the same temperature variations. But an examination of the roads shows many slabs in continuous stretches which have not cracked at all, regardless of the age of the road. It can, therefore, be concluded that temperature changes alone are not sufficient to cause cracking of the slabs in general.

While extraordinarily heavy moving loads may not be so generally applied to all the slabs, and therefore not cause as uniform an appearance of cracks, yet if this be a principal cause it could be expected there would be a large number of contiguous cracked slabs. But there is practically no evidence to indicate that there have been loads heavy enough to cause the pavements to crack from this reason alone.

The third cause that has been mentioned—unequal settlement of the foundation—is one that would not be generally distributed; for while settlement might occur in one place, there very likely would be considerable distances where it did not occur. Moreover, it will be appreciated that the manifold conditions which would produce unequal settlement would cause an erratic occurrence of any results from this source. And the haphazard occurrence of the cracks would indicate that the cause is not general throughout the length of the roads. The writer is, therefore, of the opinion that the majority of the cracks are due primarily to unequal settlement of the foundation or subsoil beneath the broken slabs. It is quite possible that settlement by itself would perhaps not be sufficient to cause the slab to crack, but on the passage of heavy traffic or with the movement of the slab under temperature changes there would be added just enough extra stress to overcome the strength of the slab and produce the crack. If, therefore, it is possible to guard against unequal settlement of the foundation, one of the chief sources of cracks in the pavement will be overcome.

The writer has observed that the concrete slabs usually do not crack until after they have been in service about a year. The first cracks generally appear during the late spring and early summer following construction. An explanation is that during the winter and early spring the ground is well saturated with moisture and dries unevenly; the consequent settlement is, therefore, not uniform. Special precaution with the underdrainage should accordingly be taken to provide thorough and uniform draining.

The writer does not believe that it is necessary to place expansion joints as close together as 25 ft. On three pieces of work constructed under his supervision in 1912, totalling 2.3 miles, none of the sections was less than 50 ft. in length, many being 60 and 75 ft., and one or two as long as 100 ft. The number of cracks per mile in these roads at present is: Transverse cracks, 9.1; longitudinal cracks, 9.1, or 18.2 cracks per mile. The total number of cracks in the 1912 work on the Wayne county roads, using 25-ft. sections, is 19.1. It will be necessary to have much more data before it can be definitely concluded as to how frequent the joints should be; but from the observations that have been made it seems that the joints may be made further apart than 50 ft. rather than nearer together.

Lest a wrong impression should be gained from the emphasis laid upon the defects found in the Wayne county roads, the writer would state that from a number of personal inspections he feels that the Wayne County Commissioners have amply justified their adoption of this form of construction.

A NEW TYPE OF ENGINE.

A new type of rotary engine has been invented by a Birmingham firm. A model is being shown in London, where it is described as "England's answer to her critics—an engine that is far and away better than even the Gnome." It is claimed that the engine, which is driven by petrol, is almost vibrationless, while its weight is only 2½ pounds per horse-power. It has no fly-wheel, no crank-case and no cam-shaft. The new engine is expected to have far-reaching effects on the motor car, the motor boat and the aeroplane.

SANITARY SURVEYS OF RIVERS.*

By J. R. Malek, C.E.,
Assistant Provincial Sanitary Engineer, Regina.

IN dealing with the subject of this paper, the writer wishes to state that the object in view is to make a few general remarks on the necessity of carrying out sanitary surveys of rivers and the general lines employed in carrying out such work, but does not propose to deal with sewerage purification works or water filtration plants situated on the banks of rivers and streams in this or other countries.

Object.—Sanitary surveys have all been carried out chiefly with a view to ascertaining the state of the streams which have been subject to contamination, either by the discharge of crude sewage of adjacent towns into the river or else by the general refuse of communities along their banks or through industrial wastes and the waste water from mines or quarries or other works too numerous to mention.

It need hardly be mentioned here that the duration of the work and the observations to be taken, may extend over any period from a few days, weeks or months to possibly one or two years, according to the ultimate object in view or to the size and varied conditions to be met with in the various rivers or waters under observation.

Results of Pollution.—Unfortunately, it is only too true that as civilization has advanced and the number of factories and towns have become the centres of manufacturing industries, that the tendency has been in the past to use these courses in their near vicinity as an easy and inexpensive means of getting rid of the ever-increasing filth and rubbish to be expected to collect from such centres, with never a thought bestowed on the trouble and future sickness in the shape of epidemics of typhoid, dysentry, cholera and diphtheria, not only to themselves, but to the towns and villages lower down on the same stream, which may be their nearest water supply, but to the farmers and dairymen whose animals water themselves in the river or at the pools left on the shoals.

The older countries have long ago realized the necessity of investigating the serious condition of their waterways, and extensive sanitary surveys have been carried out by some of their most eminent scientists, engineers and surveyors, with a view to ascertaining the extent of the contamination, which "Findings" are submitted in the shape of reports to the governments concerned.

The United States and Canada, both comparatively new countries, are likewise realizing the dangers likely to arise from the present state of pollution of their streams, rivers and great lakes.

In the States, two recent surveys will, no doubt, be fresh in the minds of those present (a) the thorough and exhaustive sanitary survey of the "Potomac River" by Asst. Surgeon J. Goldberger, the full report of which is given in the "Report on the Origin and Prevalence of Typhoid Fever in the District of Columbia," which was brought out in 1907 in the form of a report by the United States Government, (b) the very recent extracts on the report by Messrs. Forbes and Richardson, of the sanitary survey of the "Illinois River," in connection with the pollution caused by the sewage discharge from the Chicago Drainage Canal.

The Canadian Engineer, of July the 13th, 1912, published extracts from the report by Mr. James Meadows, sanitary engineer to the Board of Health at Quebec, on the survey of the Ottawa River, carried out by him.

The object of this survey was to arrive at the difference in the state of the river in 1910, compared to the condition when Dr. Wyatt Johnstone made his in 1891, when the population for Ottawa and Hull combined was only half what it was in 1910.

Dr. W. Johnstone, in July, 1891, found that samples taken at a point five miles below Ottawa, had 500 bacteria per cubic centimeter, the next highest return was at Thurso, a town thirty miles below Ottawa, when it was 201 bacteria per c.c., from this point they gradually diminished.

In September, of the same year, his next survey was carried out at a point 25 miles below Ottawa, the samples taken showed the number to be 1,530 bacteria per c.c. at a point 65 miles below the capital, they had diminished to 48 per c.c.

The survey carried out by Mr. Meadows in 1910 shows in nine years a very great increase of pollution in the river, owing to the increase of population and the discharge of sewage and factory wastes that was taking place.

At Pembroke, the samples taken gave 110 bacteria per c.c., at 113 miles lower down and seven miles below Ottawa, they showed 700 bacteria per c.c. The next highest reading was 1,000 per c.c. at a distance of 179 miles, after which it decreased rapidly.

In the October survey of 1910, when the water was at its lowest level, the samples taken showed that at Pembroke there were 43 bacteria per c.c., at Ottawa, 106 miles lower down, the samples had 100 per c.c., at 113 miles, or seven miles below Ottawa, 1,600 per c.c. The highest taken was at a point 133 miles away when the samples taken showed 1,900 per c.c. It there dropped to 1,450 per c.c., at a distance of 179 miles from Pembroke.

The above is given to show how severely even such a large river as the Ottawa may suffer through continued pollution taking place and the great value a sanitary survey is, in enabling the authorities to get a clear understanding as to its conditions.

Professor Heider, in 1893, in his extensive and prolonged sanitary survey of the River Danube, into which Vienna discharged its sewage, found that it was carried along the right bank of the stream, preserving its own bacterial characteristics and not mixing perfectly with the water of the river for a distance of more that 24 miles. Where sudden dips take place in the river bed it has been found that these act like sewage tanks accumulating sludge.

In a recent river survey carried out by the writer for a civil action in which the discharge of crude sewage by a small town was causing considerable damage to property lower down along the side of the stream for which the owner clained damages, the sewer pipes had been placed in a diagonal line across the river, thereby forming a kind of groyne, throwing the current on to the opposite bank, which, owing to the gravel shoal that had been formed, set up a back current on to the plaintiff's land, causing lighter solids to settle along the bank and seriously damaging his property.

At a distance of 20 yards from the mouth of the pipe, the bed of the river shelved down and for some distance formed a saucer like hollow. It was noted when the river got to summer or normal levels, that the ordinary current had little or no effect on the deposits lying at the bottom and even with a "freshet," which increased the depth of the water by an additional five feet, it made no appreciable difference. It was found after careful examination

*Read before the Third Congress of the Canadian Public Health Association, Regina, Sask.

that only after a rise of 8 feet above the normal, a portion of this matter got away, and that in the ordinary way the rapid shelving of the river's bed caused the current to pass over it, whilst the surface water was considerably disturbed, the portion beneath was not in the least affected until a heavier "freshet" came down and scoured out.

Dominion Health Commission.—It is with considerable satisfaction that we see that the Dominion Government has recently formed a Health Commission of 18 members to look into and report on the health of the cities and towns upon the banks of our rivers and streams in this country when it is to be hoped that they will frame such laws and regulations as will prohibit the discharge of untreated sewage and trade wastes, as well as other impure matters, which are liable to injure the health of the community at large, into the waterways, which should be looked upon not as ready-made sewers, but as valuable national assets.

Surveys.—To get a general and fair estimate of what is taking place will of a necessity demand not only an inspection to be made during the open seasons or summer months, but also during the winter period when the streams and watercourses are "ice" bound, to note the changes taking place as well as to obtain an idea of the rate of flow or the state of aquatic and animal life during this period.

To sanitary engineers and sanitarians, sanitary surveys open up a very vast and at present almost unexplored "field" of operations, and as the population increases (as it does year by year), close investigation of the state of all waters will demand their unceasing attention if the preservation of the public health is to be their principal object.

The government of this province has already set an example to its sister provinces by organizing sanitary surveys on a systematic scale of all its waterways and creeks, and perhaps a review of the methods now being employed to ascertain the conditions that are prevailing will not come amiss.

In the first instance, "waterways" to be surveyed, if within a reasonable distance, are always first visited to gain an idea as to the best means of surveying them in a thorough and expeditious manner to enable the engineer who is employed to make an exhaustive report.

Plans are then obtained of the section or area to be taken in hand, which, if on too small a scale, are enlarged to such a size as shall allow corrections to be made and measurements clearly marked thereon.

"Field sheets" are also prepared, such as will be suitable to meet the requirements of town or country, with the necessary questions printed on, to gather the data it is necessary to obtain and on which the report will be based.

Large plans should be avoided, 24 in. x 20 in. are found the most convenient for outside work, each of which should be marked in "alphabetical" manner and pinned one on top of the other to a light drawing board or on to stout cardboard, which is swung over the back, when not in use, thus leaving the hands free.

Record plans on large sheets should in the meantime be prepared in the office as well as a "Record Book" into which is entered all the information obtained, so that it can be referred to from time to time or when it is necessary to take up the record part of the survey.

The surveys should be conducted at least twice in the same year, but owing to the extreme climatic conditions met with in this country, it is impossible to lay down any hard or fast rules on such a point, so much will depend upon the district, stream and the purpose for which the work is being carried on.

Where work in towns is concerned or such houses affected or likely to affect the survey situated along the banks of streams and creeks, information should be obtained and everything done to gather such data as shall enable a full report to be compiled.

A gauge is placed in the stream and the height of the water is taken, with the hour of the reading as well as the day, month and year, tests are also made as to the rate of flow of the current and the quantity of flow in gallons per second, the course of the current is noted and erosions due to this cause are also marked in as well, whilst large shoals of gravel and such as would be likely to affect the general run of the current are marked in on the plan.

A thorough examination of the banks is to be undertaken with a view to ascertaining the nature of the pollution taking place as well as the nature of any pools left behind which are likely to cause the breeding of flies (especially when near human habitation or from which dairy cows and others might be likely to water at) the bed of the river, creek or stream, where visible, is examined and a note of such aquatic plants growing there, also of the animal life or fish life, as well as that of insects. Soundings in shallow pools may be frequently taken where necessary. This may be taken by means of wading with a six-foot pole or rod marked in feet, inches and half inches, where deeper water is encountered and boats are not available, a waterproof tape with a conical lead may be employed and run over a pole with a small guide pulley at the end, the lead should have a slightly scooped-out bottom which, if greased, will serve the double purpose not only of sounding, but will also give a sample of the bottom which should be examined at the time, or kept for a more opportune moment when a fuller examination may be carried out.

Where sewer outfalls occur these should be noted on the plans with all the necessary measurements taken and, if run out into the river, the angle should be carefully noted.

Sewage fungus should be looked for at these points, and a sample obtained for examination by the chemist, who may be employed to analyze the samples at the labatory, the returns of which will be put in the final report.

Samples.—The writer always prefers to leave the taking of samples till the last, so that there may be as little delay as possible in getting them in to be tested owing to the rapid changes that take place where delay owing to distance is likely to occur, a little addition of formaldehyde or chloroform to the sample for dissolved oxygen test will usually help to keep it in the same state as when taken for about 48 hours.

The bottles to be used should be glass bottles with tight-fitting glass stoppers (for preference) well sterilized, covered with a small piece of cloth tied down. When taking the sample the fingers are to be kept clear from the mouth of the bottle, which should be well rinsed in the water to be sampled and then filled to within half an inch of the stopper.

In conclusion, the writer would suggest that where important surveys are to be made, samples should always be taken and analyzed by a competent chemist, especially when it happens that the survey is being carried out with a view to finding out the actual conditions prevailing in the river as the preliminary step to arranging for a supply of water for a town.

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ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Water Pressures in Large Circular Conduits .. 711
Ottawa's Proposed Aqueduct 711
The Highway Commission at Belleville 712

Leading Articles:

Stresses in Circular Pipes 695
Some Phases of the Channel Tunnel Controversy 701
Value of the Fixed Carbon Test 703
Concrete Roads 705
Discussion on "Concrete Roads" 707
Sanitary Survey of Rivers 709
Cross Sections of Breakwaters to Withstand Wave Action 714
The Treatment of Unsurfaced Roads 718
Sewage Pumping Machinery and Appliances... 720

Coast to Coast 723
Personals 724
Coming Meetings 724
Railway Orders 725
Construction News 76
Technical and Municipal Societies 94

WATER PRESSURES IN LARGE CIRCULAR CONDUITS.

With the expansion that has taken place during recent years in the utilization of water resources, both for power and for industrial and domestic consumption, there has been an accompanying increase in variety of the problems connected with the design of pipe-lines. One that has risen to a degree of importance calling for rapid and accurate solution bears upon the use of circular pipes. The use of conduits of larger diameters has become widespread, although it cannot be said that the stresses to which they are subjected are a matter of common knowledge, or have always been taken into account in the design.

Water powers that were considered economically impossible of development in the past are now being harnessed and brought into commercial use by the installation of long feeder penstocks. Also, increased density of population on every side demands an adequate supply of pure water, with which is frequently associated the necessity of pipe lines of great length and of large carrying capacity. These conditions are likely to develop rapidly as time goes on.

It is true that the use of circular pipes of relatively small diameter has not entailed serious difficulty for the designer. With the use of conduits of larger diameters, under certain conditions, however, various elements of design come in for careful treatment. One phase of the problem has been almost totally ignored. It comprises the large bending moments that are created in the shell of a circular conduit lying in a horizontal position, and filled with water.

This most important phase is dealt with in the first article in this issue of *The Canadian Engineer*, and we feel that we are particularly fortunate in being able to present this analysis by Mr. Hogg. The subject, to our knowledge, has never been treated in engineering literature before.

The article also includes a general discussion of the analysis of the stresses in, and the design of, water conduits, which should prove of interest to the engineering profession.

OTTAWA'S PROPOSED AQUEDUCT.

Ottawa City Council very wisely rejected, last week, the proposal to amend Sir Alexander Binnie's report, substituting a 58-inch pipe line, with a carrying capacity of 33,000,000 gallons, for the 54-inch pipe line that was recommended. (See *The Canadian Engineer*, Oct. 16th, 1913, page 595, *et seq.*) The argument favoring the adoption of a conduit of larger diameter, was based upon the fact that, at the present rate of growth of population, the city would be obliged to set about increasing its water supply in six or seven years, which will be about three years after the line is completed. It is claimed that, with the present rate of consumption ranging from 175 to 190 gallons per capita per day, the city will soon attain a population that will demand a greater daily supply than the 25,000,000 gallons which the proposed 54-inch pipe, emptying into the service reservoir, would provide.

In his report, Sir Alexander Binnie threw particular emphasis upon the enormous waste of water in Ottawa. It was stated that it could be reduced to 100 gallons per head per day; and his report was based upon this figure. Doubtless, measures will be taken forthwith to stop the leaks in pipes and house fittings, since it is plain that,

owing to defects in such connections, over 100 gallons per day is lost for each head of population. Thus, without coercive measures to reduce the quantity actually used by consumers, the present distribution may be improved so that the 54-inch pipe would provide a supply sufficient for many years to come.

What the City Council might well have done, however, would have been to discuss the advisability of a duplicate pipe line for this 235,000-foot aqueduct leading from the outlet of Long Lake to the service reservoir. Although the pipe line, as projected, will be eight or nine feet below the surface of the ground, it must pass through loamy and swampy ground, and has several streams and rivers to cross by means of bridges, the largest of which will have a 150-foot span. Coupled with severe winter weather, these conditions are such as to indicate the advisability of a duplicate line to guard against water famine in case of an obligative emptying of the pipe for repair. A 12-day reserve, which the service reservoir is designed to hold, may be found altogether too inadequate and the time may be too short in which to get equipment and materials to the defective spot in the aqueduct, and the necessary repairs completed.

The water supply of a city is something that demands greatest care to be taken in its design, construction and operation, to eliminate all dangers of interruption for any length of time. A great deal depends upon design. It is not often that the designing engineer escapes criticism if deficiencies appear even after the system has been in operation some little time. In Ottawa's case, duplication of pipe line should be given more consideration at this stage.

THE HIGHWAY COMMISSION AT BELLEVILLE.

No fewer than thirty-five representatives from surrounding municipalities greeted the Public Roads and Highway Commission at its sitting in Belleville on Nov. 4th. Their suggestions were for the most part of a practical nature, showing that the road question has been receiving sound consideration and that the counties are anxious to assist the movement just as far as they possibly can. Among the recommendations brought forward there are few that the Commission can pronounce outside the scope of early realization, if the agitation for better roads throughout older Ontario meets with the recognition that is its due.

A few of the suggestions, expressive of the general feeling of the Belleville meeting, are as follows:—

(1) To prevent a still greater decline in Ontario's rural population, something must soon be done to improve the roads.

(2) A permanent Road Commission should exist, to obviate an undue amount of patchwork in county road building.

(3) Counties should be grouped, for purposes of road standardization.

(4) There should be more Government inspection of roads, and the Government should force counties to begin maintenance duties earlier after construction.

(5) More regard should be shown, where possible, for the lighting of county roads.

The following recommendations of the Road Committee of the County Council of Hastings were presented by Mr. N. Vermilyea, president of the Good Roads Association:—

"That legislation be passed prohibiting the manufacture of new vehicles and the renewal of old ones carrying 1,500 pounds or over with a less width of tire than four inches, and five years only be allowed for changing to the same width the tires of existing vehicles of similar capacity.

"That a tax of fifty cents per horse-power be imposed in lieu of the existing license fee upon all autos up to and including twenty horse-power, 75 cents per horse-power on autos above twenty horse-power and up to and including thirty horse-power, $1 per horse-power upon all autos above thirty horse-power, and that the money so raised be applied for highway improvement.

"That expenditures hereafter upon all county roads and bridges shall be borne one-third by the county in which they are situated and two-thirds by the Government of the province; that it is of supreme importance that the cost of maintenance should be borne in the same proportions as the cost of construction by the county and province respectively; that as we consider county roads should be constructed in such places only as will be in the general interest, we are opposed to a frontage tax; that the highway connecting the producer with the producer's market receive first consideration, and that such roads be selected where the council of each county shall approve."

COST OF OPERATING ELECTRIC TRUCKS.

OF interest to Canadian manufacturers and contractors are the figures contained in a report recently presented at the Electric Vehicle Association in Chicago, on the costs of motor truck operation. The estimates cover a wide variety of sizes and operating conditions. As a matter of fact, the operation of a motor truck is beset with so widely varying conditions—differing with every city, every trade and almost with every installation—as to make figures, as a rule, very unreliable as a guide though, of course, they do frequently tell what certain owners have succeeded in doing. The contribution mentioned above, however, is the work of a special committee, and its figures are based on a large range of electric vehicle installations in various cities. The following is from a table appending the report:—

Capacity, lbs.	700	1,000	2,000
Approximate price	$1,500	$2,200	$2,600
Fixed charges—			
Interest at 6%	$ 90	$132	$156
Depreciation at 10%	150	220	260
Fire insurance at 1%	15	22	26
Liability insurance	100	100	100
	$355	$474	$542
Maintenance—			
Battery upkeep	$170	$180	$200
Tire upkeep	130	150	180
Mechanical parts upkeep	50	60	80
	$350	$390	$460
Garaging—			
Electric power	$120	$140	$170
Storage and washing	180	180	180
Garage labor	100	120	160
	$400	$440	$510
Annual operating cost	$1,105	$1,304	$1,512

Daily cost (312 days)	$3.54	$4.18	$4.84
Drivers per day	2.00	2.00	2.50
Total daily cost	$5.54	$6.18	$7.34
Capacity, lbs.	3,000	4,000	7,000	10,000
Approximate price	$3,000	$3,400	$4,000	$4,500
Fixed charges—				
Interest at 6%	$180	$204	$240	$270
Depreciation at 10%	300	340	400	450
Fire insurance at 1%	30	34	40	45
Liability insurance	100	100	100	100
	$610	$678	$780	$865
Maintenance—				
Battery upkeep	$240	$285	$365	$415
Tire upkeep	230	280	400	600
Mechanical parts upkeep	90	100	125	150
	$560	$665	$890	$1,165
Garaging—				
Electric power	$240	$300	$360	$400
Storage and washing	180	180	180	180
Garage labor	180	200	250	300
	$600	$680	$790	$880
Annual operating cost	$1,770	$2,023	$2,460	$2,910
Daily cost (312 days)	$5.67	$6.48	$7.88	$9.32
Drivers per day	2.50	2.50	3.00	3.00
Total daily cost	$8.17	$8.98	$10.88	$12.32

Edison battery equipment will have lower maintenance and higher power consumption than above.

Depreciation at 10 per cent. should provide one complete equipment renewal in 10 years, which is not figured in maintenance as above.

Interest should strictly be at 3 per cent. as depreciation fund gradually reduces investment.

HANDLING OF IDLE PLANT.

THE systematic methods of handling plant, in the construction of the Panama Canal are still in evidence, despite the fact that much of it has already been retired from service. The *Canal Record* recently published official rules for the laying up of all idle equipment. They are valuable as general information to engineering contractors, who have the same procedure to follow at frequent intervals. They are as follows:—

Locomotives.—Boilers should be emptied and thoroughly cleaned of all scale and foreign matter. Boilers should then be filled with water, leaving space enough for at least two barrels of crude oil or a sufficient amount of crude oil to cover the internal surfaces of boiler and tubes. This oil should be put in at dome, then blow-off cock should be opened up and boiler drained. The same instructions apply to locomotive tanks as to boilers. The front end of locomotives and fireboxes of all boilers should be thoroughly cleaned and brushed off with wire brush and given a coat of tar paint. This paint can be put on with a spray. The coal space on all locomotive tanks should be thoroughly cleaned and scaled and surface given a coat of tar paint. All exterior surfaces of equipment should be painted if necessary, using the standard grade of paint which is commonly used for that purpose. The jackets on all boilers should be given a coat of white lead and tallow. Smoke stacks should be covered with sheet-iron covering made specially for this purpose. Main rods of locomotives should be disconnected and all bearing and bright surfaces receive a coat of white lead and tallow. Eccentric straps and blades should be removed from locomotives and placed with main rods in the cabs, and cabs boarded up. The steam chest cover should be lifted, cylinder heads removed, and all surfaces treated with a coating of white lead and tallow. It will be necessary to remove the valves and pull pistons in order to get at the parts, which should be replaced, steam chest and cylinders closed, and the crossheads blocked in order to eliminate the moving of the pistons in cylinders. The air pumps and the feed pumps on all equipment should be opened up and surfaces treated with a coat of white lead and tallow. The cap on engineer's brake valve on locomotives should be lifted and the surfaces of the valves, etc., slushed with vaseline. All exterior surfaces of cab fittings should be given either a coat of white lead and tallow or vaseline. Interior surfaces of triple valves and injectors need not be treated, as they are brass. Journal box cellars on all drivers and engine truck wheels should be well packed, also journal boxes on tanks.

Steamshovels.—The same general rules for the care of locomotives will apply to steamshovels. All engine pistons, valves, rods, eccentric straps, "A" frame collar and swing circle to be removed; shafts lifted from bearings, wearing surfaces cleaned, doped with white lead and replaced. Boilers should be stripped with lagging, and cleaned as outlined for locomotive boilers. Water tanks should be taken off shovels, inspected, and if found in bad condition they should be scrapped. Roofs should be painted with tar paint; also coal platforms and dippers. Other parts now covered with oil or grease can be protected with a coat of crude oil, which will be sufficient protection.

Unloaders, Cranes, Spreaders, Hoisting Engines, Trackshifters and Piledrivers.—Machinery should be gone over and given a coat of white lead and tallow, as outlined for steamshovels.

Miscellaneous Machinery, Including Shop's Machinery and Tools.—Air pumps and feed pumps on all equipment should be opened up and surfaces treated with a coating of white lead and tallow. All bearings, journals and bright surfaces of all machinery and equipment should be given a coat of white lead and tallow.

PAVING BRICK FROM FURNACE SLAG.

AN extensive industry is being developed in the north of England, at Middlesborough, based upon the utilization of blast-furnace slag. It is described by Mr. Frank G. Bolles in a recent Daily Consular and Trade Report. Several companies are now engaged in the work and are apparently very successful both as to results obtained from the brick as well as commercially. The method pursued in the manufacture of these bricks is as follows:

A suitable manufacturing site is selected near the blast furnaces which are to supply the slag, this plant being connected by an industrial railway upon which the molten slag is carried from the furnace to the molding machine. The latter consists of a metal wheel which may be of any suitable diameter, but which in the case examined was approximately 30 ft., this wheel being supported upon a vertical shaft. The spokes of the wheel are made of round rods and the construction of the wheel

itself is quite similar to the wire-spoked wheel used for vehicles. The metal rim upon which the molds are bolted is approximately three-fourths inch thick and 6 in. wide. In the plant examined this wheel carried 120 molds 9 ins. long, 3½ ins. thick, and 4 ins. deep, which is the standard size for paving brick. A variety of other molds are used, but the bulk of the work is of the paving-brick size. The molds are made of two pieces, the front end or right side being an arm in one piece which is bolted to the rim of the wheel, while the left side, back end, and bottom is another piece. The latter is hinged to the part which is secured to the rim of the wheel and held for casting purposes by a catch on the front end of the stationary piece. On the right side of the mold is cast a lip which assists the operator in more readily striking the mold when pouring the hot slag. Before casting the molds are dusted with a powder, the appearance of which would indicate it to be Portland or other cement.

The car which carries the slag is of plate steel with a fire-brick lining, the top being covered over with a removal cap, in the centre of which is a hole approximately 18 ins. in diameter, through which the slag is poured when the car is filled at the furnace. At the bottom of this car is a tap similar to those used upon blast furnaces. The car of molten slag is run alongside the wheel, the trough to the tap extending over the molds; the clay plug in the tap is knocked out and the molten slag runs into the mold. As soon as it is filled an operator, by means of a handwheel mounted upon a sheet-steel heat deflector and connected through rods and miter gears to the centre of the molding wheel, turns the latter so that the next mold comes under the flow of hot slag, and so on until all the molds are filled. By the time that the wheel has made a quarter revolution the cast brick has sufficiently cooled to that they may be dropped out of the molds by knocking off the catch which holds the bottom in place.

As soon as they have dropped to the ground they are taken by laborers to the annealing furnaces, into which they are thrown in a promiscuous heap. These furnaces, of which there were six in the plant examined, held approximately 1,100 brick at one charge. The heat retained in the brick when they are thrown into the furnace, together with a very small amount of fuel, again brings them to a cherry red, and as soon as the furnace has been filled it is closed and allowed to cool gradually, 24 hours usually being required before the bricks are removed.

The capacity of the slag car is approximately 3½ tons, from which 360 to 400 paving bricks are made. The bricks, when cleaned up, having all of the rough corners knocked off which have been left in the process of casting, weigh about 14 pounds each. These bricks are proving very efficient for street paving and are being exported to Canada, the United States, and many other countries.

OIL VERSUS COAL AS FUEL.

According to British Trade and Commerce reports, opportunity has been taken of the considerable development in the use of oil as a fuel in the place of coal to revise the rules in connection with the burning and carrying of oil fuel, the flash point of which does not fall below 150 degrees Fahrenheit. These rules were originally adopted in 1902, and advantage has been taken of the experience since acquired to bring the regulations up to date.

CROSS SECTIONS OF BREAKWATERS TO WITHSTAND WAVE ACTION.*

By Col. Frederic V. Abbot,
U.S. Corps of Engineers; M. Am. Soc. C.E.

TWO prime factors, exposure and cost, determine the best form of cross section to adopt for a breakwater. Exposure varies with the fetch of waves and with the depth of water at the structure and the front between it and the open ocean. At Charleston, S.C., with moderate depths and outlying shoal areas to break the full force of the ocean waves, a rubble mound cross section has served well for the jetties, built to deepen the channel, but serving also as breakwaters to reduce the force of waves in the jetty channel. In construction care was taken to avoid using small stone for a hearting and covering it with selected large stone, as has been frequently done in Europe. Run of the quarry was used up to about low-water, the drilling and blasting being conducted so as to produce as large a percentage of stone of 7-ton weigth as possible. Above low-water level a skeleton was made of stone from 1 to 7 tons in weight dropped directly along the axis up to a height somewhat above high-water level, and left with side slopes as steep as they would stand; this skeleton was covered with quarry run also dumped directly along the axis with natural side slopes up to a height of 10 or 12 feet above high-water. The first heavy storm would knock this grouting and the upper part of the skeleton down, beating the smaller pieces in among the undisturbed larger pieces of stone forming the skeleton, and distributing the balance on the slopes. The grouting was then replaced to the former height, taking this time much less stone than at first, and a new storm was awaited. It generally proved to be necessary to repeat this process three times before the cross section assumed a final permanent form, with crest approximately at high-water level. Writing from memory only, it is the writer's impression that at the outer ends of the Charleston jetties, 20,000 feet from shore, the mound was ultimately nearly 90 feet wide at mean low-water with a crest about 5 feet above; the crest, which was very smooth and level, was about two-thirds of the way from the seaward to the harbor side of the 90 feet lying between low-water levels on the two sides. At depths greater than 15 to 25 feet on seaward side, depending on the local protection afforded by outlying shoals, the slopes were nearly 1 on 1, and from those depths to the crest the seaward surface was convex toward the sea, the slope becoming very gentle for the 2 feet immediately below the crest. The upper surface was singularly uniform and smooth, considering the great size of many of the stones. The harbor side was similar but much steeper throughout. This form of cross section permits waves to mount the slope and fall over into the harbor with the least abrasion and injury to the structure, and it has resulted from the action of the very forces it is intended to resist. The engineer has simply supplied material, which waves have molded into final shape. The stilling effect of such a structure is not as great as that of one designed to throw the entire wave back to the front, but, except in very heavy weather, the water between the Charleston jetties is not rough enough to inconvenience any vessel adapted to ocean traffic. An advantage of this method of construction is that each part

*From Col. Abbot's article on the subject in "Professional Memoirs" for Nov.-Dec., 1913.

of the structure has a cross section just sufficient for its individual exposure, and therefore no stone is wasted to give a section stronger than is needed; repairs are extremely easy if a shifting of the other shoals exposes any part of the superstructure to heavier seas than existed there when it was built. The last stone was deposited on the jetties about twenty years ago, and I am told that there has been no sensible degradation of the crest

enormous quantities of stone. Failures prove more than successes, and it is possible that at that point some form of cross section like the Columbo sloping block or the Sandy Bay coursed squared stone might have been cheaper in ultimate cost. The preparation of a suitable flat base for such an accurately laid superstructure would, however, have been vastly difficult and costly on the Columbia River bar.

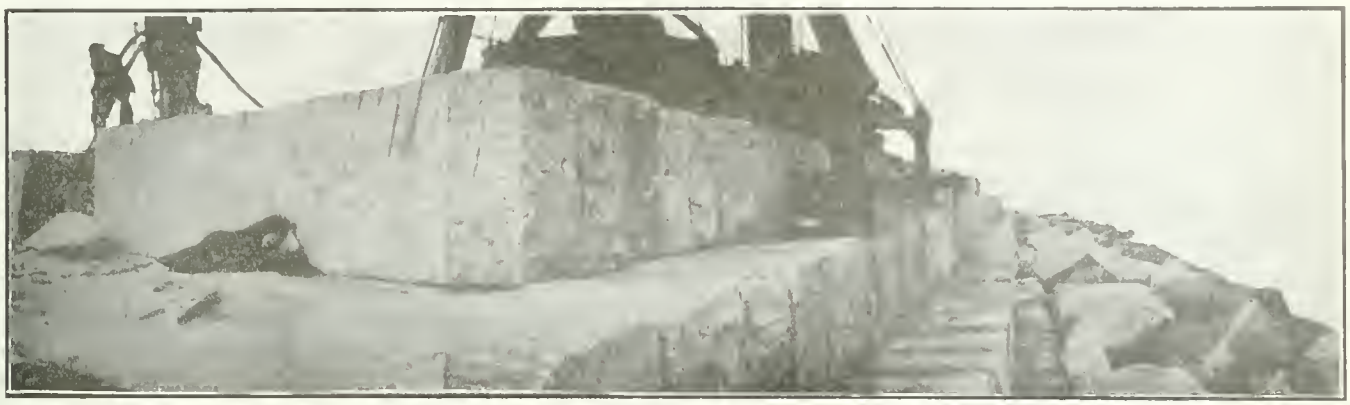


Fig. 1.—Drilling Holes for 30-ton Capstones, Sandy Bay Breakwater.

level in that time, although a number of West Indian hurricanes have passed over the harbor and done vast damage to the city and to shipping in the inner bay.

The Galveston jetties were originally built with rather small stone hearting covered with heavy stone sides and cap; the storm of 1901 produced disastrous effects; as soon as the capping or side covering was broken the interior washed out and the whole structure ravelled and collapsed for considerable distances.

At the Columbia River jetties the exposure and outlying depths are so great that a random cross section somewhat similar to that at Charleston has so far proved impossible to maintain above mid-tide without using

At Point Judith, where the exposure is perhaps comparable with that at Charleston, a moderate rubble mound, with a superstructure of large blocks set to form a regular cross section, with predetermined surfaces of heavy rubble on the top and seaward side, has stood for years with comparatively small repairs, but when they have been necessary the regularity of the structure has made them costly because a number of stones, only slightly displaced, had to be taken up and reset to restore the bond and to avoid conspicuous irregularities. Where lines are straight, or surfaces are planes, the eye is quick to detect any elevation, depression, or bulge, and this is a serious disadvantage of too regular outlines in break-

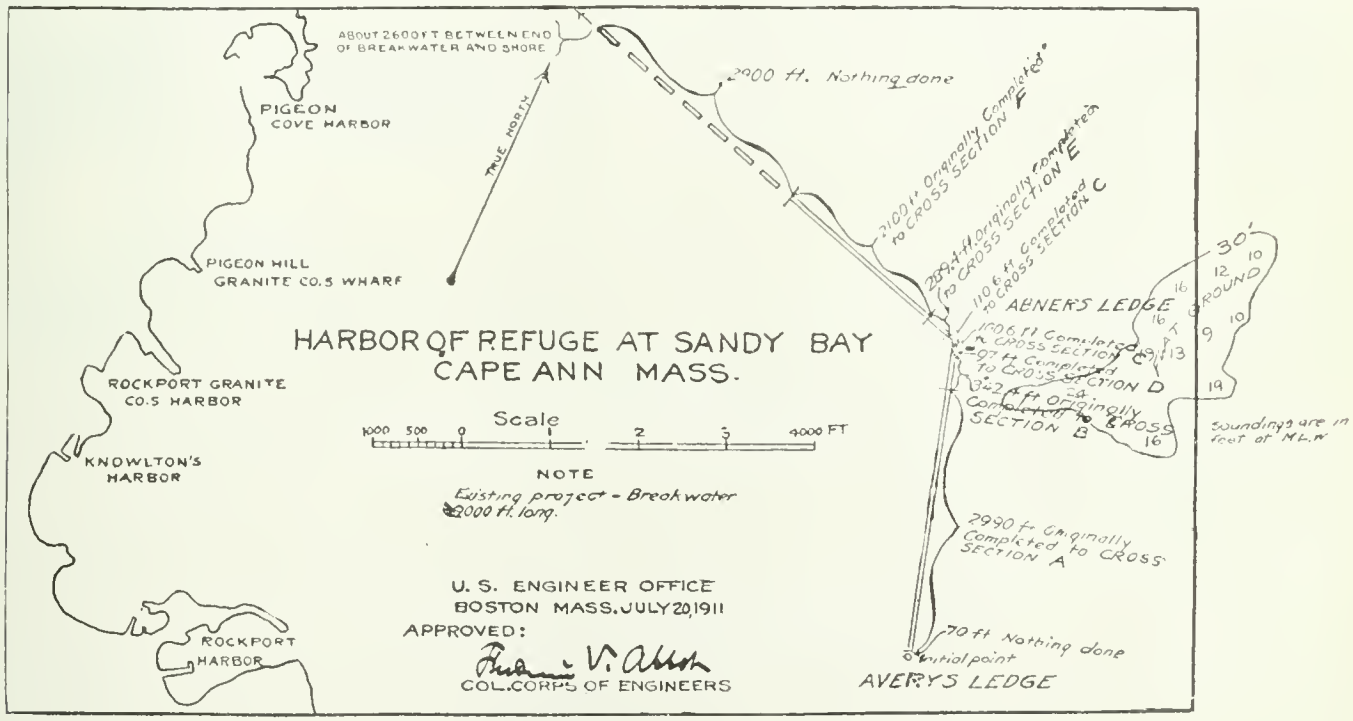

ABOUT 2600 FT. BETWEEN END OF BREAKWATER AND SHORE
PIGEON COVE HARBOR
PIGEON HILL GRANITE CO.S WHARF
ROCKPORT GRANITE CO.S HARBOR
KNOWLTON'S HARBOR
ROCKPORT HARBOR
TRUE NORTH
2900 ft. Nothing done
2100 ft. Originally Completed to CROSS SECTION F
209.4 ft Originally completed to CROSS SECTION E
110.6 ft. completed to CROSS SECTION C
ABNERS LEDGE
30'
GROUND
1606 ft Completed to CROSS SECTION B
97 ft Completed to CROSS SECTION D
322.4 ft Originally Completed to CROSS SECTION B
soundings are in feet at M.L.W.
HARBOR OF REFUGE AT SANDY BAY
CAPE ANN MASS.
Scale
1000 500 0 1 2 3 4000 FT
NOTE
Existing project - Breakwater 2000 ft. long.
U. S. ENGINEER OFFICE
BOSTON MASS. JULY 20, 1911
APPROVED:
COL. CORPS OF ENGINEERS
2990 ft Originally Completed to CROSS SECTION A
70 ft Nothing done
Initial point
AVERYS LEDGE

Fig. 2.—Plan of Sandy Bay Harbor, Showing Breakwater.

waters where the forces in action are so great as to make deformations probable. Where integrity of the structure depends on bond or a smooth surface for waves to mount on, such deformations are not only very unsightly but seriously impair capacity to withstand subsequent storms.

At Gloucester, Mass., a very carefully built breakwater, with a superstructure of extraordinarily narrow cross section (side slopes of 1 on 0.7) has safely withstood storms of great severity and waves of great force, but the breakwater does not receive the unbroken force of the heaviest waves. It has recently received a wide sea apron of 5-ton rubble, to break up the force of waves before they strike the superstructure proper. In January, 1913, a storm moved a number of cap stones. They have been reset, and dowelled to the course below, to prevent sliding.

At Sandy Bay conditions are extreme. For long distances the depth of water is 800 feet; the exposure is to the northeast, from which direction come the heaviest storms; there are no outlying shoals to protect the part of the breakwater lying in the deepest water. A heavy rubble mound forms the base of the structure. An attempt to bring it up to 18 feet above mean low-water (9.4 feet above high-water) by simple heavy random blocks failed on the first attempt, and the experiment was not repeated. It is to be regretted that it was not pushed further, for it is possible that ultimately, as at Charleston, S.C., a cross section would thus have been secured exactly

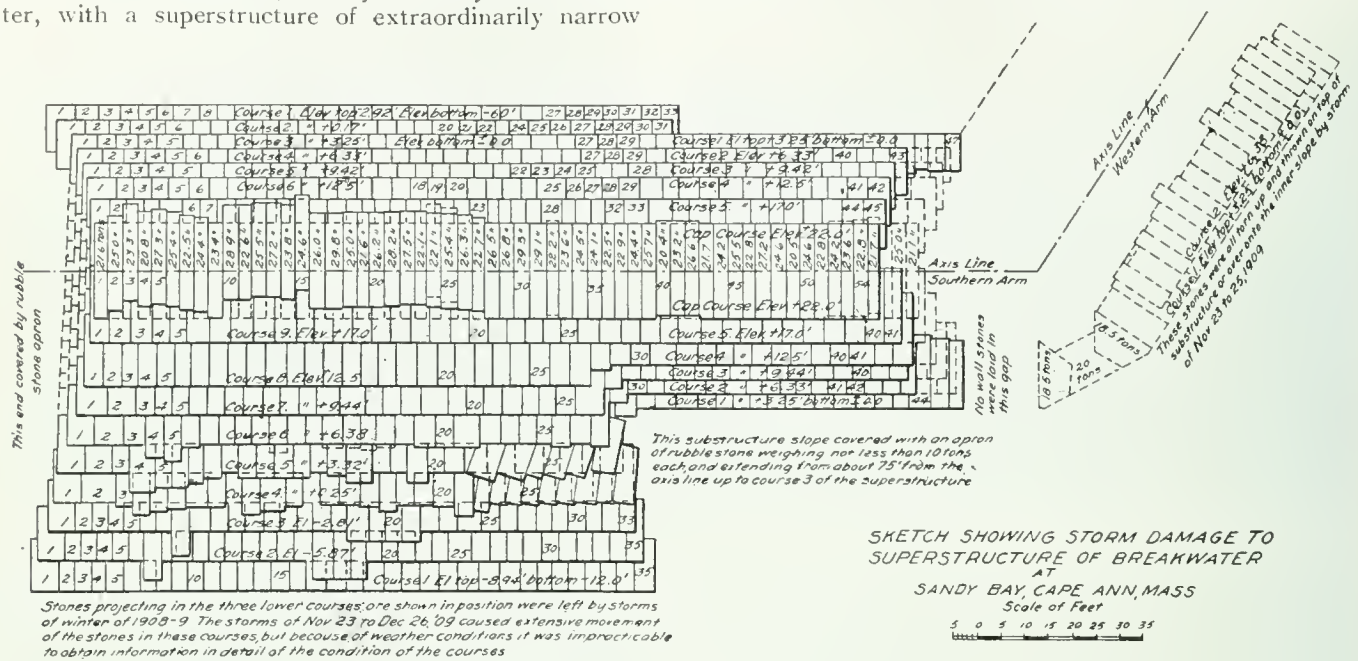

This end covered by rubble stone apron
Axis Line Western Arm
Axis Line Southern Arm
Cap Course Elev +28.0'
Course 5 Elev +17.0'
No wall stones were laid in this gap
This substructure slope covered with an apron of rubble stone weighing not less than 10 tons each, and extending from about 75' from the axis line up to course 3 of the superstructure
These stones were all torn up and thrown on top of substructure or overan the inner slope by storm of Nov 23 to 25, 1909
18 Stones
20 Tons
Stones projecting in the three lower courses are shown in position were left by storms of winter of 1908-9. The storms of Nov 23 to Dec 26, '09 caused extensive movement of the stones in these courses, but because of weather conditions it was impracticable to obtain information in detail of the condition of the courses
SKETCH SHOWING STORM DAMAGE TO SUPERSTRUCTURE OF BREAKWATER AT SANDY BAY, CAPE ANN, MASS
Scale of Feet
5 0 5 10 15 20 25 30 35

Fig. 3.—Diagram of Storm Damage, Sandy Bay Breakwater.

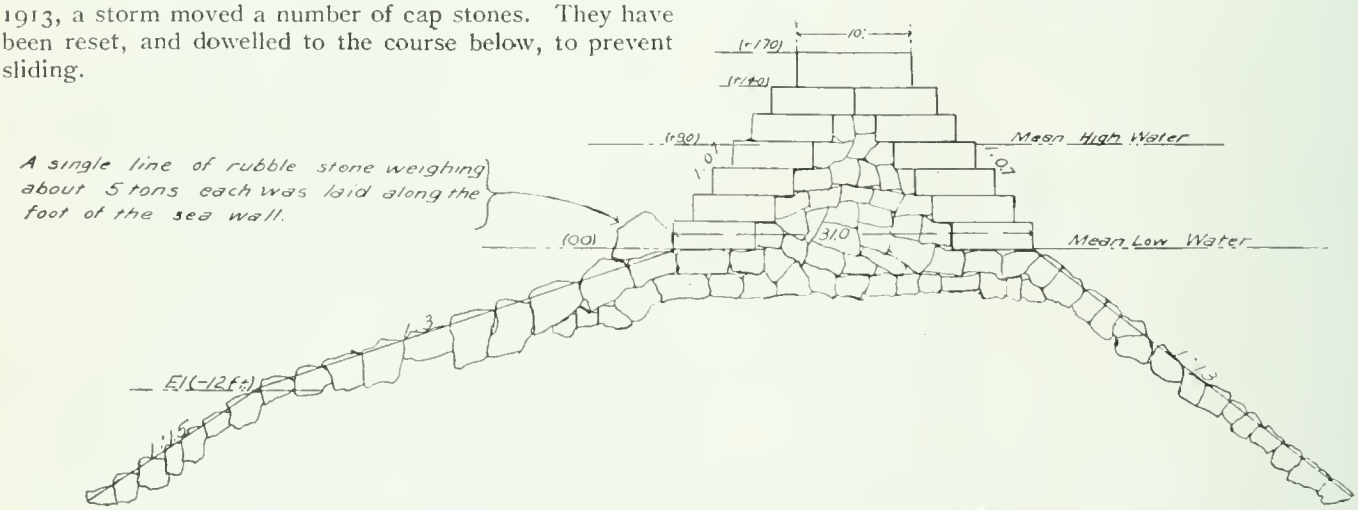


Fig. 4.—Cross Section of Dog Bar Breakwater, Gloucester, Mass., as Constructed.

NOTE:—*Caps* are 3 foot rise, vary in width of face from 5.2 feet to 4.6 feet and weigh 8 tons to 11.5 tons with an average weight of 9.25 tons. *The walls* are in six courses in a rise of 14.0 feet or theoretically 2.33 foot rise per course. In construction the stone was quarried 2.2 foot rise for the first 5 courses, and the 6th course was cut to the rise necessary to secure the approximate grade of bed for the caps, resulting generally in slightly heavier stone in the 6th course.

The length of stone in the walls was specified to be not less than 7 feet nor more than 8 feet. The dimensions and weights of stones computed on an average length of 7.5 feet are as follows:—

	Sea Wall.	Harbor Wall.
Maximum width of face	5.6 feet	6.0 feet
Minimum width of face	2.5 feet	2.2 feet
Average width of face	3.4 feet	3.2 feet
Weight of maximum stone	8.2 tons	8.7 tons
Weight of minimum stone	4.0 tons	3.2 tons
Weight of average stone	4.9 tons	4.7 tons

Substructure:—Specifications required that in the seaward slope no stone should be used weighing less than 3 tons and that average weight of stone in each cargo should be not less than 4 tons. In rubble mound generally and harbor slope the stones ranged in weight from 500 pounds to 4 tons.

adapted to the exposure. The depth is so great, however, that an enormous quantity of stone would have been needed to give sufficient base for the part affected by wave action, which here extends to 30 feet below mean low-water, as shown by actual surveys. In designing a superstructure for this breakwater, all engineers have attempted to keep the width of foundation a minimum on account of the great quantity of stone needed to fill out the slopes of the substructure in 80 to 90 feet of water. From the bottom up to a depth of 30 feet below mean low-water the mound stands stable with slopes of 1 on 1; from that level up to mean low-water heavy rubble seems

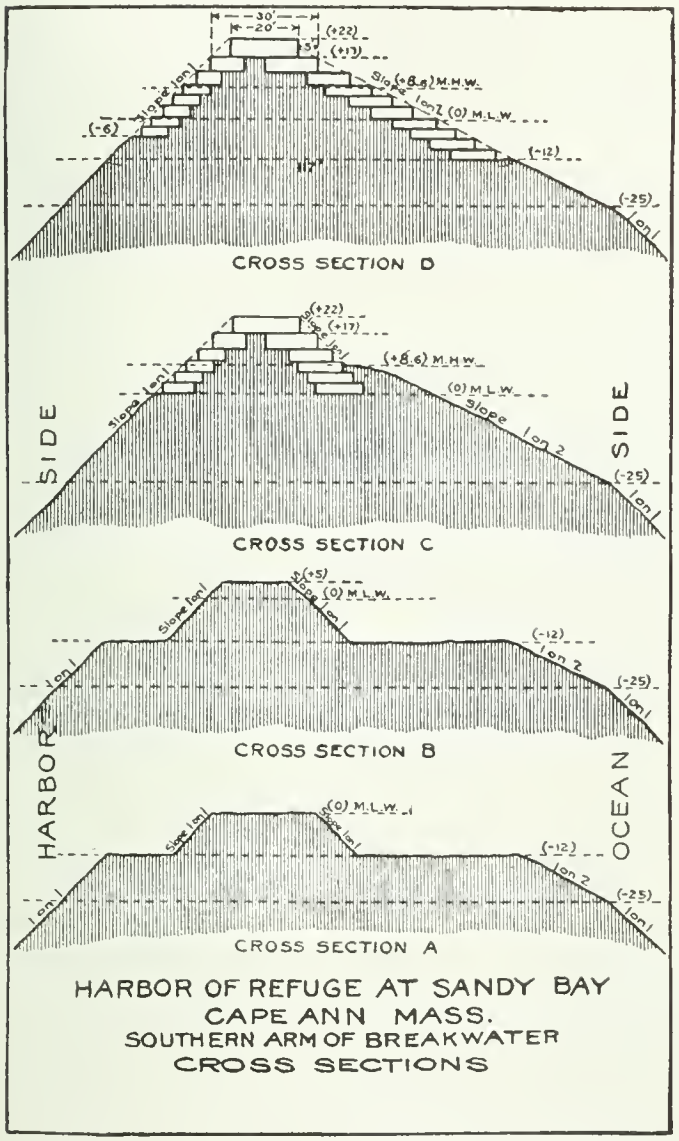


Fig. 5.—Sandy Bay Breakwater Cross Sections.

to stand safely at about 1 on 2. The first experiment with closely laid, uncut dimension stones was to set by divers on the seaward side a row of heavy rectangular headers at level—12 referred to mean low-water, and a similar row at level—6 on the harbor side, filling between the rows with medium heavy rubble. Successive rows of dimension stone blocks were laid on these foundation rows, so as to give a stepped seaward slope of 1 on 2, and a stepped harbor slope of 1 on 1 up to level + 17, where the two rows were only about 5 feet apart at the inner ends of the headers. Capstones, 20 feet long and 5 feet rise, were set to bond the two walls. This superstructure withstood several winter storms, but in 1908 displacement of stones (see illustrations herewith) showed that for a permanent superstructure the cross section was insufficient.

The latest form is due to Col. Edward Burr, who kept the harbor side of the superstructure unchanged, except that the lowest course is now at low-water and not 6 feet below. The capstones are as before, but each is supported against sliding toward the harbor by a 2-inch dowel pin set in a hole in the underlying course of the harbor wall, and solidly grouted in place. Below the cap the seaward face is built in steps sloping 1 on 1 and not 1 on 2, with the main object of giving greater lap of the upper stones on those in the lower courses, to resist the tendency to pull out to the front—the way in which the prior section failed most signally. In both harbor and land walls he stopped the dimension stone steps at mean low-water in order to secure better inspection of the bedding of those most important blocks. The berm created by drawing back the foot of the seaward slope was utilized by using is as a shelf to hold 10-ton rubble, which was brought up to high-water level in front of the dimension stone. The rubble tends to shatter the waves before they reach the superstructure proper.

In 1909 a short section of this new superstructure withstood almost unchanged the heaviest storms of the past twenty years, and in accordance with recommendations of the Department, Congress has appropriated sufficient funds to build 800 feet of this cross section, of which 200 feet are on the western arm, and 600 feet are on the southern arm. This will be a sufficient length to develop the full destructive force of waves to which the southern arm is exposed, and if it prove sufficiently resisting the rest of that arm can safely be built to that cross section. There is an outlying shoal, submerged from 30 to 10 feet in local peaks, which gives that arm some protection. The western arm, however, crosses a wide, deep depression in which there are no depths less than 80 feet between the structure and the ocean to the northward and eastward; here the exposure will be the maximum, the fetch being the whole width of the Atlantic Ocean, and experience gained in the work will be the only safe guide for the officer charged with building the part of the superstructure opposite to this depression. The writer's own inclination would be to make the superstructure like the rest of the work, if found practicable, but to widen out the berm and the rubble front slope by the deposit on that side of large quantities of the heaviest granite rubble that could be bought.

The writer believes that Congress has been wise in suspending work on the superstructure of Sandy Bay until such time as an exceptionally violent easterly storm of some days' duration gives further data on the sufficiency of the present form, which has safely resisted all waves that have so far come against it.

ELEVATOR CAPACITY OF THE G.T.P. RAILWAY.

At present there are on the G.T.P. Railway in Manitoba 25 elevators with a capacity of 757,000 bushels; in Saskatchewan, 178 with a capacity of 5,350,000 bushels; in Alberta, 25 with a capacity of 745,000 bushels; and at Fort William, the largest elevator in the world with a capacity of 5,750,000 bushels. For the prairie provinces, the total capacity is 6,852,000 bushels; including the Fort William elevator, the grand total on the G.T.P. Railway is 12,602,000 bushels

THE TREATMENT OF UNSURFACED ROADS.

IT is stated that there are 2,100,000 miles of roads throughout the United States that are unsurfaced, or rather, that have never been re-surfaced. These roads are composed of materials which run from the finest silt to the hardest granite, and the treatment of one will naturally be entirely different from the treatment of another. It would be difficult to ascertain the various soils or natural earths that go to compose the wearing "surface" of these unsurfaced roads. Yet, they must be carefully maintained, owing to the absence of suitable surfacing materials in numerous sections of the country, and the high cost of handling by railroads, preventing their being surfaced with stone, gravel or other suitable material.

At the American Road Congress in Detroit, Mr. W. S. Keller, State Highway Engineer of Alabama, read a paper dealing with unsurfaced roads, and their maintenance. He divided this type of road into three classes, as follows:—

First, the ordinary country road opened when this country was young, leading from one settlement to another or from a farmer's home to that of his nearest neighbor. These roads were not opened through any process of law, in fact, there was no law governing roads in those early days, but by following trails of least resistance, removing trees and such rocks as would not permit the axles of wagons to clear, the pioneers of this country made it possible to travel, in a way, from place to place. We have many roads in Alabama now in use that were opened and traveled during the wars of long ago. Of course, such roads were opened hurriedly and little or no attention was given to grades or alignments. Settlers, taking advantage of work that had been done, built their homes along these military roads or traces as they are frequently called. In the construction now of more modern roads, it is difficult to better the alignment of these roads on account of homes, churches and schools which have been built close to these highways. However, in many places, these roads have been and are being changed to meet the demand of traffic of to-day. The genuine bad roads of the South belong solely to this class. They cannot be maintained for the reason that they have never been constructed and the great amount of work necessary to keep them in passable condition disheartens the man who by law is compelled to work them. Until these roads are re-located, avoiding heavy grades and marshy bottoms, sharp angles and useless twists and graded so that they will have good drainage, we may expect them to be bad.

The second class of unsurfaced roads are the ordinary graded earth roads which have proper alignment, grade and drainage. The construction of an earth road is simple, but sometimes the simplicity of it causes the average county commissioner or supervisor to overestimate his ability as a road builder. The proper construction of an earth road consists first of a careful inspection by the proper official to determine what beneficial changes in grade and alignment can be made, taking into consideration initial cost and cost of maintenance. The centre line and grade of the road should be established by an engineer. After the centre line has been established and width of road bed agreed on and grade established, construction work can begin. The proper and efficient grading force for the work should consist of a foreman, eight or ten good two-horse teams with drivers, one wheel and one drag scraper for each team and one extra wheeler and drag for emergencies, one good railroad grading plow, one grading machine, one split-log drag, one dump man and one loader with five or six extra men for grubbing and other work. The foreman should be an experienced grading man who understands handling earth and knows when it is proper to use drag scrapers, wheel scrapers or wagons. The road should be so graded that the ditches or gutters are parallel with the centre line of the road and uniform distance from it. When completed, the road should be uniform in width and surface should be smooth and even, free from holes and high places with a uniform crown with a fall of one inch to one foot from centre to gutters. On grades this ratio of fall should exceed that of the grade to such an extent that water will readily flow to the ditches instead of down the road. Drain pipe should be freely used and no water should be allowed to flow over the road if it can be avoided. In some cases it is not practical to build the road above high-water. In such cases danger signs should be posted showing at what stage the water becomes too high to ford the stream.

We have in the South nearly every kind of soil from sticky gumbo on the one hand to coarse sand on the other. The methods used for improvement of roads through a section of one will not do altogether for the other. The worst roads by far that we have in the South are in our rich and fertile prairie lands where, unfortunately, there is very little road building material to be found. This soil readily absorbs water and becomes very sticky after rains. It expands freely and dries rapidly when the sun shines and becomes very hard under the tamping effect of teams and vehicles. From observation and experience I have learned that these roads of all others require a very high crown and the driving surface should only be wide enough to allow two vehicles to pass. If a road is narrow with a fall of not less than one and one-half inches to the foot, water will shed rapidly to the ditches and the entire surface will dry out quickly. A road of this kind can be constructed quickly and at little expense, except where grades are to be reduced or bottoms filled with a grading machine, or even with a split-log drag. The latter method will require more time, but in the end will be found to be very satisfactory. No earth road can be maintained in good condition unless it is so constructed as to drain well and unless it is kept free from ruts and holes.

The third class of unsurfaced road which we frequently have to deal with are those in sections of country where the soil or earth is really road building material, composed either of gravel, sand-clay or top soil so that when the road is graded it is, in fact, surfaced. Where this condition exists, splendid roads can be built at a minimum cost.

The maintenance of unsurfaced roads is radically different from the maintenance of surfaced roads. For instance, the patrol system used on macadam roads would be entirely inadequate for earth roads. One man can keep up two or three miles of macadam road where he would unquestionably be unable to keep in good condition a like amount of unsurfaced road. With the use, however, of a team and drag, he would be able to keep in good condition twenty miles of ordinary graded earth road. Some very zealous advocates of the drag claim everything for it, from the removal of stumps and rocks to the ditching of roads. I am a great believer in the drag, but from experience, I know that obstructions must be removed and proper drainage provided for before

it is effective. It has been difficult with the road men of the South to convince county authorities that this little machine is of value. The writer, when in charge of road work in a Tennessee County, inaugurated a system of dragging that proved very successful. Ten roads were graded a distance of three miles each. The grading was completed in November. With surface of these roads fresh and loose, it was a foregone conclusion that the winter rains would soften them to the extent that they would become impassable under heavy traffic. Contracts were made with a farmer on each of these roads to keep them dragged during the months of December, January, February and March and the price paid was 30c. an hour for a man and team. The county furnished the drags. As an inducement to the men to do good work, the county offered prizes of $25, $15 and $10 for the best kept roads. Specifications for dragging and rules governing the contest were furnished each contestant. One important rule was that the prizes would be awarded to the men who kept their roads in the best condition at the least cost. In order that the engineer might keep in close touch with the work, postal report cards were furnished each man and they were required to fill them out every Monday, showing the distance dragged, hours consumed and cost for the previous week, and mail them to the office of the engineer. In this way it was practically impossible for a dishonest man to render an account for more time than he really consumed without it being detected or if he worked more than was necessary, the reports of the other contestants, when compared with his, disclosed it. On the other hand, if one should be neglecting his work by not dragging sufficiently it was likewise detected. This thirty miles of road was kept in splendid condition despite the fact that two heavy snows fell during the four months. The most interesting fact connected with the contest was the road that was awarded first prize cost the county only $15, or $5 per mile.

In many Southern States the roads are maintained, or at least are supposed to be, by what is known as statute labor, which means a man subject to road tax may work out his tax under the direction of a beat or district overseer. Such labor is practically worthless, and few men are required to work out the stipulated number of days. As it seems to be impossible to entirely abolish statute labor, the question that confronts us now is, what is the best system coupled with this labor to use in the maintenance of our roads. Good results have been accomplished in several counties in Alabama by putting the work in the hands of a few regularly employed foremen who give all of their time and attention to the work, instead of leaving it to many beat overseers who work when it suits their convenience, or do not work at all when it suits them, as it usually does. These foremen are furnished with two or three teams with regular drivers, wagons, scrapers and grading machines, split-log drag and necessary small tools and as many beats or districts assigned to each as he can work. A census is taken in each foreman's territory at the first of the year of all men subject to road duty, and he is furnished with a list of names and is required to work every man who has not paid the required amount of cash into the county treasury in lieu thereof. No foreman is allowed, under penalty of dismissal, to receive cash from work hands, but such hands as desire to pay must make their payments to the proper county official at the court house. This method has proven good in most cases, but as a general thing the best results cannot be accomplished by permitting men to work out their road tax.

TRIANGULAR RAILWAY TIES.

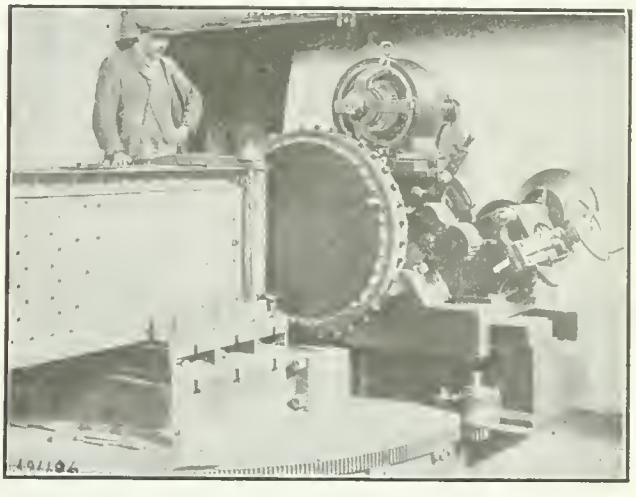
During the past twelve years upwards of four million triangular ties have been laid by the Great Northern Railway, from 150,000 to 200,000 now being inserted annually. Ties of this shape have an advantage which the following description will disclose:—

In their manufacture either two or four ties are cut from a log, timber cutting four ties being preferred, as the annular rings of such ties are convex and provide better drainage. After a log is squared it is cut diagonally into either two or four pieces 16 in. long on one side and 8 in. in depth. Triangular pieces 2 in x 2 in. in size are cut from each of the two upper corners, leaving the upper face of the tie 12 in. wide. The ties are 8 ft. long. They are treated with a 6 per cent. solution of zinc chloride, equivalent to an injection of ¾ lb. of zinc chloride per cubic foot of timber.

It will be noted that ties of this type are more or less self-tamping, especially at the rail ends, and it has been found to reduce somewhat the expense of joint maintenance in gravel ballast. When not used in conjunction with the ordinary rectangular ties, the triangular tie is believed to give promising results, as some of the best track now in use is thus carried.

MOTOR-DRIVEN ROTARY PLANER.

The accompanying illustration shows an interesting form of planer for very large work, such as facing the ends of columns, cast-iron bed-plates, stringers, etc., and machining engine frames and other heavy castings. The cutting tools are arranged in a circle, which rotates when in operation.



Rotary Planer, Electrically Driven.

The machine illustrated can handle work 40 inches wide and 6 feet long. It is mounted on a circular base, on which it can be turned, and thus increasing its range of operation. It is manufactured by the Newton Machine Tool Works, Philadelphia, and is driven by a Westinghouse motor.

TELEPHONE FROM HOLLAND TO ENGLAND.

A submarine telephone is to be laid between Holland and England. The length of the cable will be 105 miles. According to the present project, the total expense will be near $3,000,000, and will be borne conjointly by the two countries.

SEWAGE PUMPING MACHINERY AND APPLIANCES.

By Gerald Priestman,
President, Merritt Hydraulics Company, Philadelphia, Pa.

Various types of sewage pumping apparatus are in general use, each type being adapted to its own particular work and the selection in any one case must rest largely upon the decision of the engineer. The pumping of sewage differs from the pumping of water in that provision must be made when handling sewage, to take care of the solids, grit and any foreign matter—rags, sticks, etc., which may enter the pump. In other words, the sewage pump or lifting apparatus must be entirely reliable. A shut-down may affect the health of a whole community.

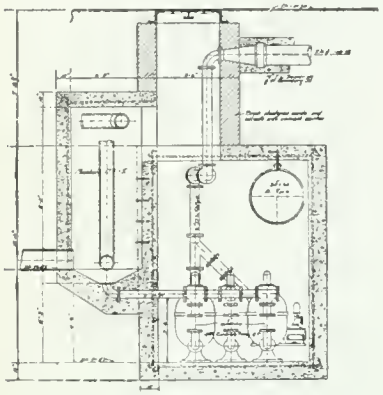


Fig. 1.

Pneumatic Ejectors.—Since all rubbing surfaces or moving parts are eliminated and the sewage is lifted entirely by a piston of air, the pneumatic ejector is well adapted to pumping crude and unscreened sewage. Fig. 1 illustrates a typical isolated sewage pumping plant with three Priestman ejectors and air tanks installed complete in a pit below the street level. An installation of this kind would be made, for instance, to pump sewage from a low lying district of a sewerage system up to a main outfall sewer, saving the excavation and construction work necessary to lay the large main sewer at a deeper level so as to permit drainage by gravity.

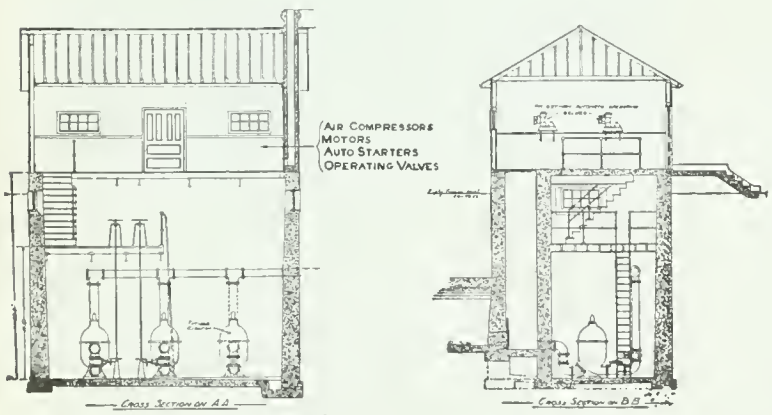


Fig. 3.

Air is supplied from a central compressor plant furnishing air to other similar ejector stations or else for other work. Besides the air tank and ejectors there is also installed in the pit, the ejector operating valve. With this type ejector, the air valves may be located at some convenient and accessible place near the top of the pit and are independent of the ejector bodies themselves, being connected with them by small piping only. The operation is as follows: Sewage gravitates to the ejector bodies; as it rises to the top it entraps and compresses the air present in the small bell. This bell is connected by small piping to the operating valve. The slight compression acting on a diaphragm in the valve is sufficient to operate it so that the main air valve is opened and air is admitted to the ejector to displace and discharge the sewage. The valve is also designed and set so that the air supply is cut off after a predetermined interval before all the sewage has been displaced so that the remainder of the discharge takes place while the air is expanding and the greatest economy is secured.

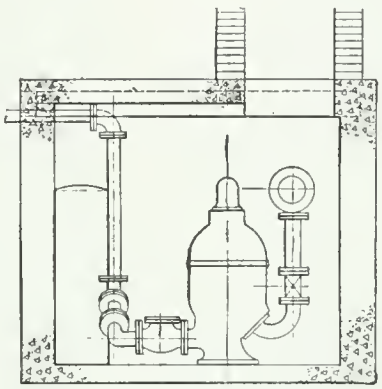


Fig. 2.

Fig. 2 shows another isolated compressor station of somewhat different arrangement and with only one ejector. Where there is only one pumping plant to be installed a complete ejector plant with motors, compressors and auxiliaries is installed in a suitable station, as shown in Figs. 3, 4 and 5. In Fig. 3 the ejector proper is in the pit below the street surface, while the air compressors, motors, auto starters and operating valves are in the house immediately above the pit. The advantage of operating valves which may be located at a distance from the ejectors, is apparent; the valves are located above the street level along with the compressors and auto-starters, where they can all be readily inspected and oiled by the engineer. Fig. 4 shows the operating valves located on the wall to the right of the small com

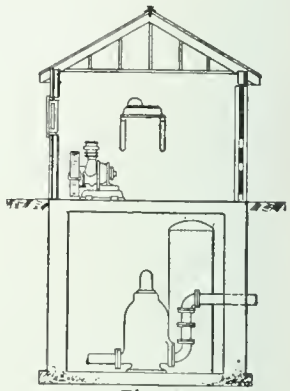


Fig. 4.

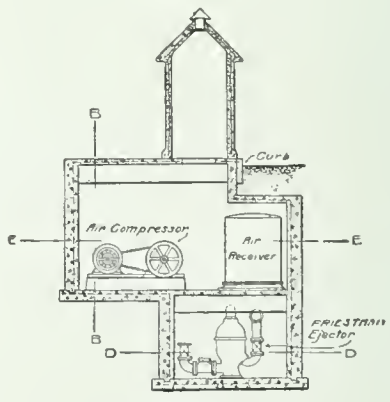


Fig. 5.

pressor, both above the street level, while the ejector and air tank are below in the pit. Fig. 5 shows a complete system below ths street level in a very compact station.

The advantages of the pneumatic ejector have already been pointed out, namely, the absolute reliability of operation depending on the fact that the power is transmitted, not

by plungers, pistons, impellers, screws or similar devices, but by a piston of compressed air. The mechanism for opening the valve to admit the compressed air as, for instance, a

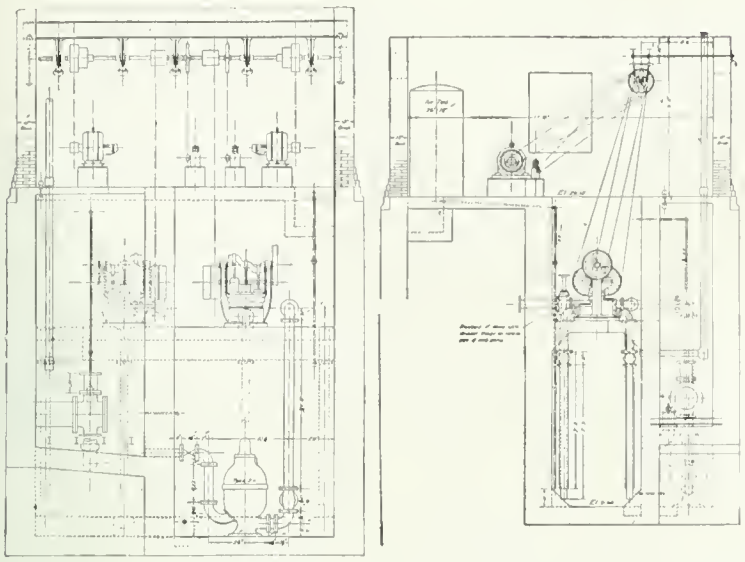


Fig. 6.

float rising with the sewage, may also be replaced by a piston or spring of compressed air which acts upon a suitable diaphragm in the valve mechanism. By this arrangement all moving parts are entirely eliminated in every stage of the operation of the ejector, nothing coming in contact with the sewage but air.

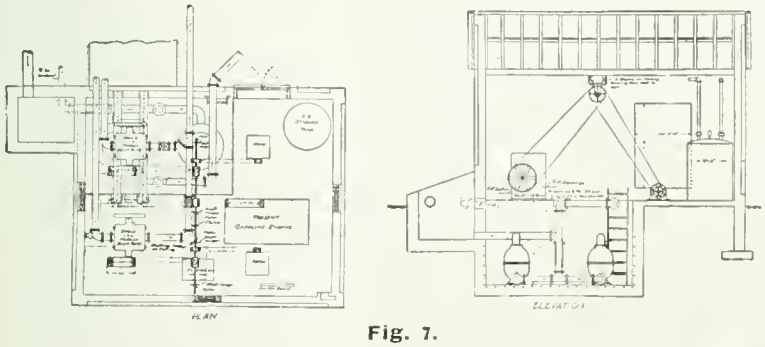


Fig. 7.

But while the pneumatic ejector is very reliable, it is open to some objection on the grounds of inefficiency in large plants operating continuously. In small plants, the reliability of the pneumatic ejector and the fact that it handles crude and unscreened sewage and thus requires no attendance, cleaning of screens, and is entirely fool-proof make the question of efficiency of minor importance. This is even more the case where the sewage flow is intermittent. The compressor automatically maintains the air supply in the tank and when there is no demand the air compressor is shut down. The ejector does not operate until it is filled and it may discharge once an hour or twice a minute, depending upon the rate at which sewage gravitates to it. On the other hand, a small pump of the centrifugal or plunger type may be operating for long periods at far under its full capacity, thus underloading the driving motor as well, with resulting fall in efficiency.

The main reason for the higher efficiency of the pump, as compared to the pneumatic ejector, is that with the pump the drive is direct, whereas, with the pneumatic ejector the driving motor must first compress the air, which in turn discharges the sewage, but an improvement in the efficiency of ejectors is obtained, however, by using the air expansively. By cutting off the air supply at a pre-determined point expansion occurs during the discharge of the remaining volume, so that the air is released from the ejector body at a pressure approximating that of the atmosphere instead of the full pressure of the air in the storage tank.

Centrifugal and Plunger Pumps.—If the sewage is thoroughly screened, a centrifugal pump will handle it at somewhat lower efficiency than that when handling pure water, as the solids and grit and grease which cannot be screened out cause corrosion and incrustation of metal parts. Screens must always be supplied, but even these will not prevent rags and other foreign matter from entering the pump impellers where they are passed with difficulty and very often become entangled and cause vibration and reduction of the pump capacity, and eventually requiring a shut-down.

By making the screens finer, a larger proportion of the solids may be prevented from entering the pump, thus increasing its reliability but, on the other hand, necessitating more frequent cleaning of the screens and more careful attention to the working of the plant. The

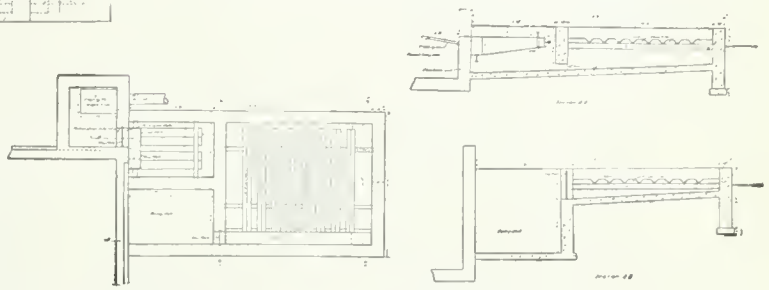


Fig. 8.

accumulation of screenage becomes foul and dangerous to health and the removal of the screenings themselves is costly and troublesome.

Priestman Natural Compound Pumping System.—The ordinary stationary screens have not proved satisfactory, as pointed out, because they require constant attention and become rapidly choked and the removal of the screening is very objectionable and costly work. But screens cannot be done away with or else the pumps will clog. The Priestman natural compound

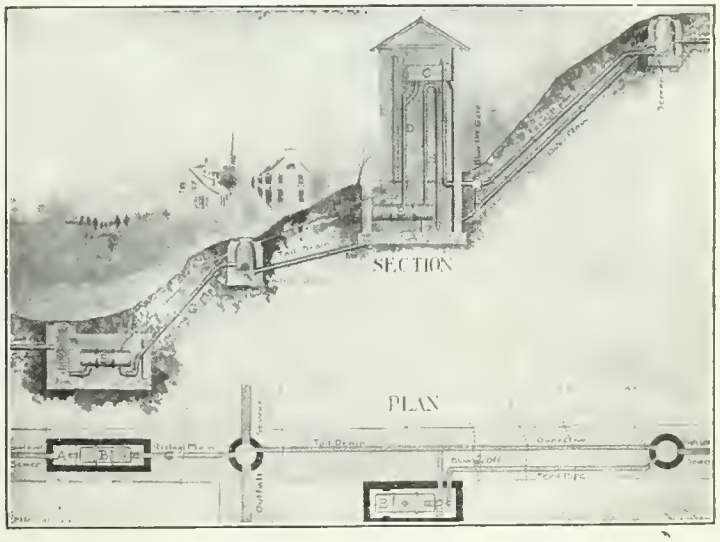


Fig. 9.

pumping system has been perfected in order to overcome these difficulties by separating the solids in the sewage from

the liquids by pre-tanks and then lifting them separately by pumping apparatus best adapted to each service from the standpoint of both reliability and efficiency.

Instead of the ordinary screens the solids are separated out by pre-tanks in which baffles, collecting weirs, self-cleaning screens, etc, are so arranged that the solids are retained in one portion of the tank and the clarified liquid passes on to another. The solids, which make up only a few per cent. of the total volume, gravitate into Priestman pneumatic ejectors and are discharged by compressed air into the delivery main

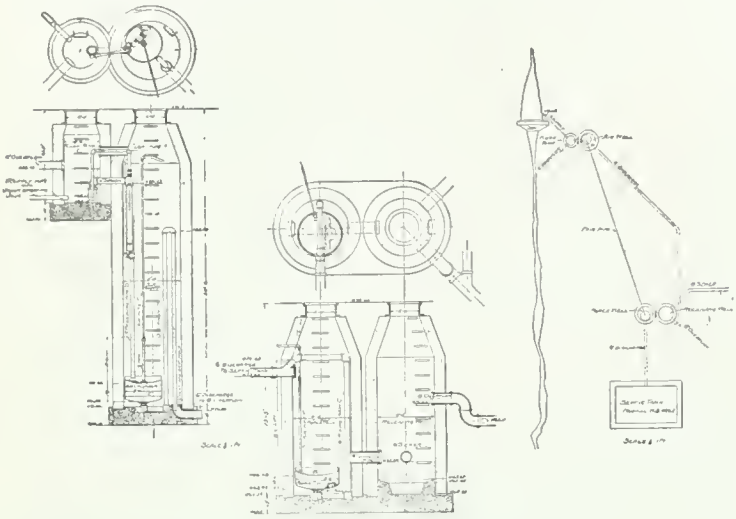


Fig. 10.

by-passing the pump or else to a separate discharge pipe. The clarified liquid is pumped by either high efficiency centrifugal or plunger pumps. The pumps can be driven by motors, gas or oil engines or steam turbines. The air compressor is small and may be readily driven by belting or from the shaft of the main driving motor or engine.

Figs. 6 and 7 show the sewage pumping stations designed on the Priestman natural compound pumping system comprising Priestman ejectors for the sludge and high efficiency triplex plunger pumps for the clarified sewage. Instead of the plunger pumps, centrifugal pumps could also be used. Fig. 8 shows the pre-tank as used in the installation shown in Fig. 7. The drawing shows the inlet chamber, the sludge chamber, weir chamber and the pump well from which the clarified sewage is lifted while the sludge gravitates to the ejectors.

Automatic Sewage Lifts and Water Power.—By use of the automatic sewage lift, sewage may be pumped by sewage,

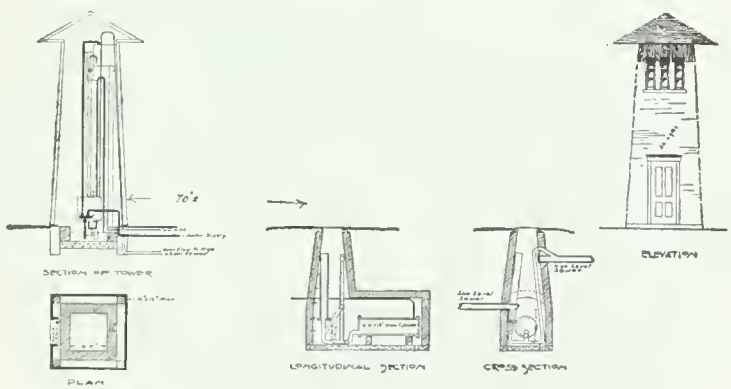


Fig. 11.

without cost, or else with the water power lift by water. As conditions do not always permit of the use of the lifts, they are not found so generally in service, but the entire absence of operating cost with these devices warrants their consideration under all circumstances.

The cost of a sewage system may be decreased by draining a low-lying district separately and lifting the sewage, thus avoiding deepening the excavation throughout the entire system. A pumping station may not be advisable owing to the cost of attendance of operation. In such cases a study should be made of the possibility of using the automatic sewage lift. Very often topographical conditions permit of using the power stored in high level sewage to compress air so that the low level sewage may in turn be lifted by using this compressed air furnished at no cost. The lift is entirely automatic and clogging is avoided by the flushing effect of successive discharges of sewage. A typical installation of an automatic sewage lift is shown in Fig. 9.

Instead of pumping the low level sewage by power derived from the fall of high level sewage, water from a nearby stream or city main may be used instead. Fig. 10 shows a sewage lift wherein the power is derived from damming a small stream and Fig. 11 shows a water power lift operating on city water

PLASTIC FIRE BRICKS.

Boiler-door arches and furnace linings in one solid piece are now said to be practicable, owing to an invention of plastic fire brick by the late Lester Betson. The brick is pounded into the shape desired. It is quite stiff, and will remain as placed, it is said, without the use of forms or molds, except for a simple temporary support in a door-opening or under an arch. It is then set by means of a slow fire in a short time. When it becomes very hard it may be put to immediate use.

It is claimed that the bricks are neutralized for expansion and contraction, so that they are not cracked or otherwise affected by sudden changes of temperature. Clinkers do not readily adhere to the surface, which is smooth and unbroken. As it fills all crevices, it should be gas and air-tight. The brick is being introduced into Canada by the Inland Sales Company, Limited, of Winnipeg.

The International Engineering Works, Limited, of Amherst, N.S., Canada, have recently opened three new offices in addition to their regular offices at Montreal, Toronto, etc. These representatives are George M. Taylor, 816 Burrards Street, Vancouver, B.C.; J. F. Tracey, 321 Edmonton Street, Winnipeg, Man., and Grodwards Company, Cobalt, Ont.

The experiments of British railway companies which are considering the adoption of wireless telegrapry for railway signalling, marks a new departure in the progress of wireless and in the advance of railway science. The Midland, and the London and Southwestern railway companies have experimented with the Prentice automatic system, a Canadian invention, based upon co-operation between electrical and mechanical devices on a traction engine. (See *The Canadian Engineer* for Sept. 18th, page 470.) The London and Southwestern has laid a high frequency wave wire on the centre track and a series of insulated wires beneath a locomotive to receive radiant energy worked from these.

A green light in the engine cab indicates that the line is clear, and when the section ahead is not clear a red light shows. An audible warning is given and the brakes are applied automatically. The Midland Railway is using an improved pattern of the Railophore system employed on German state railways, rendering the passing of set danger signals impossible. Four distinct signals in the engine cab are followed by automatic brake application.

COAST TO COAST.

Vancouver, B.C.—Plans are being prepared for $5,000,000 worth of new civic work in Vancouver for next year.

Moose Jaw, Sask.—Reliable authority is given for the announcement that a union station is assured for Moose Jaw, though its situation is yet undecided.

Vancouver, B.C.—The Trout Creek bridge, the highest railway trestle bridge in British Columbia, is now completed for traffic. It has been erected at a cost of $11,000, is about 250 feet high and almost of the same length.

Yorkton, Sask.—The C.N.R. has called off its men from further grading work at Yorkton, and the grade from Wroxton is almost completed, though there is no certainty as to the time when steel will have been laid to this centre.

Ottawa, Ont.—Expenditures by the Public Works Department last year aggregated $18,844,223, according to the annual report, now being issued. Of this amount, $10,177,831 was spent on harbors, including dredging, and $7,420,885 on public buildings.

Brantford, Ont.—The present source of supply for gas to Brantford is far from sufficient, and complaints are general in the city about the low pressure of gas. To relieve the situation, work on the trunk line from Tilbury field, which will supply St. Thomas, London, and Woodstock, is being rushed to completion, and it is expected that Brantford will be connected in January.

Victoria, B.C.—Work costing in the neighborhood of $30,000 has been completed on the roadbed of the Victoria and Sidney Railway. The roadbed has been re-ballasted practically from Victoria to its terminal at Sidney, the bridges have been rebuilt, and a new gasoline-electric car has been introduced which is giving satisfaction. The result is that the public are now furnished with a really first-class suburban service.

Selkirk, Man.—Many citizens were present on November 2nd to witness the turning on by Mayor Ross, of Selkirk, of the switch that put in motion the motors of the first large power installation of the Selkirk municipal electric light and power department, e.g., the planing mill, box and grain door factory of the Wm. Robinson Company. The municipality is selling its power at the 3 cent rate, with further reduction for large consumption.

Fort William, Ont.—The C.P.R. rocker bridge across the McKellar River between Islands One and Two at Fort William, has been completed and will be used to carry trains to the new $2,000,000 coal dock and to the new freight docks. The bridge has been erected at a cost of $200,000, will carry double railway tracks, and may be used to serve for extensions of the street railway to island terminals.

Montreal, Que.—Last spring low-lying river banks covered with mud and snow outlined the shore stretching from the Black Diamond line wharf past Sohmer Park to the foot of Papineau Avenue. Now along this section of shore has been constructed a rampart of new wharfage, the wharf from the Black Diamond line shed sloping up to a level with the high wharves approached from Commissioners Street; and from behind this rampart comes the sound of the rush of work on the foundations of the steel sheds, which will be erected doubtless on the new wharves next season.

Moncton, N.B.—The condition of Moncton streets has been the cause of much local dissatisfaction and criticism. The city has used for paving purposes wooden blocks, slag, and macadam; but the results have been unsatisfactory. This is partly due to the difficulties a new city always experiences in paving operations; for streets are being continually dug up for sewerage, gas, water, and other installations. Moncton has almost settled the question of good sidewalks; and the citizens are now feeling that the authorities should direct their efforts towards an efficient system of street paving.

Cornwall, Ont.—The contractor, Mr. G. R. Phillips, of Cornwall, has completed the new pier at the eastern entrance to the Cornwall Canal. The work has been going on for the past year and a half. The pier is 600 feet long, and the style of construction conforms with the usual style of such structures. The entrance has also been widened and will relieve the congestion of craft frequent at the foot of the canal. A pier somewhat similar was erected about two years ago above lock 17, and with the addition of this new pier, navigation at the eastern end of the Cornwall Canal will be rendered much more safe.

Victoria, B.C.—Of the four piers to be constructed near the Ogden Point breakwater, three are to be 800 feet in length, and one 1,000 feet. They will be capable of accommodating the largest vessels that will be used in the Pacific trade for many years to come. Three thousand and four hundred feet of dockage, which will be provided by the piers for which tenders have been invited, will be doubled when all four piers have been completed. The importance of this work to the local cities and to the province is magnified by the fact that all material to be used in the construction, stone and concrete, will be of local manufacture.

Grand Falls, N.B.—The installation of a modern electric light system has been completed at Grand Falls. When the light was turned on for the first time, out of 400 lamps, only one was found to be out of commission. In addition to the street lamps, many churches, public buildings and private have been lighted by the same system; and the town has erected a large concrete sub-station, and is employing an electric pump for the waterworks system, instead of steam pump, which was not sufficiently powerful. The power is being supplied by the Maine and New Brunswick Electrical Power Company, Limited, whose power-house is situated at Arooscook Falls.

Halifax, N.S.—At Halifax, a pier is being constructed which, when complete, will be the most modernly equipped for accommodating oceanic travel in the world. The work requires 1,818 concrete piers, the largest ever used for a like purpose; and these are being driven into the harbor bottom by the biggest pile-driver in the world. The whole pier will be 700 feet long by 235 feet wide, provided with the best possible railway accommodation; and the superstructure will be a two-story fireproof immigration building of solid concrete, 200 feet wide, and almost as long as the pier. When finished, Halifax will possess the most excellent of immigration facilities.

South Vancouver, B.C.—Plans for local improvements for South Vancouver, now before the Municipal Council, will when carried out make that city one of the most modern municipalities in the Dominion. By-laws for the construction of a municipal electric light and power plant and a municipal gas plant have been taken up and given readings. They are now awaiting the approval of the ratepayers. Petitions asking the council to refer the by-laws to the property-owners for a vote at the time of the municipal elections or sooner are being circulated and largely signed. If these petitions are signed by ten per cent. of the voters, the by-laws will be referred to the ratepayers in due course, and if they are passed steps will be taken at once to begin the construction of the plants.

Port Alberni, B.C.—The city of Port Alberni, the new city at the head of the Alberni Canal, now possesses in its new $120,000 waterworks system, one of the finest supplies of water in the Province, equal in clearness and purity, it is said, to the celebrated Capilano brand. The supply is brought from a dam at an elevation of 614 feet, situated

seven miles from the city, and which collects the water as it comes falling over the rocks from its glacial source above the Golden Eagle basin. The retaining wall, which is a solid, massive piece of work, is constructed of huge, cribbed logs, filled in between with rocks. The building of this wall was a long, costly operation, as owing to floods the work was arduous, and delay was occasioned by the half-built wall being swept away when a sudden flood, caused by heavy rains, undid in a night the labor of weeks. The wall was built up again and is substantial enough to resist any pressure that can be brought to bear upon it. The water enters the intake pipe through the latest system of cleaning and screening chambers, which collect all small debris which would have a tendency to enter the pipe. Five miles of 16-inch continuous wood stave pipe, discharging three and a half million gallons a day, and capable of providing for 25,000 people, convey the water to the city limits, after which 10 and 12-inch steel pipes are used through the main streets, smaller wire-wound pipe, tapping the mains, being used for laterals. The average pressure on the mains is 70 pounds to the square inch, thus allowing a good head for fire-fighting purposes.

PERSONAL.

STANLEY M. OBORN, A. M. Can. Soc. C.E., A. M. Inst. C.E., has resigned from the Toronto City Engineer's office and has begun practice as a consulting civil engineer and architect.

SIR ALEXANDER BINNIE, whose recommendations Ottawa is acting upon in connection with her water supply, has been asked by the city to assume the duties of chief engineer of the accepted Thirty-one Mile Lake proposal.

CHAS. MURPHY, general superintendent of the Canadian Pacific Railway Company, at Winnipeg, and formerly general master of transportation, and local superintendent at Toronto, will likely accept an appointment to the Dominion Railway Commission, to begin duties January 1st, 1914.

W. G. MILLER, Provincial Geologist and Inspector of Mines for Ontario, was entertained by a dinner in his honor at the Toronto Club recently, in recognition of his scientific accomplishments and the public service he is rendering to Canada in connection with his administration of Provincial duties respecting geology and mining.

J. G. McMILLAN, B.A. Sc., has been appointed Inspector of Mines for the Cobalt district, succeeding T. F. SUTHERLAND, who, as reported in our issue of June 26th, 1913, became Chief Inspector of Mines for Ontario on July 1st, succeeding E. T. CORKILL. Mr. McMillan returned recently from Hudson Bay, where he conducted harbor surveys for the Dominion Government. He is a graduate in mining of the University of Toronto.

OBITUARY.

The death occurred, recently, of Sir William Henry Preese, known in England as the "father of wireless telegraphy." He was in his 80th year. Sir William introduced both the telephone and talking machine into England and was the inventor of many patents connected with the telegraph and telephone. For several years he was engineer-in-chief and electrician to the British Post Office and was at one time president of the Institute of Civil Engineers.

The death is also reported of Alfred Russel Wallace, one of the leading British scientists, in his 91st year. During his life he made unusually large and valuable contributions to natural science and economics, and travelled in every part of the world in pursuit of his studies. He was a prominent authority on the land question and a strong advocate of land nationalization.

CANADIAN SOCIETY OF CIVIL ENGINEERS, OTTAWA BRANCH.

Mr. G. R. G. Conway, chief engineer of the British Columbia Electric Railway, addressed the Ottawa Branch recently, on the construction of the Coquitlam Dam. This work, which has just been completed, is of special interest to engineers from the fact that in the construction hydraulic process was used. By this process streams of water under great pressure are turned on the hillsides, washing out the stones, clay, etc., which flow through flumes to the place where the dam is under construction. This continual falling builds up the dam which is packed solid by the great weight of water coming over the falls into it. The water in this particular lake has been raised about 60 feet.

This work proved to be exceedingly expensive, as the water supply for New Westminster comes from the same lake, and for this fact the land which was to be flooded by the raising of the water had to be cleared of all vegetable matter that might contain microbes. The total cost of clearing the land was about $666,000. This was of particular interest to Ottawa engineers, because in raising the level of Thirty-One Mile Lake the ground to be flooded must also be cleared of all vegetable matter.

COMING MEETINGS.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

NATIONAL MUNICIPAL LEAGUE.—Annual Meeting will be held in Toronto, November 12th to 15th. Secretary, C. R. Woodruff, 705 North American Building, Philadelphia, Pa.

AMERICAN INSTITUTE OF ARCHITECTS.—Forty-seventh Annual Convention, to be held in New Orleans, La., December 2nd, 3rd and 4th.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.—Annual Meeting will be held in New York, December 2nd to 5th. Secretary, W. H. Reed, 154 Nassau Street, New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The Annual Meeting will be held in New York, December 2nd to 5th, 1913.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—Annual Meeting to be held in New York, December 10th to 13th. Secretary, C. D. Odsen, Polytechnic Institute, Brooklyn, N.Y.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—Seventh Annual Convention will be held at Great Northern Hotel, Chicago, December 29th to 31st. Secretary, I. W. Dickerson, Urbana, Ill.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS
OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20684—October 31—Authorizing C.N.O.R. to connect, temporarily, with G.T.R. near town of Pembroke, Ont.: Provided Co. (C.N.O.R.) bear and pay all expenses incurred in construction, maintenance and removal of said connection.

20685—November 3—Approving general plan showing crossing of G.T.R., and Muskrat River, and detail plans of substructure of proposed bridge.

20686—October 27—Refusing application of Port Hammond and District Improvement Association, Port Hammond, B.C., for order requiring C.P.R. to put into effect same or similar week-end fares from Port Hammond to coast cities as now in effect from Vancouver to Port Hammond.

20687—October 27—Authorizing Esquimalt and Nanaimo Ry. to cross track of Wellington Colliery Co., Limited, or Canadian Collieries (Dunsmuir), Limited at or near Trent River Ry. Co., construct safety switch at or near station 290 on line of Wellington Colliery Co., Limited, and station flag man at said crossing for purpose of flagging all trains over same. And directing each of said Cos. bear and pay half cost and expense of constructing and maintaining said crossing, and half cost and expense of constructing, maintaining and operating safety switch, and wages of said watchman.

20688—October 27—Authorizing Wellington Colliery Ry. Co., to cross Esquimalt and Nanaimo Ry. at mile 5.924, subject to certain conditions.

20689—October 30—Establishing collection and delivery limits of Canadian and Dominion Express Cos., in city of Owen Sound, Ont.

20690—October 29—Authorizing C.P.R. to construct spurs for Fort William Starch Co., Limited, Toronto, Ont., from a point on easterly limit of right of way of main line, Man. Div., in Lots 6 and 7, Con. D., Island No. 2, Fort William, Ont.

20691 October 29—Authorizing, pending installation half-interlocking plant, C.P.R. to operate trains over branch line, crossing C.N.R. adjoining Neebing Avenue, Fort William, subject to certain conditions.

20692—October 29—Authorizing C.P.R. to construct spur for Rutley Lumber Co., Limited, Regina, Sask.

20693—October 27—Approving location C.P.R. station at Oakshela, in N.W. ¼, Sec. 34-16-6, W. 2 M., at mileage 8.0 on Co.'s main line, Moose Jaw Subdivision.

20694—November 3—Authorizing C.P.R. to construct, subject to terms of proposed agreement, temporary spur for Carter Halls-Aldinger Co., Limited, Winnipeg, Man.

20695—October 30—Authorizing C.P.R. to open for traffic portion of double track from mileage 25.5 to 28.0, Broadview Subdivision, a distance of 2.5 miles.

20696—October 28—Authorizing C.P.R. to construct sidings for the Toronto Structural Steel Co., Limited, Toronto, Ont., from a point on existing siding track, within limits of right of way of Ry. Co., in Lot 8, Con. 5, Tp. York, in northwesterly direction across Oak Street, town of Weston, into premises of said Steel Co., in Lot 9, Con. 5, Tp. York, Co. York, Ont., at mileage 4.46, Ont. Division.

20697—October 30—Amending Order No. 19127, dated April 25th, 1913, to provide that authority to construct sidings and cross Gilkinson Street, Hamilton, Ont., granted under said order, be subject to certain conditions. That consent of city to said crossing be not taken as in any way prejudicing its position when question of grade separation arises. That time for construction and completion of work, limited by Order No. 19127, as amended by Order No. 19312, dated May 10, 1913, be extended for three months from date of this order.

20698—October 30—Extending, for a period of ninety (90) days from date of this order, time within which G.T.R. complete siding and spurs therefrom into premises of Toronto Structural Steel Co., Limited, on Lot 9, Con. 5, Tp. York.

20699—October 31—Approving plans and specifications of Bogart Drain, where same crosses G.T.R. on N. ½, Lot 9, Con. 4, Tp. of Elgin, Ontario.

20700—October 31—Approving station site and station of G.T.P. Ry. at Tyee, mileage 26.5, Prince Rupert East, in Lot 27, Rge. 5, Coast District, B.C.

20701—October 31—Amending Order No. 19215, dated May 6th, 1913, by adding clause "2" to provide for cost of maintaining subway over Thompson Road, Tp. Bertie, Co. Welland, Ont., as follows:—15 per cent. by Pere Marquette R.R. Co., 47½ per cent. by G.T.R., 30 per cent. by M.C.R., and 7½ per cent. by Tp. of Bertie.

20702—October 31—Authorizing G.T.R. to construct siding into premises of Gidley Boat Co., town of Penetanguishene, Ont.

20703—October 30—Amending Order No. 19759, dated July 4th, 1913, by striking out Sec. 2 and substituting therefor following:—"That consent of city to crossing be not taken as in any way prejudicing its position when question of grade separation, or any further protection that may be required at crossing, arises."

20704—October 30—Amending Order No. 19764, dated July 4th, 1913, by striking out Sec. 2 and substituting following:—"That consent of city to said crossing be not taken as in any way prejudicing its position when question of grade separation, or any further protection that may be required at crossing, arises."

20705—November 3—Approving location C.N.R. third-class station at Bengough, Sask.

20706—October 31—Approving revised location C.N.R. Greenway Branch through Secs. 2 and 3, Tp. 3, Rge. 23, W.P.M., Man., from mileage 78.95 to mileage 80.21.

20707—October 31—Approving location C.N.O.R. station grounds at Deseronto, Tp. Tyendinaga, Co. Hastings, Ont., at mileage 134 from East Don.

20708—October 31—Authorizing M.C.R.R. to construct siding, or coke track, into premises of the American Cyanamid Co., in Tp. Stamford, Co. Welland, Ont. And approving and authorizing clearances as shown on said plan. Ry. Co. to construct and complete said siding within three months from date of this order.

20709—November 3—Authorizing C.P.R. to construct spur from Haley's Station, Ont., into premises of Renfrew White Granite Co.

20710—November 4—Authorizing C.P.R. to construct spur into premises of McCormack Manufacturing Co., Limited, in Lot 9, Con. 1, Tp. London, Co. Middlesex, Ontario.

20711—October 28—Authorizing T., H. & B. Ry. to construct spur, with two branch lines or offsets therefrom, in city of Hamilton, Ont., to serve Canadian Westinghouse Co., Limited, subject to and upon certain conditions.

20712—November 3—Approving locations of C.N.O.R. station grounds, namely—At Alice, mileage 96.65 from Ottawa, and at Hiam, mileage 91.6 from Ottawa, Tp. Alice, Co. Renfrew.

20713—October 28—Authorizing C.N.R. to construct across eleven (11) highways on its Alsask Southeasterly Line, Sask.

20714—October 28—Approving C.N.R. location of Station at Chandler, Saskatchewan.

20715—November 4—Authorizing C.N.R. to construct across five (5) highways on its Calgary-Macleod Branch, Prov. Alta.

20716—November 3—Authorizing C.N.O.R. to take, for purpose of carrying out diversion approved by Order No.

19871, dated July 22nd, 1913, portion of Lot 22, Con. 9, Tp. Fitzroy, Co. Carleton, Ont., property of S. Reid, Learmouth.

20717—October 30—Approving revised location C.N.R. Maryfield Branch through Tps. 5 and 6, and Rgs. 25 to 29, W. 2 M., Sask., from mileage 194.82 to 224.58.

20718—November 3—Amending Order No. 20469, dated October 1st, 1913, by striking out words, "and no objection to the granting of the application having been filed by city of Winnipeg, although duly notified as appears by affidavit of service of notice of the application, filed," and substituting therefor words following, in recital to said Order, namely: "and reading the objection on behalf of the city of Winnipeg, filed."

20719—October 28—Approving location C.P.R. station at Outram, Sask.

20720—November 4—Authorizing, subject to terms and conditions contained in agreement, with exception of provision that spur be moved on demand of Municipality, C.N.R. to construct spur for P. Hrynczuk from a point on Oak Point Branch, near Roy (Pacific) Ave., Rural Mun. Rosser, across said Avenue and through Lots 26, 58 and 59, Block 8, Plan No. 774, property of P. Hrynczuk, to Ross Ave., Mun. Rosser, Man.

20721—November 3—Extending, until December 1st, 1913, time within which C.P.R. complete work of diverting Nine Mile Road, in Lots 6 and 7, Con. 9, Tp. South Gower, Co. Grenville, Ont.

20722—November 4—Authorizing C.P.R. to construct extension to existing siding for W. Booth Lumber Co., Limited, Toronto, Ont., on land lying westerly of right-of-way of Company's main line, Ont. Div., and northerly of road allowance between Cons. 1 and 2, Etobicoke, Ont., at West Mimico.

20723—November 4—Authorizing C.P.R. to construct spur for Steel Equipment Co., Limited, Ottawa, Ont., on part Lot 17, Town of Pembroke, Ont., at mileage 106.52 from Ottawa.

20724—November 4—Authorizing C.P.R. to open for traffic portion of its double track from Ernfold to mileage 70.0 on Swift Current Subdivision, Sask.

20725—October 29—Authorizing, subject to terms and conditions of resolution, C.P.R. to construct new double-track bridge at Napier St., Iberville, Que., mileage 19.5, Farnham Subdivision.

20726—November 4—Authorizing C.P.R. to construct, by means of grade crossing, two extra tracks across Deveber Ave., Mun. of Taber, Alta.

20727—November 4—Authorizing C.P.R. to construct Bridge No. 35.92, White River Sub. Div., Lake Superior Div., near Goldie, Ontario.

20728—October 29—Authorizing C.P.R. to construct Bridge No. 0.32 at Lorne St., city of Kamloops, B.C.

20729—October 29—Authorizing C.P.R. to construct, by means of grade crossings, its ballast pit spur across highways from mileage 0 to 3.05 of said ballast pit spur, at mileage 3 from Bassano, on Bassano Easterly Branch.

20730—October 29—Authorizing C.P.R. to construct, by means of grade crossing, its ballast pit spur aross highway between Sec. 19-6-11, and Sec. 24-6-12, W. 4 M. on Weyburn-Sterling Branch.

20731—October 28—Approving location C.P.R. station at Mara, B.C., in N.E. ¼ Sec. 8-20-8, W. 6 M.

20732—October 28—Authorizing, subject to terms of proposed agreement, Canadian Bridge Co., Limited, to construct foot-bridge and grade crossing over Pere Marquette R.R. at Walkerville.

20733—October 27—Authorizing C.P.R. to construct, at grade, extension to passing track across Boundary St., Didsbury, Alta.

20734—November 3—Authorizing C.P.R. to construct road diversion in Sec. 4-23-27, W. 3 M., Sask., on Swift Current Northwesterly Branch. To construct, by means of grade crossing, its Swift Current Northwesterly Branch Line across said diversion, at mileage 96.3 on said branch line from Swift Current.

20735—October 27—Authorizing V.V & E. Ry. & Nav. Co., and C.P.R. to operate their trains over crossing at Burrard Inlet, city of Vancouver, B.C., without their being brought to a stop.

20736—October 29—Authorizing Montreal Light, Heat and Power Co. to lay concrete water tunnel under C.P.R. in Municipality of Ville LaSalle, Que., on south side of Lachine Canal, opposite to Lot No. 1021.

20737—October 30—Authorizing G.T.P. Branch Lines Co. to construct spur for Union Coal Co., Limited, in Sec. 36-31-24, W. 4 M., Alta.

20738—October 29—Authorizing G.T.P. Ry., to construct spur turning out from its main line on 21st St. into Block 12, Inglewood Subdivision, city of Edmonton, Alta.; crossing of Brazeau Avenue, to be constructed in accordance with "Regulations."

20739—November 4—Directing that rating of 4th class provided in Canadian Freight Classification for blaugas and Carbonic Acid Gas be provided, also for oxygen and Acetylene gases in carloads. 2. Refusing application for a reduced less than carload rating of Oxygen gas.

20740—October 28—Authorizing C.P.R. to construct, subject to terms and conditions contained in agreement, by means of a bridge four tracks on its main line, Alta. Div., Lethbridge Sub. Div., over and across Westminster Road, Lethbridge, Alta.

20741—November 5—Authorizing C.N.R. to construct Bienfait-Estevan Branch over a coal mine, situated in S. ½, Sec. 19-2-6, W. 3 M., Saskatchewan.

20742—November 6—Directing that Pere Marquette R.R. Co., at its own expense, employ and maintain a watchman at crossing of highway 1¾ miles west of Kingsville, Ont., pending installation of bell at said crossing.

20743—November 5—Relieving North Shore line of C.P.R., from providing further protection at crossing of first public highway west of the west switch at Little St. Martin, Que.

20744—October 9—Relieving G.T.R. from providing further protection at crossing of public road one mile east of Wyoming, Ont.

20745—November 5—Approving locations C.P.R. stations at Tribune and Bromhead on Estevan-Forward Branch, Saskatchewan.

20746—November 6—Approving location C.P.R. station at Westerham, in S.E. ¼, Sec. 34-22-27, W. 3 M., Swift Current Northwesterly Branch, Province of Saskatchewan.

20747—November 5—Extending, until December 31st, 1913, time within which C.P.R. install electric bell, required under Order No. 20017, dated August 11th, 1913, at crossing of Main Street, village of Shelburne, Ontario.

20748—November 6—Authorizing C.P.R. and Quebec, Montreal and Southern Ry. Cos., to operate their trains over crossing at mileage 18.81 from Farnham, Que., without their first being brought to a stop.

20749—November 6—Extending, until November 30th, 1913, time within which C.P.R. install gates at crossing of Centre Street, Chatham, Ont., required under Order No. 19051, dated April 14, 1913.

20750—November 6—Authorizing C.P.R. to open for traffic portion of its Weyburn-Stirling Branch from mileage 0 to 49.2, east of Stirling, Alberta: Provided speed of trains be limited to a rate not exceeding 25 miles an hour.

20751—November 6—Authorizing C.P.R. to operate bridge crossing St. Lawrence River at mileage 41.9, Farnham Subdivision.

20752—November 6—Authorizing C.N.R. to construct across eleven (11) highways on its Alsask Southeasterly line, Sask.

20753—November 6—Authorizing C.P.R. to construct, for Godson Contracting Co., Limited, an extension to existing track and a passing siding track in Lot No. 16, Con. 10, Tp. Darlington, at mileage 53.43 on Ry. Co.'s main line, Ontario Division, Toronto Subdivision.

20754—November 7—Authorizing C.P.R. to construct Bridge No. 9.17 on Nipigon Subdivision, over Maggot River, Ont.; and rescinding Order No. 20084, dated August 18th, 1913, in so far as it authorizes construction of said bridge.

20755—November 6—Authorizing C.P.R. to construct spur for Kettle River Co., Minneapolis, Minn., from a point on existing spur in N.E. ¼, Sec. 8-11-4, E.P.M. at North Transcona, Manitoba.

20756—November 6—Authorizing G.T.R. to construct siding into premises of the Canada Stove and Furniture Co., on Lot 409-342, 259, 250, 264, parish St. Laurent, Quebec.

20757—November 6—Authorizing Galbraith and Sons, to construct tramlogging road under V.V and E.R. and Nav. Co.'s trestle bridge, No. 73, near Lincoln, B.C.

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Canadian Pacific Railway Co.'s Freight Sheds, Toronto, Ont.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+ -Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Ainsworth, B.C., wharf	Nov. 17.	Oct. 30.	74d.
Assiniboia, Man., pavement	Nov. 25.	Oct. 30.	86
Fort William, Ont., harbor and river improvements in Mission River	Nov. 21.	Oct. 30.	84
Ottawa, Ont., section 5, Welland Canal	Nov. 18.	Oct. 30.	82
Ottawa, Ont., conveyance of mails	Nov. 14.	Oct. 16.	86
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Port Hope, Ont., harbor improvements	Nov. 17.	Oct. 23.	84
Rainy River, Ont., pile protection work	Nov. 17.	Oct. 23.	82
Toronto, Ont., steelwork for bridge	Nov. 25.	Oct. 16.	84
Toronto, Ont., pumping engines, &c.	Nov. 25.	Oct. 16.	84
Toronto, Ont., sub-contracts for Methodist Book and Publishing Co.		Oct. 16.	82
Toronto, Ont., steel conduit	Nov. 18.	Oct. 23.	86
Toronto, Ont., casting, pipes, valves, &c.	Nov. 18.	Oct. 23.	86
Toronto, Ont., conveyance of mails	Nov. 14.	Oct. 23.	86
Victoria Harbor, B.C., wharfs	Dec. 9.	Oct. 30.	84
Winnipeg, Man., pumping units, &c.	Nov. 15.	Oct. 30.	74d.
Winnipeg, Man., water supply..		Oct. 16.	86

RAILWAYS—STEAM AND ELECTRIC.

Calgary, Alta.—The by-law concerning the proposition of property owners to construct an extension of the street car lines into the Shaganappi park section, with a guarantee against deficits for four years, after which time the city were at liberty to operate the line or to allow it to stand idle, has met with defeat.

Hamilton, Ont.—City Engineer Macallum has reported to the city board of control upon the expenditure required to place the East End incline railway in a safe and workable condition. He recommended that four trenches be excavated across the incline; that two of these trenches be dug to a depth of three feet into dry clay, and that two be dug into the rock edge. The clay should be burned, forming a kind of brick, and four concrete walls should be placed across here, and side ditches should be made for drainage purposes. It was all a matter of drainage, said the engineer, and if that was satisfactory the land would not slide. The cost would be approximately $3,000. The work would necessitate 2,000 yards of excavation and 250 yards of concrete, and could be completed in about a month if a good gang of men was employed. Mr. G. F. Webb will report upon the action the railway company will take in this matter.

London, Ont.—Word has been received in London to the effect that the Grand Trunk Railway system must install at once and maintain a derail and interlocking system at the intersection of Dundas Street and the interswitching line.

Medicine Hat, Alta.—The city engineer has completed plans for the Esplanade subway, and these have been submitted to the city council together with an estimate of $84,753.42, including street costs for paving and sidewalks. The council, after examining the plans, were of the opinion that the plans should be submitted to the Railway Commission and the Canadian Pacific Railway, with a provision that the street improvements, including the sidewalks and paving, may at the wish of the city be accomplished at a later date. This will reduce the cost of the subway to $52,303.00 for the present. A motion to this effect was passed and the mayor and clerk authorized to sign the plans. The council also asked for an extension of six months in the time of completion of the subway, which will allow until July 27th to have the work finished.

Montreal, Que.—The city board of control is considering the Grand Trunk Viaduct problem. Mr. Geo. R. MacLeod, city traffic engineer, recommends that the city press for the improvement; and Mr. C. Laurendeau, city attorney, is asking for instructions as to the way the city should proceed with the case, allowing the urgency for the viaduct, but desiring to be instructed if the city will pay a share of the cost. Considering all estimates of the cost of the construction, both with and without damages, the approximate cost with damages may be placed at $5,500,000.

+—Ottawa, Ont.—The Cabinet council at its session of November 7th, let the contract for new switching signals for the Intercolonial Railway for $85,000 to the UNION SWITCH SIGNAL COMPANY of Montreal, Que.

Ottawa, Ont.—The Canadian Pacific Railway Company has given notice that it will apply to the Parliament of Canada, at its next session, for an act extending the time within which it may construct several railways; one from, at, or near Hawarden, to a point at or near Floral, or Cheviot, or a point between those places in the province of Saskatchewan; another, from, at, or near Sedgewick southerly to a point in township 39 or 40, Range 12 or 13, province of Alberta; a third, from a point on Will branch to a point near the North Saskatchewan River in township 51, Saskatchewan and Alberta; a fourth, from the northwesterly terminus of the Asquith branch to a point at or near Battleford, in the province of Saskatchewan; a fifth, from a point at or near Irricana to a point in township 20 or 21 in the province of Alberta; and, a sixth, from Killam to Strathcona, Alberta.

Ottawa, Ont.—At the next session of the Dominion Parliament, the Manitoba and Northwestern Railway Company will apply for an act extending the time within which it may construct the following lines of railway from Theodore to Junction with its Russell branch in township 20 or 21, Range 28; from Birtle to Hamiota; from Harrowby to Hamiota; from Russell to a point near Shoal River; from, at, or near Theodore to Junction with Pleasant Hills branch of the C.P.R. between Govan and Lanigan.

Ottawa, Ont.—Tenders will be received up till November 27th for 196,000 ties to be delivered at Hervey Junction and La Tuque, P.Q., in quantity and quality as specified. Plans and specifications may be obtained from Mr. Gordon Grant, Chief Engineer, Ottawa, Ont. Signed, P. E. Ryan, Secretary, Commissioners of the Transcontinental Railway.

Ottawa, Ont.—The Central Canada Railway Company have made application to parliament through their solicitors, Messrs. Pringle and Guthrie, for a charter with power to construct and operate a railway from Winnipeg to Edmonton, via Yorkton, Saskatoon, and Battleford.

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Ottawa, Ont.—A charter will be sought at the next session of parliament by the Ontario Lake Front Terminal Railway, which proposes to build a line from a point on the Canadian Pacific Railway, between Havelock and Central Ontario Junction, to Cobourg, by way of Campbellford, and from the latter town to Brighton.

Regina, Sask.—Mr. F. J. Robinson has presented to the council of the local Board of Trade a motion calling upon the city council to take some action to prevent any existing line or any new company from entering the city on these or any other lines, unless they be built adjoining those already constructed. The motion met with much discussion, but was referred finally to the committee on legislation.

Regina, Sask.—A by-law has been read authorizing the street railway to borrow a further $100,000 from the bank. This will mean that by the end of the year the city will have expended on street railway construction and equipment about $400,000.

St. Catharines, Ont.—The Grand Trunk Railway sheds have been completely destroyed at St. Catharines at an estimated loss of $50,000.

Toronto, Ont.—The Ontario Government has been requested by the Mayor and representatives of the municipality of Owen Sound to assist in securing for Owen Sound railway connection with Meaford. The G.T.R. will not agree to any proposal unless Government assistance is assured. The federal government has offered the usual subsidy of $6,400 per mile, and a further bonus from the province is being sought.

Toronto, Ont.—A branch civic line down Lansdowne Avenue to the C.P.R. crossing above Royce Avenue is being advocated by Works Commissioner Harris. It is estimated that this line would cost $104,186; and that operating and interest expenses would be about $17,078 per year.

Vancouver, B.C.—Reliable information has been received in Vancouver that New York capital has been raised for the completion of the Portland Canal and the North Eastern Railway.

+—Victoria, B.C.—The contract has been awarded to EVA''S, COLEMAN AND EVANS for the supply to the city of steel rails for the light railway to be built in connection with the Sooke waterworks. About 550 tons gross will be required.

Winnipeg, Man.—In view of the fact that both the city and C.N.R. Company objected to the application of the Winnipeg Sandstone Brick Company, Limited, for the construction of a C.N.R. spur track across Pembina Street to the company's premises, no order was issued by the Board of Railway Commissioners. It was decided that the engineer of the commission should make a report upon conditions.

Winnipeg, Man.—The C.N.R. will apply in the next few days for permission to double track their cut-off across Fort Rouge, after which the Board of Railway Commissioners will consider the application for a subway under the C.N.R. tracks at Pembina highway.

Winnipeg, Man.—The Board of Railway Commissioners, which met recently in Winnipeg, decided with reference to the C.P.R. spur line over Selkirk Avenue, that the order compelling its removal should be refused, but that an order should be issued compelling the company to raise the track to the level of the other tracks, which will, moreover, enable street car connection on the line to be made. The Board also instructed Mr. George Spencer, assistant chief operating officer of the company, to make a report on the smoke and noise nuisance; and for this he was given a month's time.

GARBAGE, SEWAGE AND WATER.

Hamilton, Ont.—According to Mayor Allan, the town of Dundas cannot be supplied with water from Hamilton without repumping halfway between the two municipalities. However, if the McKittrick survey came into the city, and got the water, the water could be conveyed by repumping to Dundas; since the city will have a surplus water supply to sell to outside concerns and municipalities.

Hull, Que.—The city of Hull is maintaining an attitude evasive rather than favorable towards assuming any financial responsibility in connection with the Ottawa water supply scheme, even to the extent of the water used by Hull. The feeling was voiced by Mayor Dupuis when he gave as a reason that in lieu of Ottawa's pipe line running through Hull and the province of Quebec, the city of Hull should not be called upon to contribute for its supply; moreover, that Hull is not anxious to depart from its present source of supply.

Lethbridge, Alta.—The announcement has been made by Mayor Hardie and Alderman Aird, chairman of the public works committee of the council, that over 7,000 feet of 6 and 8-inch water main will be laid in North Lethbridge this fall and winter at a cost of approximating $10,000. Practically all the waterworks extensions to be undertaken were passed upon by the 1912 council, but were not completed owing to the lack of money. The Bank of Montreal has met the city in its request for credit, and the work is now to be undertaken.

London, Ont.—The city council has passed a motion recommending and authorizing the Board of Works to commence work this winter, if at all possible, on the new storm-sewers, and also on extension and improvement in connection with the existing sanitary sewerage system.

Medicine Hat, Alta.—The tenders for the Medicine Hat unit of the waterworks system have been opened, and the city council has decided to call again for tenders for a 2,000 k.w. generator and a 1,500 k.w. generator in order to compare prices and to decide upon the better type to use.

Oshawa, Ont.—The Board of Water Commissioners met last Friday afternoon to consider tenders for a new electrically-driven centrifugal pump. The contract will likely be awarded to Canadian Allis-Chalmers, Limited, who were the lowest tenderers, but no definite action has yet been taken. It was decided by the Commissioners to issue $20,000 debentures to cover the cost of the pump and of other repairs and additions to the waterworks. A by-law covering this amount will be submitted to the citizens January 1st, unless council should care to pass the by-law by two-thirds vote, without submitting it to the people. Filtration is recommended by the Town Engineer, Mr. Chappell, but it is thought that the necessary money will not be available for a filtration plant for another year. Oshawa uses about 700,000 gallons daily at the season of maximum demand.

Ottawa, Ont.—Tenders will be received up till November 22nd, 1913, for a supply of hypochlorite of lime for the waterworks department of the city of Ottawa. Specifications may be obtained from the city bacteriologist, Slater Street, Ottawa, Ont. Signed, John Henderson, City Clerk, Ottawa.

Stratford, Ont.—The city council has passed the recommendation of the Board of Works calling for improvements at the sewage disposal plant.

LIGHT, HEAT AND POWER.

Bellingham, Ont.—Secretary Houston of the Department of Agriculture has issued a 50-year permit to the Skagit Power Company, a subsidiary of the Stone and Webster Company. The company will construct a power plant in the Upper Skagit River country, to cost $5,000,000 and to develop 27,610 horsepower. The waterpower is to originate in the Washington national forest reserve to the north and east of Marble Mount, and comprises rights on numerous tributaries of the Skagit.

Brandon, Man.—City Electrician Skead of Brandon has completed the installation of an interlocking plant to prevent accidents in that city at the point where the street railway and the Canadian Northern tracks cross. This plant is said to be the first of its kind installed in western Canada, and consists of two one-lever interlocking machines, equipped with electric locks and circuit controllers and two signal towers erected 300 feet on each side of the crossing on the C.N.R. line. These towers have the semaphores which give the signals to trains. It was stated that failure on the part of the trains to obey signals set for danger would result in derailment, and that any failure of the electric current would cause the signals to be set automatically to danger.

Calgary, Alta.—Tenders will be received up till December 31st, for certain machinery and equipment. Plans and specifications may be obtained from *The Canadian Engineer*, Winnipeg, Toronto, and Montreal; or from T. L. Turnbull, Esq., Consulting Engineer, 202 Eighth Avenue West, Calgary, Alta.

Davidson, Sask.—The Canada Gas Producer Company of Barrie, Ont., has submitted a proposal to the town council of Davidson, by which the company will install an 80 horse-

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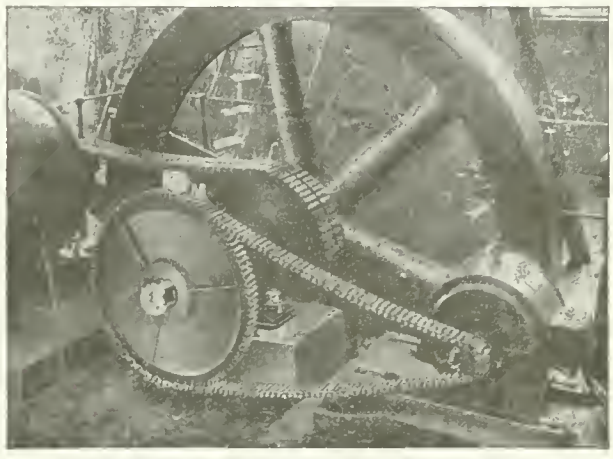

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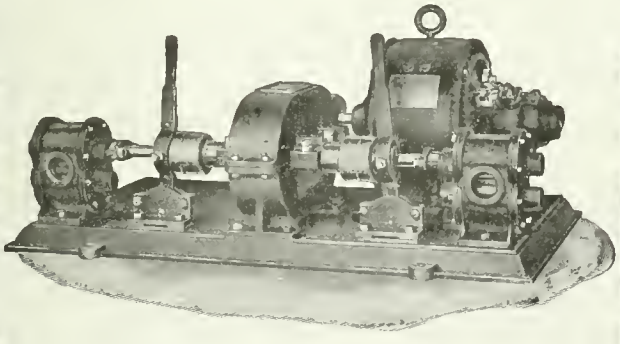

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power 3-cylinder engine, including all necessary equipment for $8,500, to be paid only on satisfactory test after installation. A by-law is to be submitted to ratepayers on December 8th.

Dundas, Ont.—The treasurer of the Town Council has been ordered to issue a corporation cheque of $2,110 in accordance with the arbitration award in the town acquiring the Dundas electric light plant. Concerning the lighting of the square occupied by the new postoffice building, the government's proposal to erect an ample number of light standards on the postoffice property, the light to be furnished by the town, was satisfactory, and was accepted.

London, Ont.—The Hydro-Electric Commission of Ontario and the London Street Railway have signed the agreement by which the company will purchase from the commission during the life of the company's franchise, which will expire in 12 years, 1,000 horsepower of direct current electricity at $36 per horsepower. The railway will be supplied with the power from December 15th.

Ottawa, Ont.—Tenders will be received up till November 20th, 1913, for electric wiring and fittings for public building, Port Colborne, Ont. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Peterboro, Ont.—The city council has passed a by-law authorizing the appointment of Mr. Robert A. Ross of Montreal as arbitrator to act for the city in proceedings between the city and the Peterboro Light and Power Company.

Peterboro, Ont.—The Power Committee of the city council is ready and willing to concede the control and operation of the Hydro system to the Peterboro Water Commissioners, and the city council has passed a resolution inviting the latter to confer with the proper authorities with a view to arranging an agreement.

+—Souris, Man.—The contract has been awarded the BRANDON MACHINE AND IMPLEMENT WORKS by the municipality of Souris for the supply of lampposts for the new lighting system, at an estimate of several thousand dollars

Victoria, B.C.—At a large meeting of the voters of Ward Six, South Saanich Municipality held recently, the following resolution was passed unanimously:—"That in view of the increasing needs of the wards adjoining the city of Victoria, they are undertaking to mortgage the credit of the rural wards who can receive no benefits therefrom, and knowing, that ultimately Wards One and Two must be included in the city of Victoria, we, the ratepayers of Ward Six, present at this meeting, are most emphatically opposed to the raising of money for sewage purposes."

Winnipeg, Man.—Among eight by-laws to be brought before the ratepayers of the city on December 12th, is one to provide $1,000,000 for power distribution.

Winnipeg, Man.—Tenders will be received up till November 19th, 1913, for the electric wiring of the addition to the Hospital for Insane, Selkirk, Man. Plans and specifications may be obtained from the Provincial Architect, 261 Fort Street, Winnipeg, Man. Signed, W. H. Montague, Minister of Public Works, Manitoba.

Yorkton, Sask.—Tenders will be received up till December 22nd, 1913, for the supply and delivery of one 500 b.h.p. combined unit. Plans and specifications may be obtained from M. M. Inglis, Electrical Engineer, Yorkton, Sask Signed, T. F. Acheson, Secretary-Treasurer.

BRIDGES, ROADS AND PAVEMENTS.

Edmonton, Alta.—The Board of Railway Commissioners has decided not to grant the request of the city to construct a highway across the G.T.P. for the purpose of extending Vermilion Avenue across the railway. This decision effectually opens the way for the city's claims for subways and permanent protective measures at all railway crossings.

Edmundston, N.B.—Engineers have completed the final survey for an international steel bridge, which is to be erected across the Madawaska River next summer.

Hamilton, Ont.—The works department have in hand a big program of improvements to be executed next year. The principal item is connected with roadways. The idea now is to charge all such work on the local improvement plan, and do away with the fund of $50,000 of $60,000 now kept for stone roads and other highways not of a permanent nature. Some of this money will have to be put aside for repairs, but there will be a big saving. Instead of paying all the costs of certain work the city will only have to foot about forty per cent. of the bill. It is also planned to give every street in the city that will not stand flushing one sprinkling of oil during next summer, to be followed by the distribution of stone screenings.

Montreal, Que.—The first Canadian Good Roads Congress will be in session at Montreal for a week in January, 1914. Delegates will be present from the leading local Road Association, Board of Trade, Municipal, Provincial and Federal Governments, the Automobile Club of Canada, and various other societies interested in obtaining good roads throughout the country. Also, in connection with the congress, there will be an exhibition of road building materials.

Ottawa, Ont.—A sub-committee from the Street Railway Extension Committee has been appointed to meet a delegation of residents of Ottawa East to discuss the matter of the best site for the proposed new bridge across the canal. After meeting the citizen's committee, this sub-committee will report directly to the Board of Control.

St. Catharines, Ont.—The city council has reserved its decision to change the figure in the C.N.R. bonus by-law from $100,000 with a provision for vehicular and foot traffic, to $75,000 to provide for a high level railway bridge alone across the canal between locks and the present low bridge of the N.S. and T.R. Port Dalhousie line. The ratepayers will decide by vote whether the railway bridge providing for vehicles and foot passengers will be constructed.

Stratford, Ont.—The city council has passed the recommendations in the report of the Board of Works for the preparation of plans for the covering of Erie Creek, and for the opening of William Street.

St. John, N.B.—A petition which is to be presented to Premier Flemming, has been circulated, and is a protest against the construction of a bridge across the St. John River in connection with the Valley Railroad, the contention being that it will interfere with navigation on the river by logs and rafts. The petitioners, however, will be strongly opposed by those acting in the best interests of the Valley Railroad. And, in addition, it is understood that a movement is on foot among automobile owners to ask the Government that the bridge be made a highway as well as a railroad bridge.

Toronto, Ont.—A conference will be held on the morning of November 11, between the York Township Council and the Good Roads Commission regarding the repairing of the Don Mills road.

Toronto, Ont.—Tenders will be received up till November 18th, 1913, for the construction of asphalt, bitulithic and concrete pavements, and of gradings and sewers. Plans and specifications may be obtained from the office of the Commissioner of Works, Toronto. Signed, H. C. Hocken (Mayor), Chairman, Board of Control.

Toronto, Ont.—The revised proposal for the widening of the north part of Yonge Street has been approved by the civic Works Committee, and it is expected that the city council will authorize a by-law for the improvement. The plan is to widen the street on the east side from Collier Street to Lawton Avenue and Heath Street, and thence on the west side to the city limits at Bedford Park. The Street Improvement Committee estimate that this change of plan will involve a reduction of about a million dollars in the original estimated cost of $3,100,000.

Toronto, Ont.—Tenders will be received up till November 15th, for the construction of bitulithic pavement on Russell Hill road, in the Township of York. Plans and specifications may be obtained from the office of Frank Barber, Esq., C.E., Township Engineer, 57 Adelaide Street East, Toronto.

Toronto, Ont.—Tenders will be received up till November 15th, for the construction of concrete sidewalk on Baby Point Crescent, in the Township of York. Plans and specifications may be obtained from Frank Barber, Esq., C.E., Township Engineer, 57 Adelaide Street East, Toronto.

Vancouver, B.C.—Tenders submitted to the civic waterworks committee upon the two routes for the Point Grey partnership pipe by Beach Avenue and Granville Street bridge, and by Smythe Street and Connaught bridge, have shown differences in favor of the Point Grey engineers. Only on

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the work of crossing False Creek does the Connaught bridge route appear to be cheaper. Before awarding contracts, the waterworks committee has requested the city engineer and Messrs. Cleveland and Cameron, Point Grey's advisory engineers, each to submit a report on the tenders, after considering which the committee will take action.

Victoria, B.C.—It is announced that the contract for the construction of the Taghun bridge calls for its completion by March 31st. The material is due to arrive on the ground within the next few days and the arrangements have been made to have the requisite steel forward d as soon as ordered. The contractors have every reason to carry forward the work rapidly in their own interests as in the event of it not being finished before the spring floods ensue there is danger of the false work being carried away, thus involving additional expense.

Winnipeg, Man.—Alderman McLennan and Mr. James Eames have urged upon the city Board of Control that the city take some action looking to the construction of a subway at Talbot Avenue and that it notify the Dominion Railway Commission to that effect; since the Commission has given notice that it will order that the crossing be protected with gates if the city does not decide to build a subway at that point within two weeks. Mr Eames urged that the construction of the subway be undertaken as soon as possible and argued that if the gates were put up they might be allowed to remain there for many years, much to the injury of the community. The cost of the subway at Talbot Avenue is estimated at $188,000. The board will not make a recommendation on the subject until the matter has been discussed with the Public Utilities Commissioner.

INDUSTRIAL WORKS.

Lindsay, Ont.—It is understood that the government is arranging to widen the canal allowance, and to this end Engineer Spence and his assistants have taken the soundings of the river at Bobcaygeon from the dam to the mouth of the river on lines across the river, 50 feet apart, and sounding every 10 feet in those lines.

Montreal, Que.—The Montreal Board of Trade is once more taking up the question of the Georgian Bay Canal, and has drafted and adopted the following resolution to be forwarded to Mr. Borden and Mr. Cochrane:—"That the construction of the Georgian Bay Canal, long advocated by the Montreal Board of Trade as being of vital importance to Canada, is now deemed specially necessary by the council of the board in view of the increasing diversion by the Canadian to American channels of the carriage of Canadian grain for export. That understanding the Government has under consideration the appointment of a commission to enquire into the commercial feasibility of that canal and deeming the composition of such a board most important, the council hereby prays the Government to permit the commercial organizations of Montreal to make recommendations for appointment thereon."

Montreal, Que.—In the report of harbor improvements recently submitted to the Chambre de Commerce by Adelard Fortier, president of that body, Lieutenant-Colonel Labelle, is quoted as stating that development of the port of Montreal will be conducted on the north shore of the river and that the present Board of Harbor Commissioners have no intention of undertaking a programme for the construction of wharves on the south shore opposite the city.

New Westminster, B.C.—Mayor Gray has received communication from Ottawa informing him that the Hon. Dr. Roche, Minister of the Interior, has signed the agreement between the city and the Vancouver Power Company in final settlement of the Coquitlam Dam controversy.

+—Ottawa, Ont.—The contract has been awarded the firm of CHAMBERS, McCAFFREY AND McGUGAN for the construction of Nassau dam on the Trent Canal for $72,768.

Ottawa, Ont.—Tenders will be received up till December 3rd, 1913, for the construction of a breakwater at Little Sands, P.E.I. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. Signed, R. C. Desrochers, Secretary.

Ottawa, Ont.—Tenders will be received up till December 4th, 1913, for the construction of an extension to wharf at Gull Harbor, Lake Winnipeg, Man. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—Tenders will be received up till December 4th for the construction of an extension to wharf at Gull Harbor, Lake Winnipeg, Man. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ontario. R. C. Desrochers, Secretary.

+—St. John, N.B.—The contract has been awarded D. C. CLARK for repairs to the wharf damaged by the SS. Wabana, at a cost of $1,600.

MISCELLANEOUS.

London, Ont.—The present equipment of the London incinerator is proving insufficient; and in the opinion of Superintendent W. C. Dodd, either the equipment will have to be increased shortly or a new plant will have to be built.

Medicine Hat, Alta.—The elevator of the Ogilvie Milling Company, with a capacity of 30,000 bushels, and containing at the time 12,000 bushels was burned recently; the engine house alone was saved.

▲—Ottawa, Ont.—Tenders will be received up till January 7th, 1914, for the construction of six 200-ton mechanical coaling plants with sandhouses complete to be erected at points on the National Transcontinental Railway. Plans and specifications may be obtained from Mr. W. J. Press, Mechanical Engineer, Ottawa, Ont. Signed, P. E. Ryan, Esq., Secretary of the Commissioners of the Transcontinental Railway, Ottawa.

Ottawa, Ont.—Ten tenders for plans have been received for the new proposed Government-owned elevator to be built at Port Nelson. The tenders have all been sent West to be considered by the Grain Commission.

Ottawa, Ont.—Armstrong, Whitworth and Company, the great British shipbuilding, contracting, and steel manufacturing firm, has been federally incorporated with stock of $2,000,000, and headquarters at Montreal. The new Canadian company is empowered to carry on a general shipbuilding, and iron and steel manufacturing business to build locomotives, automobiles, drydocks, terminals, etc.; and should war vessels be built in Canada, this company will be ready to offer tenders.

Ottawa, Ont.—While in Ottawa, a member of the firm of Barnett and McQueen, expressed himself as of the opinion that there are hopes of once more restoring to their original perpendicular the great concrete tanks of the Canadian Pacific Railway elevator at Transcona. At present, these are lying tilted at an angle of 45 degrees, one side having sank under the tremendous weight of wheat contained. However, due to the strength of reinforced concrete, the tanks have remained intact, and with the application of some herculean modern engineering force, they may be restored to the perpendicular. The proposed method is to excavate under the sunken side, powerful jacks being used to keep the structure up while the foundation is being strengthened. When this has been effected, the tanks will be allowed to sink back onto the flat surface. The leaning side will have to be heavily propped during the excavation process to prevent further listing, and to keep it in place. This work is estimated at a cost of $30,000.

Ottawa, Ont.—The Winnipeg River Power Company, Limited, with a capital stock of one million dollars and chief place of business in the city of Winnipeg, has been granted incorporation by the Department of State. Presumably this is the company which recently obtained extensive power rights at Great Falls, on the Winnipeg River.

Ottawa, Ont.—In his lecture on *The Work of the Dominion Observatory*, Dr. W. F. King stated that the big telescope to be erected by the Government may possibly be built elsewhere than in Ottawa. Owing to extreme changes in temperature, the large proportion of cloudy days and nights and other causes; and owing to the fact that this instrument will cost a very large sum of money, and the authorities naturally desire to get the most they can out of it, it will possibly be set up in the West, where atmospheric conditions are better for observation.

Regina, Sask.—An application for franchise in the city has been made by Calgary capitalists in connection with a gas scheme in many ways similar to the Georgeson scheme

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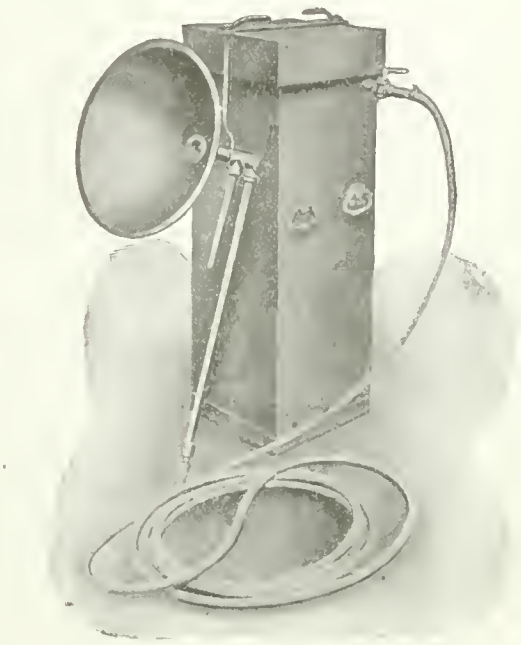

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offered about a year ago. The details concerning the contract offered by the present company are not made public, though the scheme is to pipe gas from the southern Alberta fields to Regina and other cities.

+—Vancouver, B.C.—The PALMER SHIPBUILDING COMPANY, Jarrow, has been awarded a contract for the construction of a large new steamer for the Ellerman Line, Liverpool.

+—Vancouver, B.C.—The NEWPORT NEWS SHIPBUILDING COMPANY has been awarded the contract by the Standard Oil Company for the building of an oil tanker, 640 feet long, 29 feet deep, and of 60-foot beam; equipped with oil-burning engines capable of making a speed of 10½ knots; and costing, when complete, $1,000,000.

+—Vancouver, B.C.—The contract has been awarded MESSRS. WILLIAM GRAY AND COMPANY, West Hartlepool, by Norwegian owners, for an oil tank steamer to be built on the Isherwood system of construction.

CURRENT NEWS.

Calgary, Alta.—In the opinion of Mr. R. L. Walker, as stated in the Calgary News-Telegram, the C.P.R. Company must have its Bassano dam completed, tested, and filled with water before freeze-up, in order to have its irrigation system to the south of the province in operation next year.

Fort William, Ont.—The superintendent of construction has stated that the incinerator plant being built by Mr. M. H. Braden, contractor, situated near the Neebing River between the Fort William road and the C.N.R. tracks, will be in use by the city within the next two weeks. Upon a long incline reaching from the ground to the top of the building, steel rails have been laid which connect with the electric steel railway, and specially constructed dump cars will be used to gather the garbage from all over the city and to carry it to the incinerator. When the dump cars reach the roof of the building, the contents are dumped through trap doors set between the rails, directly on big concrete slabs where it is quickly dried by the heat from the furnaces. It is then automatically shot into the furnaces where it is entirely consumed in the short space of three or four minutes. A tall brick smoke stack, 85 feet in height, has been built to carry off the smoke and gases arising from the burning refuse. Mr. M. H. Braden stated this morning that the building would cost when completed in the neighborhood of $22,000.

New Westminster, B.C.—Dredging the bar at the mouth of the Pitt River will begin within a few days, when the Pacific Dredging Company, who have secured the contract, will put their big suction dredge, Robson, at work, with its attendant outfit. Arrangements have been made by the company for depositing the material dredged on the lower end of Douglas Island. A channel 300 feet wide and 15 feet deep at low water will be dredged by the removal of nearly two million yards of silt and sand.

Ottawa, Ont.—It is stated that trains will be operated this winter on practically the whole stretch of the N.T.R. from Cochrane to Moncton. Now that steel has been laid, contractors' trains, which have been serving the mills and colonists, both east and west of Cochrane, and also between Quebec and the New Brunswick boundary, will be of service to the public, on both of these sections of the line, and to improve the condition of the track.

Ottawa, Ont.—The latest report concerning the progress of the N.T.R. from Moncton to Winnipeg is that this gap has been lined up save for the completion of the bridge over the second branch of the Megiskan River. The bridge is due to be finished by this time, and is at a point directly north of Ottawa. When the rails are laid over this bridge the whole line, except the Quebec bridge, will be connected not only throughout the eastern division, but also from coast to coast, save for 200 miles on the Grand Trunk Pacific section in British Columbia. Up to date the eastern section has cost $165,000,000 inclusive of shops and roundhouses.

Sunderland, B.C.—Messrs. Bartram and Sons, Sunderland, have completed a shelter-deck steamer, with a deadweight carrying capacity of about 8,000 tons, equipped with engines of 26-inch, 43-inch, 67-inch, and 48-inch stroke, and with three single-ended boilers. It has been sold and will be delivered in December to the Royal Mail Steam Packet Company, London, Eng.

Toronto, Ont.—Excellent progress is reported upon the construction of the Central Technical School Building, Toronto. The excavation work has been entirely completed, and two of the largest size concrete mixers are working continuously on the heavy concrete work around the boiler house section. The Dominion Bridge Company has commenced the erection of steel, and Messrs. Ross and Macdonald, the architects, report that 450 tons of steel have been delivered. The masonry has been once more begun at the north end of the building; the superintendent of the Keystone Fireproofing Company is making preparation for the laying of floors; the brick work alone being held back by the slow delivery of material.

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Canada.—Bernard Hausheer, can-manipulating machines; Bernard Hausheer, cap-soldering machines; Bernard Hausheer, solder-placing machines; Thos. D. Kelly, flexible compositions; Olof Soderlund, evaporation, distillation and similar operations; Alfred C. Clayton, water heaters; John F. Staley, safety mechanism for the winding gear of coal pits and the like. Ernest R. Lee, valve tools; Erich Ebler, processes for preparation, isolation and enrichment of radium and other radio-active substances; Albert C. Gee, rail joints; Horace H. C. Sintzenich, rail joints; Walter Broadbridge and A. L. Howard, apparatus for ore concentration; H. H. Greenway and A. H. P. Lowry, ore concentration.

United States.—James R. Calder, railway rails; Sidney E. Trout, connecting means for locomotive pilots and foot boards.

MONTREAL MARKET LETTER

Montreal, November 8th.

The local iron and steel trade is feeling somewhat more cheerful insofar as relates to particular companies, but in the matter of the general position it may be doubted if the situation has improved. The situation as respects the financing of the Dominion Steel Corporation is not quite so depressing. The financial statement for the second quarter of the fiscal year of the company is all that could be asked for, showing, as it did, an increase for the half year of half a million dollars in the matter of net earnings, as compared with the first half of the previous year, and holding out a prospect that the year might, under similar conditions, wind up with a million increase. Also, it is reported that the financing negotiations in London are making good progress and that it will not be necessary to pass the dividend on the common stock. So far as the other large basis iron and steel industry, the Nova Scotia Steel and Coal Company, is concerned, the publication of the October output has produced a most favorable impression, the company having broken all previous records in respect to steel production.

In spite of the above, it is recognized that the future is uncertain. Car companies and other large industries are still operating regularly, but the activity is due to contracts placed some time ago, rather than to those placed of late. It is admitted without question that there has been a falling off in orders as compared with a year ago and the prospects are at the moment that the works will not be so busily employed during the coming year. Nevertheless, the feeling is that enough business will be forthcoming before long to ensure the operation of the plants for some time to come.

The depressing influence seems to be coming from outside in large part. From Germany and England come advices of a falling-off in industrial activity and from nearer at hand—the United States—is the report that prices are falling lower and lower and that railways are not placing their orders. The question which is still agitating the trade here, is the extent to which this will eventually affect the Canadian market. The answer must wait on time. Meantime, prices hold steady.

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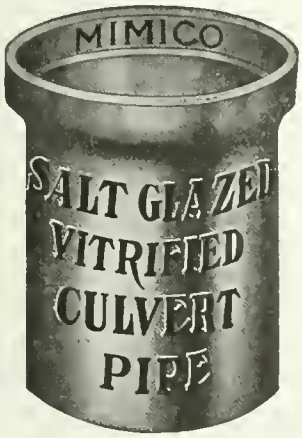

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TENDERS CALLED FOR

Sealed tenders addressed to the undersigned and endorsed "Tender for Wharf and Warehouse at Richard's Landing, Ont.," will be received at this office until 4 p.m., on Tuesday, December 2, 1913, for the construction of a Wharf and Warehouse at Richard's Landing, St. Joseph Island, Algoma District, Ontario.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the District Engineer's offices, Sault Ste. Marie, Ont.; Confederation Life Building, Toronto, Ont., and on application to the Postmaster at Richard's Landing, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 p. c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By Order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, October 31, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—48268.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

CANADIAN GOVERNMENT RAILWAYS.

HALIFAX OCEAN TERMINALS RAILWAY, HALIFAX, N.S.

CALL FOR NEW TENDERS.

Sealed tenders addressed to the undersigned and endorsed "Tender for Docks, First Unit, Contract No. 3," will be received at this office until 12 o'clock noon, Thursday, November 20, 1913, for the construction of about 6,500 lineal feet of quay wall, foundations for buildings, sewers, dredging of harbor to a depth of 45 feet at low water and filling reclaimed areas.

Plans and specifications and form of tender may be seen and full information obtained at the office of the General Manager, Moncton, N.B., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Halifax, N.S.

The right is reserved to reject any or all tenders.

By Order.

L. K. JONES,
Assistant Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 30th October, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—50200.

Sealed tenders addressed to the undersigned, and marked on the envelope "Tender for 200-ton Mechanical Coaling Plants with Sandhouses," will be received at the office of the Commissioners of the Transcontinental Railway at Ottawa, Ontario, until 12 o'clock noon of the 7th day of January, 1914, for the construction and erection complete, in accordance with the plans and specifications of the Commissioners of six 200-ton Mechanical Coaling Plants with Sandhouses complete, to be erected at the following points on the line of the National Transcontinental Railway as set forth below, viz:—

One at Monk, P.Q.	Mile	385.2
One at Bridge, P.Q.	"	460.6
One at Fitzpatrick, P.Q.	"	588.2
One at Parent, P.Q.	"	705.3
One at Doucet, P.Q.	"	806.4
One at O'Brien, P.Q.	"	915.4

Plans may be seen and forms of tender and specifications obtained at the office of Mr. W. J. Press, Mechanical Engineer, Ottawa, Ontario, and at the offices of Mr. A. E. Doucet, District Engineer, Quebec, and Mr. T. S. Armstrong, District Engineer, Cochrane, Ont.

Persons tendering are notified that tenders must be made on the printed forms supplied by the Commissioners, and that each tender must be signed and sealed by all the parties to the tender, and witnessed, and be accompanied by an accepted cheque on a Chartered Bank of the Dominion of Canada, payable to the order of the Commissioners of the Transcontinental Railway, for a sum equal to five per cent. (5 per cent.) of the amount of the tender.

The cheque deposited by the party whose tender is accepted will be deposited to the credit of the Receiver-General of Canada as security for the due and faithful performance of the contract according to its terms. Cheques deposited by parties whose tenders are rejected, will be returned within ten days after the signing of the contract.

The right is reserved to reject any or all tenders.

By Order,

P. E. RYAN,
Secretary.

The Commissioners of the Transcontinental Railway.
Dated at Ottawa, Ont., November 3rd, 1913.

Newspapers inserting this advertisement without authority from the Commissioners, will be not paid for it.—50357.

TOWN OF YORKTON, SASKATCHEWAN.

TENDERS FOR DIESEL ELECTRIC MACHINERY.

Sealed tenders marked "Tenders for Diesel Electric Machinery," addressed to T. F. Acheson, Secretary-Treasurer, Town of Yorkton, Sask., will be received up to 12 o'clock, Monday, 22nd December, 1913, for the supply and delivery of one 500 b.h.p. combined unit. Specifications and all information may be obtained upon application to M. M. Inglis, Electrical Engineer, Yorkton. The lowest tender not necessarily accepted and the right is reserved to reject any or all tenders.

T. F. ACHESON,
Secretary-Treasurer.

(For further Tenders see page 88.)

MEXICAN EAGLE ASPHALT

TRADE MARK

Refined to definite standards

Every barrel guaranteed uniform

Harrow Street, Winnipeg, paved with Mexican Eagle Asphalt.

Delivered to meet the specifications of the American Society for Municipal Improvements, the Association for Standardizing Paving Specifications or any other standard specifications

Samples, prices, analyses, etc., on request.

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

TENDERS CALLED FOR

TENDERS FOR IRON POSTS.

Sealed tenders addressed to the undersigned and endorsed "Tenders for Iron Posts," will be received at the Department of the Interior, up to noon of the 1st day of December, 1913, for the furnishing of fifteen thousand small and five hundred large iron posts for use on the survey of Dominion Lands, to be delivered at Edmonton on or before the 31st day of January, 1914.

Forms of tender and detailed information may be obtained from the Surveyor-General of Dominion Lands, Ottawa.

The tender must be accompanied by an accepted cheque on a chartered Canadian bank for the sum of two hundred dollars, payable to the order of the Deputy Minister of the Interior. This cheque will be forfeited if the party whose tender is accepted declines to enter into a contract to deliver the posts or fails to carry out the contract. If the tender is not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

Newspapers copying this advertisement without authority from the Department will not be paid.

L. PEREIRA,
Secretary.

Department of the Interior,
Ottawa, October 31st, 1913.

TENDERS FOR MACHINERY AND EQUIPMENT.

Tenders will be received by the Bowness Improvement Company at their offices, 202 Eighth Avenue West, Calgary, Alberta, until 5 p.m., December 31, 1913, for the following machinery and equipment:—

"L." One 200 k.w. Traction Motor Generator.

"M." One four panel Switch Board.

"N." One 250 k.v.a. Generator.

"O." One Vertical Single Acting Multi-Cylinder Gas Engine.

Bidders must enclose certified cheque in the amount of 5 per cent. of their tenders. Cheques of unsuccessful tenderers will be returned immediately after contracts are awarded. Specifications may be obtained from the engineer, and may be seen in the offices of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg, 62 Church Street, Toronto and 628 Transportation Building, Montreal.

The lowest or any tender not necessarily accepted.

T. L. TURNBULL,
Consulting Engineer,
202 Eighth Avenue West,
Calgary, Alberta.

TENDERS FOR BITULITHIC PAVEMENT.

Sealed Tenders plainly marked as to contents will be received at the office of the undersigned, up to **Noon of Saturday, November 15th, 1913,** for the construction of Bitulithic Pavement on Russell Hill Road in the Township of York.

Plans, specifications and all necessary information may be seen at the office of Frank Barber, C.E., 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer.

Toronto, November 11th, 1913.

DEPARTMENT OF RAILWAYS AND CANALS, CANADA.

WELLAND SHIP CANAL.

SECTION No. 5.

NOTICE TO CONTRACTORS.

Sealed Tenders, addressed to the undersigned and marked "Tender for Section No. 5, Welland Ship Canal," will be received at this office until 12 o'clock noon on **Tuesday, November 18th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in Charge, St. Catharines, Ontario.

Copies of plans and specifications may be obtained from the Department on the payment of the sum of fifty dollars. To bona fide tenderers this amount will be refunded upon the return of the above in good condition.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor, which schedule will form part of the contract.

Contractors are requested to bear in mind that tenders will not be considered unless made strictly in accordance with the printed forms, and in the case of firms, unless there are attached the actual signature, the nature of the occupation, and place of residence of each member of the firm.

An accepted bank cheque on a chartered bank of Canada for the sum of $100,000.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
L. K. JONES,
Assistant Deputy Minister and Secretary.

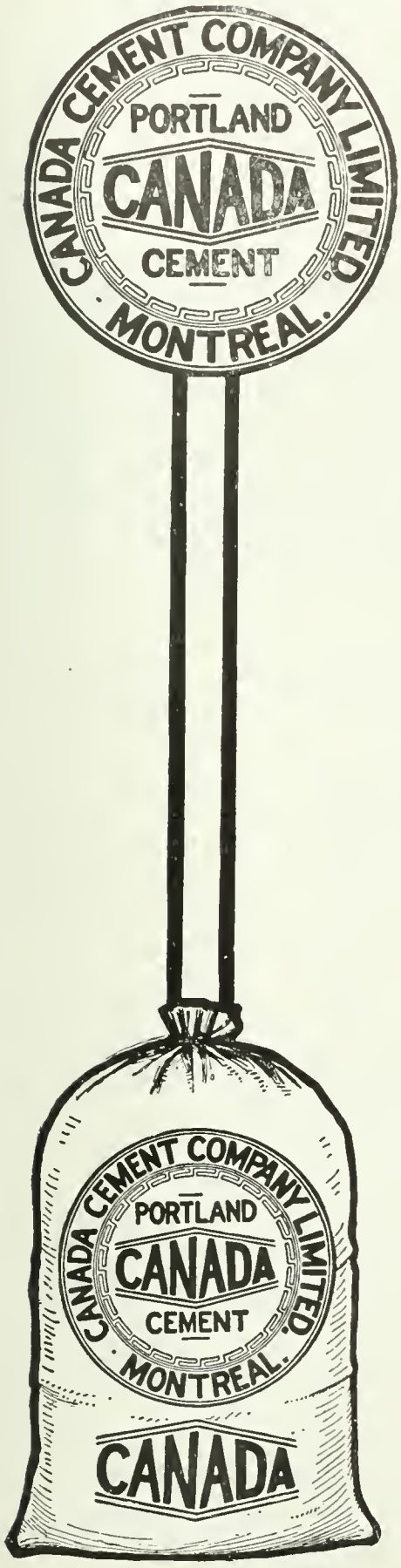
Department of Railways and Canals,
Ottawa, 29th October, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—50010.

(For further Tenders see page 86.)

MUNICIPAL OFFICIALS ARE INVITED TO FILE PLANS AND SPECIFICATIONS OF PROJECTED WORK AT ANY OF THE **CANADIAN ENGINEER** OFFICES — IT WILL BE FOUND A CONVENIENCE TO CONTRACTORS AND WILL RESULT IN MORE AND BETTER BIDS BEING SUBMITTED

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Second-Hand Machinery

Advertisements under this heading three cents per word per insertion, if not "displayed." Minimum 50 cents per insertion.

Contractors' Machinery For Sale Or Rent

We have in stock the following second-hand equipment for immediate delivery.

Get further details and prices.

1 - 7" x 10" double cylinder, double drum steam hoist
1—6½" x 8" double cylinder, single drum steam hoist.
1—No. 2 Ransome concrete mixer.
1—No. 3 Ransome concrete mixer.
5—6 ft. Ransome concrete carts.
1—8"x 10"x 8" steam driven air compressor.
1—6" x 5" x 7" steam driven air compressor.
1—6" belt driven centrifugal pump.
1—5" belt driven centrifugal pump.
1—15 H.P. semi-portable boiler on skids.

H. W PETRIE, LIMITED
General Machinery Dealers. TORONTO, Ont.

FOR SALE.—One 35 h.p. gas engine, in good condition, suitable for city or natural gas. Apply Box 1505, General Post Office, Winnipeg.

WANTED.—Duplex Steam Pump, size 17 by 10 by 12. Slight variation in dimensions not detrimental. J. L. Millard, Aylmer, Ontario.

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.—Assistant Engineers, Transitmen, Levellers, Rodmen, Chainmen, Inspectors and Draftsmen for all branches of engineering work. We make no charge to enroll you on our books. Send for application form. Civil Engineer's Employment Bureau, P.O. Box 62 Station "B.," Montreal.

CHIEF ENGINEER.—An excellent opportunity offered to an experienced engineer to connect with an established Consulting Engineering and Construction Corporation, based on co-operative plan; offices in Cleveland, Detroit, Buffalo and New York City. The position requires a man to take complete charge of the mechanical and electrical departments. Highest references and $1,500 investment required. Contract with salary, commission and expenses guaranteed. Address Box 174, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

STENOGRAPHER.—Experienced in engineering correspondence, estimating and accounting, desires position, preferably as secretary. Gilt-edged references. Please address, Box 168, *The Canadian Engineer*, Toronto.

ENGINEER—Long experience in erecting and running steam and electrical installations of high capacity (in charge), desires position in the above, or as master mechanic. Technical knowledge. Just finished construction work. All round and skilful. Highest references. Box 176, *Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

IN THE MATTER of Canadian Re-Issue Letters Patent 147,858, dated November 7th, 1911, and issued to William Arthur Bone, James William Wilson and Cyril Douglas McCourt, for steam generation, feed water heating and the heating of liquids generally. Take notice that the Invincible Renovator Manufacturing Company, Limited, of 81 Peter Street, Toronto, Ontario, Canada, have commenced manufacture of apparatus for the purpose of steam generation, feed water heating and the heating of liquids generally, covered by said letters patent, and are prepared to supply any demand for the same at a reasonable price. Ridout and Maybee, 59 Yonge Street, Toronto, attorneys for Bone, Wilson and McCourt.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patents Nos. 90234 and 90235 granted on November 29th, 1904, to William A. Lawrence, of New York, U.S.A., for rubber extraction, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, 53 Queen Street, Ottawa; Russel S. Smart, resident.

FOR SALE OR LEASE United States and Canadian Patents Nos. 872073 and 107427 respectively for improvements in the design of filters for water supply, or sewage disposal, the principal of which has been favorably commented upon by the technical press of both continents, and is being gradually and inadvertently imitated in the design of modern works. Particulars on application to the Proprietor, Box 248, Red Deer, Alberta, Canada.

NEW INCORPORATIONS.

Coleman, Alta.—Pelletier Lumber Company, Limited, $100,000.

Mundare, Alta.—The Mundare Mercantile Company, Limited, $15,000.

Saskatoon, Sask.—The Metal Shingle and Siding Company of Saskatoon, Limited, $500,000.

Newcastle, N.B.—Miramichi Dredging Co., Limited, $4,350. W. H. Belyea, C. C. Hayward, J. Ferguson.

Winnipeg, Man.—Winnipeg River Power Company, Limited, $1,000,000. E. Frith, C. Whitefield, A. P. Scott.

Montreal, Que.—The Belair Tank and Tower Co., Limited, $20,000. T. Belair, H. Gougeon, J. R. Constantineau.

Salmon Harbor, N.B.—The Salmon Harbor Coal Company, Limited, $150,000. G. Sergeant, Jr., R. McClain, W. F. Williams.

Sault Ste. Marie, Ont.—Northern Building-Material and Iron Co., Limited, $50,000. J. Matheson, A. A. Stoness, A. R. Johnston.

Ste. Agathe dea Monts, Que.—Ste. Agathe Lumber and Construction Company, Limited, $300,000. L. E. Parent, J. A. Pare, F. Forget.

Winnipeg, Man.—Goold Engineering and Supply Co., $20,000. J. L. Stanley, Crossen, W. A. Goold, P. R. Crossen. Shipman Electrical Co., Limited, $100,000. C. S. Shipman, S. T. Smith, E. T. Leech. Eastern Terminal Elevator Co., Limited, $250,000. J. A. Richardson, A. C. Ruttan, H. Gauer. Builders' Association of North Winnipeg, Limited, $5,000. M. Koffman, O. J. Lipshitz, M. Rudin. The Canada Brick and Coal Producers, Limited, $250,000. J. F. Walker, A. Farquhar, L. Swanson. The Canon Lake Lumber Co., Limited, $100,000. P. P. Elliott, W. L. McIntosh, G. A. Elliott.

Manufacturing 48" Pipe at Berlin, Ontario, Canada.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, November 10th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron, $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25 lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4 30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21.25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions, as laths, X, $2 10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8 50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized: ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22 50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57 50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, November 12th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3 55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.60; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40 60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16-25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, November 11th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3-16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7.16, $4.75; ½, $4.50; 9-16, $4.50 ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30 22, $4.30; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American 18 to 20 gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full cnil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in. $3.35 base; machinery, $3 base; share, $4 50 base; share crucible, $5.50; cast share steel, $7.50; tire caulk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Nov. 20, 1913

Contents of this issue on page 743

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

NOTES ON PROVINCIAL LAND SURVEYING

CALCULATION OF COMPASS-SURVEYED AREAS BY DOUBLE MERIDIONAL DISTANCES—PLOTTING BY THE USE OF CO-ORDINATES—RESPECTS IN WHICH THE PRACTICE OF SURVEYING HAS CHANGED

By J. A. MACDONALD, Ottawa, Ont.

IT is generally conceded among surveyors that there is but one absolutely correct method of calculating the area of a compass-surveyed plot of ground. In compass surveying there is necessarily the intrusion of a number of errors, the number generally depending upon the number of courses. This may be readily explained. Five minutes is the closest reading that any surveyor may expect from the compass, and frequently the variation may be ten or even fifteen minutes. In one mile, therefore, where ten minutes mean twenty-three links, the liability of error becomes comparatively great, considering the fact that errors often occur in reading with a good transit, where there is fine precision, to the extent of thirty seconds, and with levels in good order. With such a liability of error, therefore, one may not expect to tie on the starting point of a compass survey. In plotting, it is found necessary to balance the errors of each course, i.e., to divide them *pro rata* among the courses according to length. This is done most satisfactorily by Double Meridional Distances.

Double Meridional Distances.—In plotting a compass-survey which, by the way, must be done by latitudes and departures, there is a favorable feature in the compass which the transit does not possess, that is noticeable. If there is an error in one deflection angle read from the transit, this error arising from improper levelling of the instrument, or its being set up on marshy or infirm ground, all the following courses are intensified in error, a succeeding course depending on the course just taken as a back-sight. With a compass an error in one course does not necessarily lead to an error in the succeeding courses, every course being independent of the other. In plotting a compass survey, therefore, latitudes and departures must, in nearly all cases, be taken, rather than measurements by deflection angles. This, of course, is the proper method of plotting a transit survey also, but it is not always used on account of the extra labor involved in calculating the latitudes and departures. With a table of latitudes and departures, given to minutes, as are now obtainable, however, it is not a laborious task.

The parallel ruler used to be an indispensable requisite of the old compass surveyor. This is found very convenient in plotting—in fact, it is almost the *sine qua non* of a compass surveyor's instruments. Set squares are now used more generally and particularly for railway work. It might be stated that the method of latitudes and departures is now mostly used in plotting railway plans. But in plotting railway plans the meridian, whether magnetic or astronomical, is not passed through each station as is usually done when plotting a field survey made by a compass, and using the parallel ruler, and the protractor for plotting. These two instruments go hand in hand, one being a complement of the other.

There is another method, and the one mostly used in plotting railway plans by latitudes and departures. This is by the use of the set squares and the scale; no protractor being used. On the National Transcontinental Railway, plotting the traverses and the locations with a protractor was forbidden. The latitudes and departures, sine and cosine, being calculated, the latitude was scaled from the last station, using the set of squares to parallel the meridian on the plan and precisely at right angles with it, the distance measured and marked. From this point, and precisely at right angles, the departure was scaled and marked, and the intersection of these lines indicated the new station. This method, while it would answer with a compass survey, is seldom, if ever, used; at least, it was not used by the old surveyors. The protractor and the parallel ruler were usually the instruments used for plotting, and are, as already stated, the most convenient instruments for plotting surveys made with the compass to-day.

Much more attention was given by the old compass surveyors to plotting and lettering than is given by present-day surveyors. It is interesting to note the beautiful work (now considered altogether unnecessary) of some of the old surveyors, which is to be seen in the land office at Ottawa. There must necessarily have been a good deal of time taken over this work, which one would now be ready to call "lost time," but in those days time was not such an important factor as in these strenuous times, and the mighty rush and competition existing at present does not warrant taking any more time over a plan than is absolutely necessary. There is no time now for artistic work, old English letters and elaborate north prints. Stamps and stencils, and even the typewriter, do considerable of the lettering to-day.

Taking the plot, shown on page 498 of *The Canadian Engineer*, (Fig. 2) the plot, Fig. 1, is how it looks when plotted with the protractor and parallel ruler. It will be seen that the last course does not tie to the starting

point, nor will any compass-survey tie unless, perchance, the errors balance. To join the line of the last course with the first will change the bearing of that course, and that would make it different to what it is on the ground, and would vitiate the plan. What must be done, is to balance all the courses, deducting or adding, as the case may be, a little to all of them. This cannot be conveniently or correctly done except by the method of Double Meridional Distances, as explained below.

Table I.

Stations.	Bearing.	Distance.	Latitudes. N.	Latitudes. S.	Departures. E.	Departures. W.
1	S. 63° 15′ E.	11.25		5.06	10.04	
2	N. 80° 00′ E.	11.03	1.91		10.86	
3	S. 50° 10′ E.	12.09		7.74	9.28	
4	N. 16° 00′ E.	6.10	5.86		1.68	
5	N. 42° 30′ E.	13.50	9.94		9.11	
6	N. 70° 20′ E.	11.38	3.85		10.71	
7	N. 3° 15′ E.	9.10	9.08		0.59	
8	N. 34° 30′ W.	10.45	8.61			5.91
9	N. 75° 15′ W.	28.45	7.24			27.51
10	S. 32° 30′ W.	38.15		32.17		20.49
Totals	.....	151.50	46.49	44.97	52.27	53.91
			44.97			52.27
	Error in latitude	1.52	Error in depart.	1.64		

Referring to Table I., it is prepared as follows: By means of a traverse table, or by sines and cosines, find out the latitude and departure for the angle of each course. By adding up the four columns find the difference between the N. and S. columns and also the E. and W. columns. In this instance there we find that the N.'s are 1.52 greater than the S.'s, and that the W.'s are 1.64 greater than the E.'s, causing a serious closing error as plotted by the protractor. (Fig. 1).

To divide the errors prepare a table precisely the same as the foregoing, except that the horizontal spaces are farther apart, and that the adding up of the old N., S., E. and W. columns are omitted. The additional columns are made subsequently. The new table is as Table II.

We have found by the first table that the N.'s and the W.'s are too long, and therefore must be shortened; while the S.'s and E.'s must be lengthened, all of them in the following proportions,—Sum of all the distances: any given distance:: total error of latitude or departure: error of latitude or departure of given distance.

Thus commencing with the latitude of distance 1, we have, as the sum of all the distances, = 151.50: distance (1) = 11.25:: total latitude error, = 1.52: latitude error of distance (1) = .11.

Now, as the latitude of distance, or side, 1 is south, it must be lengthened, so it becomes = 5.06 + 11 = 5.17, as figured out on the new table.

Table II.

Station.	Bearing.	Distance.	—Latitudes— North. (+)	—Latitudes— South. (—)	—Departures— East. (+)	—Departures— West. (—)	Total latitude.	Total departure.	Double meridional distance.
1	S. 63° 15′ E.	11.25		5.06	10.04				
				.11	.12				
				5.17	10.16		— 5.17	+10.16	10.16
2	N. 80° 00′ E.	11.03	1.91		10.86				
			.11		.12				
			1.80		10.98		— 3.37	+21.14	31.30
3	S. 50° 10′ E.	12.09		7.74	9.28				
				.13	.14				
				7.87	9.42		—11.24	+30.56	51.70
4	N. 16° 00′ E.	6.10	5.86		1.68				
			.05		.07				
			5.81		1.75		— 5.43	+32.31	62.87
5	N. 42° 30′ E.	13.50	9.94		9.11				
			.14		.14				
			9.80		9.25		+ 4.37	+41.56	73.87
6	N. 70° 20′ E.	11.38	3.85		10.71				
			.12		.12				
			3.73		10.83		+ 8.10	+52.39	93.95
7	N. 3° 15′ E.	9.10	9.08		0.59				
			.10		.10				
			8.98		0.69		+17.08	+53.08	105.47
8	N. 34° 30′ W.	10.45	8.61			5.91			
			.11			.11			
			8.50			5.80	+25.58	+47.28	100.36
9	N. 75° 15′ W.	28.45	7.24			27.51			
			.29			.30			
			6.93			27.21	+32.51	+20.07	67.35
10	S. 32° 30′ W.			32.17		20.49			
				.34		.42			
				32.51		20.07	0.00	0.00	20.07

Sum of sides	151.50
Sum of northings	45.55
Sum of southings	45.55
Sum of eastings	53.08
Sum of westings	53.08

Again, we have for the departure of distance 1: Sum of all the distances, 151.50: distance 1, 11.25:: total departure error, 1.64: departure error distance 1, .12.

As the departure of distance 1 is last it must also be lengthened, hence it becomes 10.04 + 12 = 10.16, as figured out on the new or second table.

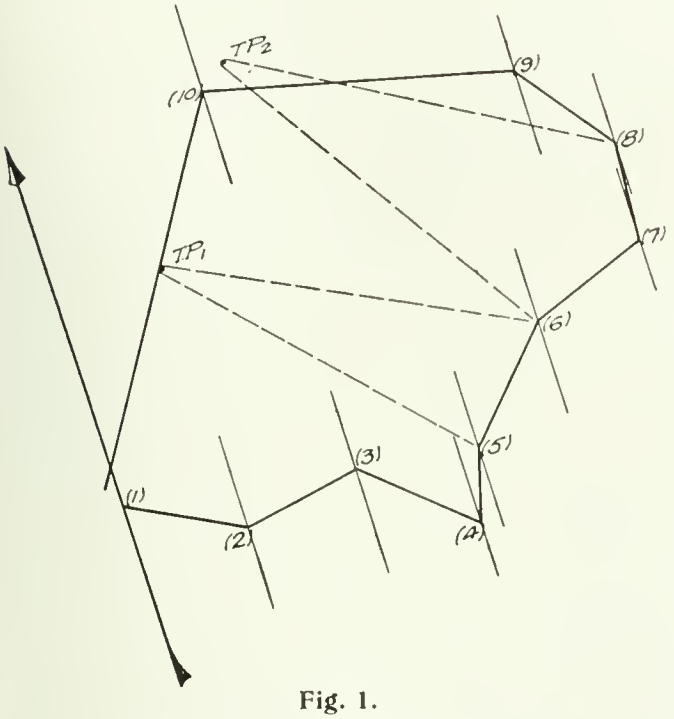


Fig. 1.

Proceeding thus with each side, we obtain all the corrected latitudes and departures shown in the new table. If we now add up the four columns of corrected N. S. E. W. values, we find that the northings equal the southings, and the eastings equal the westings, thus proving that the work is now correct. The corrected latitudes and departures must necessarily change the bearings and distances of every side, but without knowing either of these we can plot the survey by means of the corrected latitudes and departures alone, and without the use of the protector at all. When the closing error is small this is unnecessary, but when the closing error is large, as in this case, in balancing the errors of latitudes and departures, the surveyor usually interprets those errors by inspection, and without taking the trouble of calculating them. By judicious inspection the total errors can be approximately apportioned to each course in both latitude and departure.

Plotting by the Methods of Co-ordinates.—The method of plotting by co-ordinates, i.e., traverses may be performed in two ways: First, the stations shown in Fig. 1 might be laid down from the columns of latitudes and departures, but it would be necessary, in order to plot them, to draw parallel meridians through each station, as shown in Fig. 1, and to lay down each successive station from that which had been plotted before it. As each operation will thus be referred to a new point, in itself dependent on that which preceded it, the sources of error become increased with the number of fresh stations to be plotted. But by referring each station to the meridian of Station 1, both for latitude and departure, as in Fig. 2, any error which may occur in laying down one point is not carried on through the series, the fixing of that point being an isolated operation, independent of every other in the survey. The advantage of such a mode of protection is too apparent to need further comment.

Instead, therefore, of picking off these northings and southings in succession from each other, it is much more proper to prepare the column of total latitudes (column eight) showing how far each of the points, 2, 3, etc., is north or south from Station 1. This being done, the points can be located on Fig. 2, north and south from 1 without moving the scale each time and, of course, with greater accuracy. Such a column is readily formed. Its accuracy is proved by the final result being Zero. A similar column of total departures is prepared (shown in the ninth column of the table) which gives the distances of the points 2, 3, 4, etc., each from the meridian line. Thus, starting from point 1 with side 2, the work likewise proves itself by the final result being Zero.

Starting from the meridian, passing through 1 and the point 1, the first station, mark a point 2′ southward on the meridian, 517 links, and from 2 on a line perpendicular to the meridian, mark a point to the west 1,016 links, which will be station 2, 1—2 representing the amount of southing, and 2′—2 the amount of westing of the point, as referred to the first station 1. Similarly for the others, join stations 1—2, 2—3, etc., which will represent the distance measured, and in the present case the complete lines of the boundary. The details of the survey and the features of the country, offsets, etc., where necessary, are supposed to be put in, as usual, from the field book. The practised surveyor will find the above description sufficient to enable him to plot boundaries or maps, and their lines of road.

In all tables of this kind it is usual to make north and east, plus (+) and south and west minus (—). The use of the symbols save a lot of work. For instance, one column answers instead of two in the table.

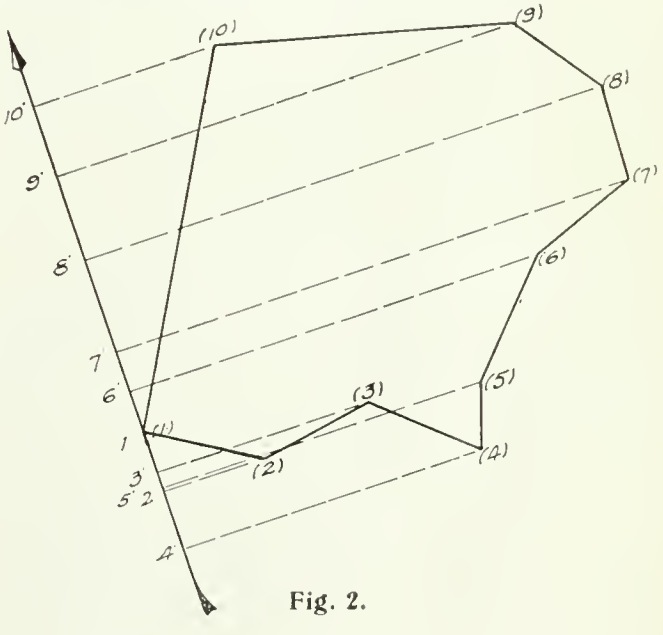


Fig. 2.

Calculating the Area.—The adaptation of the tables to the calculation of areas may be explained as follows: In calculating the area of an enclosure or boundary survey, it is necessary to assume a meridian to which to refer the departures of all stations in the survey. This should in all cases be that of the most westerly station in a boundary survey, as the north differences of latitude become then all positive, and the south all negative multipliers.

Column nine in Table II. contains the departures of each station on the boundary east of the meridian of Station 1, which is stated as the datum, because it is most westerly of the whole survey.

Column ten is introduced solely with a view to facilitating the computation of the areas, by bringing the numbers to be multiplied together into juxtaposition. This column is derived from column eight by simple addition. All operations are performed with such facility that, with the exception of taking out the traverses which occupies a somewhat longer time, the whole table may be filled up in a few minutes.

Table III.

Station	Northings	Southings	Double Meridional Dist.	N. Products	S. Products
1		5.17	10.16		52.527
2	1.80		31.30	56.340	
3		7.87	51.70		406.879
4	5.81		62.87	365.274	
5	9.80		73.87	723.926	
6	3.73		93.95	350.433	
7	8.98		105.47	947.120	
8	8.50		100.36	853.060	
9	6.93		67.35	466.735	
10		32.51	20.07		652.475
				3762.888	1111.881

Subtracting 3762.888 N. from S. products, 1111.881, equals 2651.007, divided by 2 equals 1325.503 square chains, equals 132.55 acres, plus offsets.

It now remains only to calculate the corrected bearings and distances, or length of the sides of the survey, all of which are necessarily changed by the adoption of the corrected latitudes and departures. This operation will only be necessary where the changes are large. To find the bearing from any station, divide its departure (E. or W.) by its latitude (N. or S.); in the table of natural tangents find the quotient, the angle opposite it being the required angle of bearing. Thus, for Course 1, we have $\frac{5.17 \text{ S.}}{10.16 \text{ E.}} = .5088 =$ natural tangent, opposite which is the required angle, 63° 02′. The bearing, therefore, is S. 63° 02′ E.

Again, for the distance or length of any side, from the table of natural cosines take the cosine opposite to the angle of the corrected bearing, divide the corrected latitude (N. or S.) of the side by the cosine, giving the required distance. It will then be necessary to make a table similar to the following:

Table IV.

Stations.	Bearing.	Distance.
1	S. 63° 02′ E.	11.40
2, etc., etc.	.....	.....

This table will contain all the corrections of the foregoing survey, and if the bearings and distances are correctly plotted, they will close perfectly.

Postmaster-General Samuel, of London, Eng., is inviting applications on tender for the construction of the second of three high-power wireless stations to form an Imperial chain from contractors able to satisfy experts by a practical demonstration of the efficiency of their system. The demonstrations will be required to indicate the capacity of the respective systems to carry on continuous and efficient communication, day and night, over a distance of 2,000 miles.

RESTORING THE TRANSCONA ELEVATOR.

THE contracting firm of Barnet-McQueen Company, Limited, of Minneapolis, who designed and constructed, last year, the 1,000,000-bushel grain elevator for the Canadian Pacific Railway at Transcona, Man., which structure sank and listed to an angle of about 30° from the vertical, on October 18 and 19, when almost filled with grain, have announced a plan by which they hope to fully restore it to its proper upright position. The undertaking will be one of the most unique and unusual of any ever attempted in Canada, and will be observed with great interest.

The elevator consists of a working-house and a reinforced concrete bin-house consisting of 65 circular bins of 14 feet 4 inches inside diameter, and 90 feet depth, arranged in five rows of 13 bins each, and 48 interstice bins, also used for grain storage. The binhouse is built on a foundation which is in the form of a floating monolithic reinforced concrete slab, 195 x 77 feet in area, resting upon a soil of stiff clay, about 12 feet below the surface of the ground, and with the clay extending to a depth of 45 feet or more below the surface. Test loads upon the clay indicated a bearing strength of four to five tons per sq. ft. at the time the slab was built, which was in July, 1912.

Readers will remember a previous announcement that on Saturday, October 18th, the huge structure, practically full of grain, began to settle gradually, the ground for a distance of 25 feet or more on the east, north and west sides of the binhouse, heaving up for about 6 feet. During the 24 hours the movement continued until finally an inclination of about 30°, as stated, was reached. The foundation line of the eastern portion then rested about five feet above its proper level, while the opposite side sunk in the neighborhood of 30 feet. While the listing was in progress, the roof structure and the conveyer cupola slid off and were demolished. The removal of this portion of the load apparently checked the movement of the foundation.

It is interesting to note that the structure itself is but little damaged. The bins, containing practically 1,000,000 bushels at the time, remained intact, and it is just announced that practically all of the wheat consigned for lake shipment before the close of navigation, has been removed without loss through waste or fermentation due to the possible intrusion of ground water. This has been accomplished by tapping the bins through the sides, and erecting temporary conveyers between the bins and the railway cars. The removal progressed at the rate of about 40 carloads per day.

Mr. J. G. Sullivan, chief engineer of the Canadian Pacific Railway, at Winnipeg, has expressed himself of the opinion that neither the design nor construction of the building have been at fault in any way, and that the unfortunate occurrence, due to the crushing out of the foundation sub-soil, was ultimately caused by the shifty material below the 30 to 40 feet of clay with which Winnipeg and its vicinity are underlaid. This material makes it almost impossible to go down below the clay even by sinking air caissons. Practically all foundations in the vicinity of Winnipeg are therefore of the floating type, and heavy structures have frequently been known to settle as much as a few inches. In the case of grain elevators, unusual care is always taken to have the grain distributed as evenly as possible to prevent eccentric loading.

Concerning the restoration of the elevator, the contractors are planning to excavate below the eastern portion, allowing it to sink and become perpendicular.

Powerful jacks will then be used to support the structure while the strengthening of the foundation is in progress. When this is completed the elevator will be allowed to rest upon the new surface, and repairs, including the steel roof structure and cupola, will then be made. It is estimated that it will cost approximately $30,000 to restore the structure.

MANITOBA'S LOG-DRAG COMPETITION.

THIS year the first, second and third prizes for gravel roads in the log-drag competition which was inaugurated four years ago under the auspices of the Manitoba Good Roads Association, went to the municipalities of Rockwood, Kildonan, and St. Paul, respectively. In the case of earth roads, they were awarded to Macdonald, Springfield, and Macdonald, in the order named. The winners received their awards at a banquet given by the association on October 29th, in Winnipeg, Mayor Deacon officiating at the presentation. The judges in the competition, who had presented their decision at a previous meeting, were Mr. C. F. Tallman, Street Commissioner of Winnipeg; Mr. A. McGillivray, Manitoba Highway Commissioner, and ex-Mayor Waugh of Winnipeg.

In the course of his remarks, the mayor suggested that it would be well for the municipalities to seriously consider the use of asphalt or concrete as a road material, and expressed his belief that their use would be better throughout the province than the building of any amount of clay roads with gravel surface. He also suggested that it might be more advisable to consider the abandoning of fixed survey lines in construction of new roads, with a view to carrying the roads along better locations, exchanging the road allowances with the land owners.

Hon. Dr. Montague, Minister of Public Works for Manitoba, in speaking of the good roads movement, referred with pride to the streets of Winnipeg, and declared that no city in eastern Canada or in the United States had made the progress in the matter of good streets that Winnipeg has made. He expressed his opinion that the subject of roads in Manitoba was almost entirely an agricultural problem, rather than a motor problem, and was of more importance than nine out of every ten agricultural questions under discussion to-day. It was the problem of bringing the farmer in closer touch with shipping facilities for his products.

Dr. Montague referred to the city of Winnipeg voting $13,000,000 for a new water supply, and $6,000,000 for the installation of a power plant, and intimated that a yearly grant from the Dominion Government of $25,000,000 for the construction of good roads throughout the country would be most timely.

Over 110 members of the association and farmers from surrounding municipalities were present at the banquet, presided over by Reeve Henderson, of Kildonan, president of the association.

At its meeting on October 3rd, the association drew up and sent on a resolution to the Union of Manitoba Municipalities, convening this month at Portage la Prairie,, requesting that the government take over the construction of all the leading highways in the province; that it levy a special tax of one mill on the dollar in the total assessment value of the province, and that the cost of construction be covered by a payment of one-half of the cost of the road from the fund so raised, the government to pay an additional 25 per cent. and the benefited property the remaining 25 per cent.

THE ADOPTION OF FUEL OIL.

THE rapidity with which fuel oil has been displacing coal in many lines of industry has become a point worthy of note the world over. Thirteen years ago oil as a competing fuel with coal was practically unheard of on this continent. The first experiment along the lines on which it has now become so important was the conversion in 1900 by the Southern Pacific Railway of one of their locomotives from the use of coal to oil. That was the beginning. At the present time oil-burning locomotives are operated exclusively upon 20,910 miles of line in the United States, and 587 miles in Canada; and, in conjunction with coal burners, on an additional 4,720 miles in the United States. Some idea of the enormous rapidity of the adoption of oil may be formulated when it is considered that a length of track capable of encircling the globe has been converted from the use of the one fuel to the other in such a short period of time.

The two chief sources at present are the vast fields in Texas and in southern California, as is well known. From the accompanying map it is seen that considerable development has taken place in Texas with lines reaching some distance northward, also in a westerly direction to Southern California. From Southern California the advance has been most pronounced, owing to the facility of water transportation along the coast, and to the expensive variety and unsatisfactory quality of the coal in the Western States.

In a recent article by H. Foster Bain on "Fuel Problems on the Pacific" the following facts were noted: Fuel oil is delivered from Alaska to Peru at prices giving it marked advantage over coal, not taking into consideration the incidental advantages of cleanliness, lower cost of handling, and decreased fire room expenses. Fuel oil is delivered on the Coast at 85 cents to $1 per bbl., equivalent to a cost of $3 to $3 50 per ton for coal, considering fuel value above 3 to 3½ bbls. corresponding in heating value to a ton of coal. The surplus above ground, over 40,000,000 bbls., the extent of territory developed, and the ease with which production is increased, give every assurance of continued supply at a reasonable price for years to come.

The use of oil for locomotive purposes is purely an economic question, depending on the relative cost of oil, coal, and electricity, except perhaps when oil is enforced by law owing to the necessity for fire protection. On the Pacific Coast practically all railway companies, and some who even own their own coal mines, have adopted oil, the use of which is almost as rapidly being taken up at sea, where its use is even more advantageous.

The general points favoring use of oil fuel in locomotives are:—

(1) Saving in time and labor in loading.
(2) Reduction of staff for handling.
(3) Increased cleanliness.
(4) More complete combustion and therefore greater efficiency.

To these may be added, in the case of marine use, a fifth and a sixth advantage—the saving of considerable room in the hold, and the reduction of boiler repairs. The latter would also seem to apply to locomotives, but from the report of A. E. Hudson, inspector for the Canadian Board of Railway Commissioners on the C.P.R. engines in British Columbia using fuel oil, we are lead to believe that such is not the case. According to Mr. Hudson,

since the conversion of these locomotives "a great many leaks have developed in the boilers, such as the crown bolts, and side sheets leaking badly."

It might here be interesting to note, in conjunction with the adoption of oil at sea, the comparative costs of coal and oil on the C.P.R. British Columbia Coast service steamship "Princess Victoria."*

Coal—	Per day.
100 tons @ $4.50	$450.00
9 firemen @ $55 a month	16.50
9 trimmers @ $45	13.50
Food for 18 men	7.56
	$487.56

Oil—	Per day.
344.17 barrels @ 90c.	$314.25
6 firemen	11.10
Food for 6 men	2.53
	$327.87

*From report of G. W. Dickie, published in "The Vancouver Province."

This comparison, together with the above remarks relative to the cost of oil, only applies to the Western States and British Columbia. The conditions in the east are entirely different. The distance from the oil fields and presence of coal in large quantities makes the latter the predominant fuel. The contrast between east and west is clearly shown by the map already referred to. Nowhere is oil used east of the Missouri and Mississippi Rivers, except in the Adirondack Preserve, where its use is enforced by law for fire protection. Relative to the cost of oil in the east, C. S. Sims, second vice-president

and general manager of the Delaware and Hudson Company, states that in 1910 oil for the locomotives of that company, working in the Adirondacks cost $57,260.33 at 2.25c. per gallon, or 28.33c. per engine mile, or $36,045.88 in excess of the cost of doing the work with coal. The cost per engine mile for coal during the same period was 10.46c. For 1912, oil cost $83,703.31, or an increased cost over coal of $56,454.96. For three years, 1910-12, the increased cost of using oil has been $119,077.09. He then states that for a much lower price a wonderfully effective patrol system could be installed. And this seems to be the consensus of opinion in the east, where oil is proposed for fire protection, though it is not disputed that the adoption of oil is much better than the best system of patrol. With the best possible safeguards applied to coal-burning locomotives, it is impossible to prevent sparks being thrown from the stack, whereas with oil there can be no danger except from a little red-hot carbon from the stack; and this can be avoided if the engineer is careful to introduce the "sand seam" at a place where fire would be impossible.

There seems to be no doubt that as a means for preventing the all too frequent forest fires oil fuel far surpasses coal. The question is, should the railways be forced to bear the whole additional cost? Several logging companies operating their own lines have adopted oil, finding that in the long run the advantage is tremendous, owing to reduction of fire loss alone. They are also using oil for donkey engines, and with the increased boiler efficiency have been able to greatly increase their output.

On the other hand, it is noteworthy that, owing to the increased price of oil fuel in the last few years, some companies have been forced to abandon it for coal, chiefly on some of their more easterly lines. Portions of the Rock Island, Sante Fe and 'Frisco roads have recently replaced some three thousand miles with coal burners. Abroad, also, the Australian government lines are abandoning oil because of its enhanced price, whereas at the same time another announcement demonstrating the progressive side of the movement is to the effect that "oil-burning locomotives are being considered for some of the government railways in India."

In conclusion, and extract from the report† of the Commission of Conservation shows the situation in Canada:

"In Canada, the Great Northern Railway is the pioneer among passenger lines. This line is using oil exclusively on its 115 miles of railway in the Cascade Division. This embraces all lines in the vicinity of the Pacific Coast.

"During 1912, the Canadian Pacific Railway established oil burners on its main line between Kamloops and Field, B.C., and on the Arrow and Okanagan branches, making a total of 338 miles. It is now announced that, during 1913, this line will extend the use of oil burners to cover the main line between North Bend and Vancouver, 129 miles, and the Mission subdivision, 10 miles. When this work is finished, the only portion of the main line of the C.P.R. in British Columbia not using oil fuel will be the portion between the eastern boundary of the province (Hector) and Field, 12 miles, and between Kamloops and North Bend, including the Nicola branch, 168 miles; total, 180 miles. The oil-burning portion of the line in British Columbia will then comprise 477 miles."

†Commission of Conservation, Canada, "Forest Protection in Canada," by Clyde Leavitt, M.Sc.F., 1913.

For those requiring more information on this subject than is contained herein, the report of the Commission of Conservation just issued (and upon which the above is largely based) will be of especial value. With this report in mind and several other articles which have been appearing in the scientific press from time to time during the past few years, a world-wide adoption of fuel oil at sea can safely be predicted, and on land in those vast areas over which fuel oil may be more readily obtained than coal. A very interesting point in connection with the fuel problem the world over is that coal is a far too valuable substance for consumption as in vogue at present, and that perhaps before long a new method of coal consumption may be introduced.

BRICK FOR COUNTRY ROADS.

IN Bulletin 23 of the U.S. Department of Agriculture, a treatise is presented on the construction and maintenance of brick pavements, with especial reference to their use on country highways. The authors are Vernon M. Pierce and Chas. H. Moorefield, chief engineer and senior highway engineer respectively of the Office of Public Roads. A brief sketch is given of the development of brick paving, followed by a description of the materials used for paving bricks, and their manufacture. The physical characteristics of these materials, and the methods in vogue for testing them are included. For a concise and authoritative treatment of the subject, readers are referred to this bulletin. We reproduce herewith some information contained in it, respecting the preparation, construction and cost of brick paving in rural districts.

The principal advantages which brick roads possess may be stated briefly as follows: (1) They are durable under heavy traffic conditions; (2) they afford easy traction and good foothold for horses; (3) they are easily maintained and kept clean; and (4) they present a pleasing appearance.

The principal disadvantage is the high first cost. The defects which frequently result from lack of uniformity in the quality of the brick or from poor construction are usually to be traced indirectly to an effort to reduce the first cost or to a popular feeling that local materials should be used, even when inferior.

In the preparation of the subgrade upon which a brick pavement is to be constructed, the essential features to be considered are thorough drainage, firmness, uniformity in grade and cross section and adequate shoulders.

Strong durable curbing should be supplied both on the sides and at the ends. Otherwise, the marginal brick will soon become displaced by the action of traffic and deterioration will spread over the entire pavement.

Satisfactory curbing may be constructed of stone, Portland cement concrete, or vitrified clay shapes made especially for this purpose. With stone the individual blocks should be not less than about 4 feet long and should have a depth of about 18 to 36 inches, depending on traffic conditions and on whether the curb is to project above the surface to form one side of the gutter. A thickness of 4 inches will ordinarily prove satisfactory. Stone curb should always be set on a firm bed of gravel, slag or broken stone, not less than 3 inches thick, and should be provided with a backing of the same material on the shoulder or sidewalk side.

Concrete curbs may be constructed alone or in combination with either a concrete gutter or a concrete

foundation. The advisability of constructing the curb in combination with the foundation, however, is doubtful. Concrete curbs should have approximately the same cross-sectional dimensions as stone curbs and should be constructed in sections not exceeding about 7 or 8 feet in length.

Vitrified clay curbing should be set in much the same manner as that described for stone curbing. The principal additional requirement is that, since vitrified clay is a lighter material than stone and the curb sections are ordinarily shorter, the bedding must be made correspondingly more secure in order to prevent displacement.

The proper type of foundation depends largely on the material composing the subgrade and the character of traffic for which the road is designed. Where the traffic is comparatively light and the subgrade is composed of some firm material which does not readily absorb water, a very satisfactory foundation may be constructed of broken stone or gravel filled with sand. Where the traffic is comparatively heavy, however, or where the material composing the subgrade is defective in any way, a monolithic concrete foundation should be used.

Gravel and broken-stone foundation may be spread in one or more courses, each of which should be from 5 to 9 inches thick before compacting. The stone or gravel should be clean, hard, tough and durable and should be graded in size between certain reasonable, fixed limits. It should be compacted in the usual manner by rolling with a power roller weighing not less than about 10 tons, and sufficient clean, coûrse sand to fill the voids should be spread and flushed into the foundation while the rolling is in progress. When complete the foundation should present a surface uniform in grade and cross section and parallel to the proposed surface of the finished pavement.

Concrete foundations are unquestionably better adapted for brick pavements than any other type. They are practically monolithic in form, nearly impervious to water, and possess a relatively high crushing strength. All of these qualities may be obtained with a relatively "lean" concrete if the subgrade has been properly prepared. Under ordinary circumstances a satisfactory foundation may be constructed of concrete composed of 1 part of Portland cement, 3 parts of sand, and from 5 to 7 parts of broken stone or screened gravel.

It is necessary to provide an adjustable cushion of some kind between the foundation and the brick for correcting any slight irregularities in the surface and to secure an even bearing for the brick. Sand has been found a most satisfactory material and is almost exclusively used. The proper thickness for this sand cushion will of course depend on the extent of the inequalities. Two inches has generally proved very satisfactory.

After the cushion is spread uniformly it should be thoroughly compacted by rolling with a hand roller weighing from 300 to 400 pounds, and any depressions which form should be corrected.

The brick may all be hauled and piled at convenient intervals along the sides of the roadway before grading is begun. Hauling over the finished pavement with wagons until it is complete and opened for traffic should be avoided. If the brick are delivered on the work as needed, they should be unloaded from wagons outside of the curb and carried to the pavers, either by hand or in wheelbarrows. Plank trackways should also be provided over the newly laid pavement for the wheelbarrows when they are used.

The brick should be laid on edge and in uniform courses running at right angles to the line of the pavement, except at intersections; and in order to "break the joints" each alternate course should begin with half a brick. In laying the brick the pavers stand on the pavement already laid and, beginning at the curb each time, carry across as many courses together as they can conveniently reach. The courses should be kept straight and close together, and if necessary each block of eight or ten courses should be driven back by means of a sledge and a piece of straight timber approximately 2 by 4 inches by 5 or 6 feet long. The brick should also be laid close in the courses and should be crowded together, if necessary, after a course is laid, by means of a crowbar inserted at the curb.

After the pavement has been laid and all defective brick have been replaced to the satisfaction of the engineer, the next step is to sweep the surface clean and smooth out all inequalities by means of ramming or rolling. The rolling should be done with a power roller weighing from 3 to 5 tons, and the pavement should ordinarily be rolled in both the longitudinal and transverse directions. The longitudinal rolling should be done first and should begin at the curbs and progress toward the crown. The roller should pass at least twice over every part of the pavement in both directions.

In order to keep the brick in proper position and protect the edges from chipping, it is necessary to fill the joints with some suitable material before the road is opened to traffic. The materials which have in the past been most commonly used for this purpose are sand, various bituminous preparations, and a grout made of equal parts of Portland cement and fine sand mixed with water.

Sand is the least expensive of these materials, but there are several very serious objections to its use as a joint filler. Bituminous fillers vary considerably in quality and efficiency, but all are more or less unsatisfactory. One of the principal objections to their use is based on their tendency to run out of the joints into the gutters during warm weather and to crack and spall out during cold weather. This tendency can, of course, be partially overcome by exercising proper care in selecting the materials. It should also be noted in their favor that brick pavements, the joints of which have been filled with bituminous preparations, are ordinarily less noisy at first than those in which a Portland cement grout filler has been used. The grout filler is unquestionably very much superior from a standpoint of durability, however, and the excessive noise under traffic which has been frequently observed in connection with its use can be largely eliminated by the use of proper bituminous expansion cushions along the curbs. It is, therefore, recommended as better adapted for filling the joints in brick pavements than any other material which has been commonly used for that purpose.

Expansion cushions should be provided for at the time the brick are laid, by placing a board of the required thickness on edge adjacent to each curb. Small iron wedges may be inserted between the curb and the board at the time the board is set. These wedges may be readily loosened and removed after the bricks have been laid and grouted, and may consequently be made to facilitate the removal of the board.

The proper thickness for expansion cushions is a matter concerning which much difference of opinion exists among highway engineers. Some engineers advocate a minimum thickness of 1 inch, while others claim

to have secured their best results by using expansion cushions having a minimum thickness as low as three-eighths inch for very narrow pavements.

The cost of brick pavements varies widely, and is affected by so many influences that it is difficult to attempt to derive a general expression showing the relation between probable cost and local conditions. The prices of brick, as also the prices of the various materials entering into the foundation, vary greatly according to the locality and the freight rate. The cost and efficiency of labor is also far from being constant. Furthermore, the material composing the subgrade and the method of preparing it may exert a marked influence on the cost of the pavement.

If C = cost of cement per barrel, S = cost of sand per cubic yard, A = cost of coarse aggregate per cubic yard, B = cost of paving brick per 1,000, and L = cost of labor per hour, with all materials considered delivered on the work and all costs expressed in cents, then the probable cost of constructing a brick pavement, including the subgrade, a 6-inch concrete foundation, and suitable curbs, may be estimated by substituting in the formula:

Cost per square yard = $1.90\ L + .213\ C + .138\ S + .157\ A + .045\ B$.

The cost as estimated from this formula should, however, be increased by about 10 per cent. to allow for wear on tools and machinery and to guard against unforeseen contingencies. If it is desired to use a different thickness of foundation, it is safe to assume that each inch subtracted or added to the thickness of the foundation will make a corresponding difference of from 8 to 12 cents in the cost per square yard.

PANAMA RAILROAD CROSS-TIES.

SOME interesting data, showing the superior durability of the black guayacum ties used in early days, has been furnished by the chief engineer of the Panama Railroad in his report on the use and life of the hardwood ties laid in the roadbed of the Panama Railroad since 1878. He shows that, according to the annual reports since that date, the greater part of the small hardwood ties used in the original track of the Panama roadbed, as it existed in 1885, were procured from the north coast of Colombia, and were of the variety of wood commonly known as lignum vitae (guayacum recina), now called black guayacum, as distinguished from yellow guayacum, a wood possessing less power of resistance to mechanical wear or decay. Other varieties of wood, such as balsams (or quira), and polvillo, were used in ties, but, practically speaking, the black guayacum is the only variety that has stood the test of time. A few balsam cross-ties, laid in 1900, were taken from the roadbed last year and replaced by larger ties.

All the ties used by the old company on the original track were small, those of black guayacum being "pole" ties, about five to six inches thick, with a 6 to 7-inch face, and 8 feet in length. But, when American Canal operations commenced, these had to be replaced by ties of larger dimensions. However, on a section of the railroad between Empire and Culebra, where the traffic was comparatively light, the small ties were left in the track; and there many of the old small-sized black guayacum ties are still to be found.

When the main line of the roadbed was first double-tracked from White House (near Las Cascades) to Tabernilla, to provide for the movement of spoil trains to and from the Tabernilla dumps, many of the small hardwood ties were removed from this section of roadbed on account of the increased traffic; and, generally speaking, these were found to be in very good condition, showing little, if any, signs of decay—though often badly worn at the rail seat by the mechanical action of the base of the rail, no tie plates being used on the ties, and though frequently "spike killed," caused by the replacing of spikes and changing of rails. However, many of these, and also ties removed after this date, are being re-laid now on the tracks connecting with the new terminal docks at Christobal, a fact which shows that the timber in the ties is practically as good as ever. In the yard tracks, where the smaller size is not objectionable, they are still expected to render a long life of service.

The mechanical wear of the old ties in contradistinction to the decay of the wood is demonstrated by the fact that while the base of the rail, and the driven spikes have cut into the hardwood and weathered it, the material in the balance is as good as ever. The records of the United States have long shown the same experience; but there the ties have probably been used only for 8 or 10 years, whereas local hardwood ties have served for from 20 to 25 years in a tropical climate where all other woods decay in from 3 to 5 years.

Black guayacum is now so valuable for purposes in connection with machinery and manufacturing arts that, for use as cross-ties, it is probably a thing of the past. Both the prices and specifications for guayacum ties show a steady variation throughout the past few years. In the first instance, there has been increase in cost, and in the second, decrease in quality. The regulations state now that the material used shall be black or yellow guayacum, but are more stringent in requirements concerning the hewing and the culling of these, and concerning conformity to a specified table of dimensions. On the other hand, prices have increased 50 per cent. from the year 1898 to the year 1911, though some of this percentage must be discounted to allow for the increase also in the size of the ties. In 1898, first-class ties, 6 x 8 inches by 8 feet, were purchased at $1.50 each; second-class ties, 5½ x 6 inches by 7.9 feet, at $1 each. In 1911, first-class ties 7 x 9 by 8.6 feet, were bought at a cost of $2.25 each, and second-class, 6½ x 8 inches by 8.3 feet, at a cost of $1.75 each.

On good authority it may be stated that substantial progress has been made of late with the scheme which aims at establishing an express service between Great Britain and Australasia, via Canada. The company, which was formed three years ago to carry it out, and in which several well-known British shipowning and shipbuilding firms are interested, is treating with a Canadian syndicate for the purchase of about 400,000 acres of land at Cape St. Charles, on the south-east coast of Labrador, an ice-free port 1,680 miles from Liverpool, or a little more than half the distance between the Mersey and New York. From Cape St. Charles it is proposed to construct a transcontinental railway to the Pacific coast, and if the project materializes, it is claimed that the journey from London to Winnipeg will be performed in five days—giving only two nights at sea—with an additional sixteen days to Sydney, N.S.W., and a corresponding acceleration to many centres in the west of Canada and the United States. The projected highway, with its transpacific extensions to Hongkong and other British possessions in Far Eastern waters, is planned to serve the purposes of war as well as the pursuits of peace.

SKIP-HOISTS.

By Reginald Trautschold, M.E.,
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THE conveying and elevating machinery so far discussed has all been of the continuous type—that is, apparatus particularly adapted for the purpose of handling material in a continuous stream and thereby realizing large capacity with minimum expenditure of power and time—but there is an equally large class of conveying machinery that performs its operations of handling materials only intermittently or in a succession of cycles; i.e., a cycle of productive work and then one in which the apparatus rearranges itself for the next cycle of productive operation. Particularly is this arrangement carried out in the case of elevating machinery in which single buckets are loaded, raised and then unloaded in some other plane, or where the loaded bucket is raised and carried over a more or less horizontal plane to the discharging point and there emptied, after which operations it is returned to the loading point for more material. This intermittent type of apparatus includes steam shovels, locomotive cranes, traveling bridges of various descriptions, cable-ways, hoisting towers and numerous combinations and modifications of such apparatus; all of which may have a varying loading point, various points or locations at which discharge of load may take place and a more or less varying path over which the loaded bucket may travel between loading and discharging. Such apparatus may be used either independently or in combination with any of the various types of conveying and elevating apparatus described in this series of articles. When used in combination with such equipment, storage hoppers or similar devices are necessary, from which the intermittently operated apparatus may take or discharge its load—occasionally hoppers are used for both operations. Such hoppers simply serve to convert an intermittent to a continuous supply, or vice versâ, and as a temporary storage from which the conveying system can conveniently obtain its load or to which the loaded apparatus can economically and efficiently discharge. The continuous type of conveying and elevating machinery discharges to such temporary storage hopper in a continuous stream and other continuous or intermittent handling equipment can take its capacity therefrom so long as the supply to the hopper is adequate. Hoppers supplied from intermittent apparatus can similarly be used to supply load for other intermittent equipment or to load continuous conveying and elevating machinery, as the discharge from the hopper may be proportioned so that the latter type of apparatus can take only its capacity and will automatically take such amount so long as the supply to the hopper is sufficient.

Another class of conveying and elevating machinery of the intermittent type travels along fixed paths, although in some types of such equipment the loading and discharging points are not necessarily fixed. Common examples of such apparatus are car-hauls, skip-hoists, etc., etc. In many installations such equipment is of even greater economic value than continuous handling apparatus; and, although it is impossible to present formulæ for ascertaining even the probable economic value of such equipment, expressed in terms of net operating cost (each and every installation presenting a distinct and individual problem that must be solved independently) or even to derive equations for approximating the cost of equipment, the importance of this class of machinery is such that a short description of certain types is necessary in forming a comprehensive opinion of the respective value of various mechanical material handling equipments.

When materials are being handled that by their weight, chemical properties, etc., may be excessively destructive to a succession of necessarily comparatively inexpensive buckets, or when the supply of material is of necessity quite intermittent, one of the most satisfactory equipments is the skip-hoist, which primarily consists simply of a skip, or bucket, that is loaded, carried to the discharging point, dumped and then returned to the starting point for another load. As ordinarily employed, skip-hoists are installed for elevating operations only, the skips running either on vertical or slightly inclined tracks, although special forms of skips can be constructed that will permit travel in a more or less horizontal path. The skips themselves may be of almost any conceivable shape or size, depending largely upon the nature of the material to be handled and the capacity desired, and may be run at almost any speed up to 600 feet per minute, and occasionally at even greater speed. They are customarily equipped with bails by which they are hoisted and which are attached to the skips below and to one side of their centre of gravity so that they automatically tip and unload on reaching the discharge point, the tracks here being so located as to allow such position of skip. The skips usually run on four wheels and various systems are employed for compelling the skip to follow the proper tracks when discharging. One very satisfactory arrangement, that employed in the installation illustrated, is to run double tracks the full length of the skip travel, the inner tracks being curved off over the receiving hopper or discharge chute as the skip approaches the end of its upward travel. In such construction, the bail is attached to the skip so that the lower pair of wheels press against and run on the outer set of tracks, while the upper set of wheels, those nearer the open end of the skip, press against and run on the inner set of tracks—those curving out toward the discharge point. With this arrangement, the wheels do not leave their respective tracks, so that when the discharge takes place the skip is upset while the flanges of the wheels, nevertheless, maintain the skip in its proper vertical plane. In installations where the track of the skip is appreciably inclined to the vertical the outer set of track is dispensed with, except for a section at the top of the hoist where the tension on the skip bail would tend to pull the skip from its tracks but for the restraining action of this outer guide. Various other arrangements of tracks are occasionally resorted to, but the object in all cases is to so guide the skip that a continuance of pull on the hoisting cable tends to upset the skip and discharge its load.

Customarily, skip-hoists are either of the balanced type or, if but one skip is used, a counterweight is employed to compensate for the weight of the skip itself. A balanced skip-hoist is simply an arrangement of two skips that rise and fall alternately so that the constant dead weight of one skip balances the other and the power required for operation is simply that necessary to raise the load and the varying unbalanced weight of the cables as the skips or skip and counterweight rise and fall. The maximum weight of the unbalanced cables is comparatively small, as steel cables—necessarily of relatively small diameter and correspondingly little weight—are nearly invariably employed, so that for all practical purposes the power requirements of a skip-hoist is simply the amount necessary to raise its maximum load in the given time, to which must be added a sufficient amount

to care for the friction losses, etc. These losses are usually figured as fifty per cent. of the power theoretically necessary for handling the load. Formulæ XXV. and XXV.-a are equations ordinarily employed in figuring the power requirements for skip-hoists and, though apt to give somewhat larger results than necessary, if the installation be carefully designed and erected, are conservatively correct and advisably employed.

Horsepower:

$$HP = \frac{15\ WH}{10000} \qquad \text{Formula XXV.}$$

$$HP = \frac{45\ Qw'VH}{1000000\ (2H + V)} \qquad \text{Formula XXV.-a}$$

Where:—

W = Weight of load handled in tons per hour.
H = Height of hoist (distance that skip travels) in feet.
Q = Capacity of skip in cubic feet.
V = Velocity (speed) of skip in feet per minute.
w' = Weight of material handled in pounds per cubic foot.

Though the great variety of skips that are employed and the numerous conditions that must be met in even a simple installation of skip-hoists make it impossible to derive a formula for ascertaining the cost of equipment, such cost is, nevertheless, very easily arrived at, knowing the conditions of the installation, for the cost of any type of skip is easily estimated, the cost of cables per foot even more easily arrived at, when the weight of the fully loaded skip and also the speed at which it is to be operated are known. Similarly the cost of the necessary hoist, counterweight, sheaves, etc., can be arrived at and, knowing the probable initial cost of the equipment, it requires but simple calculation to obtain the probable net operating cost of the system. Depreciation, renewals and repairs seldom exceed 15 per cent. per year of the initial cost.

The true economic value of the skip-hoist is not based so much on the net cost of its operation, however, but rather upon its convenience and its ability to solve many difficult elevating problems. For instance, in the handling of pig iron and similar heavy materials the skip-hoist often proves an exceedingly efficient and economical system to install, particularly as were such material elevated by an ordinary bucket elevator the wear and tear on the elevator buckets would be very excessive, to say nothing of probable breakage which might be so great as seriously to cripple the system. In the handling of brittle and easily broken materials, such as coke, the skip-hoist also finds extensive use, for if care is taken in the loading of the skips and they are not too roughly and suddenly unloaded, much breakage that cannot be properly guarded against in a bucket elevator is avoided. Special skips can be constructed of materials that will resist high temperatures, the action of acid or alkali fumes, and other destructive characteristics of certain materials—whether they be liquid or solid—so that the skip-hoist not only ranks in economic value with any other type of conveying or elevating machinery, but very frequently is the desirable equipment to install.

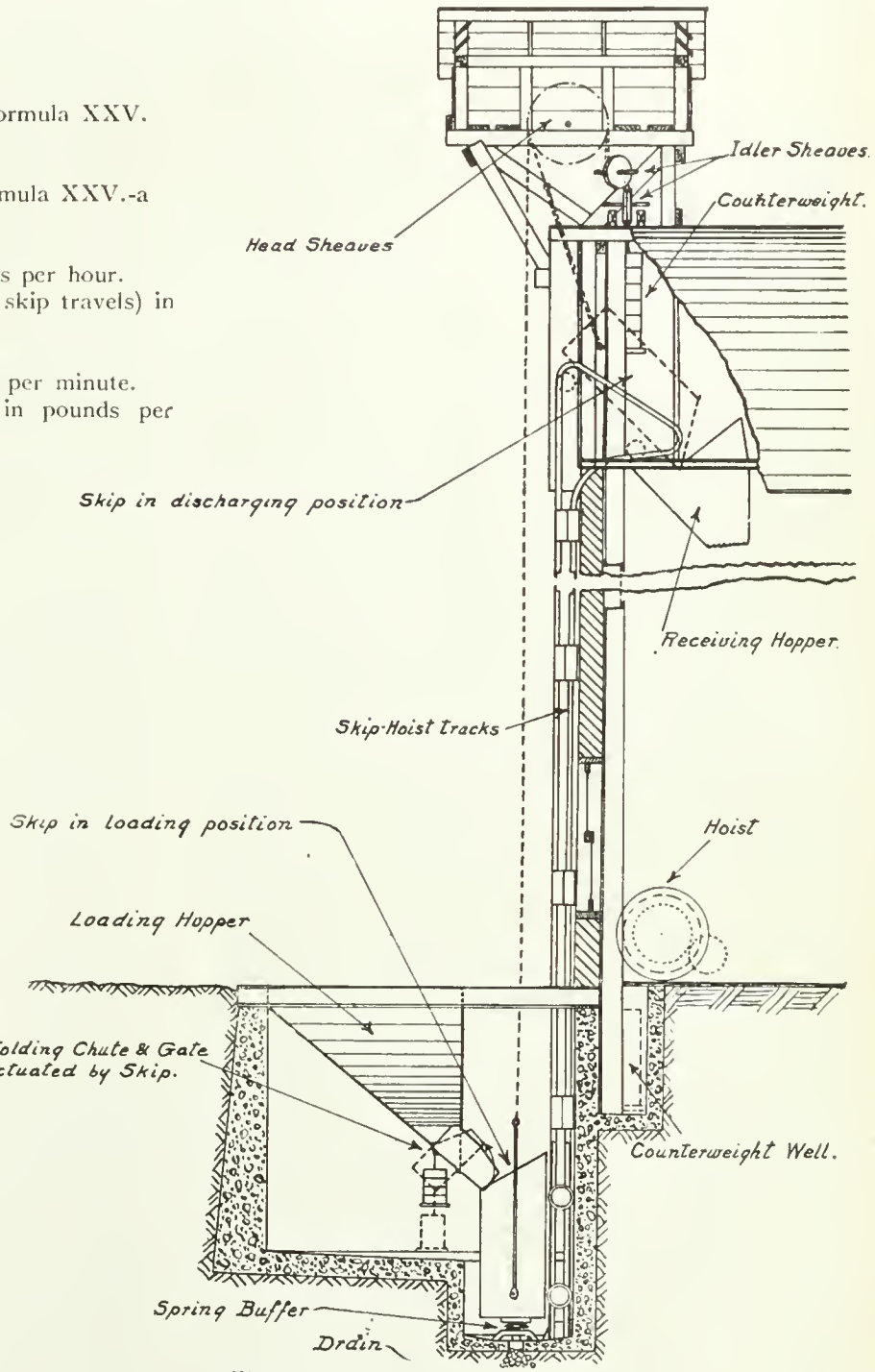

Fig. 1.—Typical Skip-Hoist Lay-out.

Canada owns thirty-eight per cent. of the world's supply of pulp wood, although it is only producing four per cent. of the world's paper. The United States has eighteen per cent. of the world's supply of pulp wood and makes forty-two per cent. of the paper.

FIXED CARBON TEST EMPIRICAL

THE SECOND OF A SERIES OF ARTICLES BY PROMINENT CHEMISTS REGARDING THE VALUE OF LIMITING THE PERCENTAGE OF FIXED CARBON IN ASPHALT

By LEROY M. LAW,

Chemist, The United States Asphalt Refining Company

UNDER ideal conditions, purchasing under specifications is beneficial to both consumer and producer. The former is enabled to state in precise terms his exact requirements in the way of material needs. This establishes quality and, as a result, all competitors are placed upon an equal footing, and competition resolves itself into the real objective: competition in price alone.

To the producer it means, first of all, that he is given an equal chance with others in the trade, and as all deliveries are to be rapidly inspected, he feels safe that another dealer cannot submit a profitless price in the hope of furnishing an inferior article. The mutual understanding, or to use the definition of contract, the "meeting of minds," is brought about through the agency of the specification proper and it is therefore highly important that this feature should receive serious consideration.

Its prime object is to define the requirements in terms which permit of ready interpretation, avoiding all possible uncertainties which may give rise to disputes under the contract. This point is vital and really forms the foundation of this great system, yet even in some of our most elaborate specifications its importance is frequently neglected.

In many of the early types we have seen such requirements as "The material must be . . . brand or equal thereto" and "the material shall have given satisfactory service under similar conditions for such a period of time." With such crude clauses, specifications fail of their purpose, for the actual requirements are at best but vaguely stated, and the producer has no way of ascertaining if his wares are "equal to" or have "given satisfactory service" in the judgment of him who reviews the bids and makes the award.

Such conditions, especially unfair to the manufacturer, are, it is true, rapidly disappearing, yet to-day, in many of the so-called scientific specifications, the adoption of requirements based on arbitrary methods of analysis has placed the honest producer in an equally uncertain and embarrassing position. One of the requirements of this nature, which has gained, and still holds, surprising popularity in many current bituminous specifications, is that limiting the so-called "Fixed Carbon." It is, indeed, difficult to understand just how this requirement even secured a foothold in asphalt specifications.

"Fixed Carbon" is a test stolen from fuel chemistry, where it serves to indicate the coke remaining after the gaseous constituents have been removed by heating the material, with exclusion of air, under prescribed conditions. Those who have had any experience whatever in fuel work know full well that this test is purely empirical and that the variations among different operators, especially in different laboratories, is often considerable.

A committee of the American Chemical Society gave considerable study to the matter some years ago and in 1899 recommended the procedure (see J. A. C. S. Vol. XXI., No. 12) that is now followed in conducting this determination. It is understood, however, that this method is not applicable even to some fuels like lignites, which are very prone to spark. How much more inapplicable, then, will the method be to softer materials, like the asphalts and road oils, which have also the disagreeable tendency of foaming out of the crucible at certain stages of the heating.

Chemists should know that city illuminating gas, their source of heat, varies in different localities. In fact, in some cities the composition is entirely different from that of others, hence a variation in heat, to say nothing of the difference in type and condition of the burners employed. It has been found that the degree to which the platinum crucible is polished has also an effect on fixed carbon results, and there are doubtless other sources of variation not as yet discovered.

The point is that engineers and chemists who advocate such requirements in their specifications, fail to realize these features, and their resulting effect on accuracy. Fieldner, of the U.S. Bureau of Mines, in speaking of the Fixed Carbon test, (see J. I. E. C., Vol. 5, No. 4) makes the following statement in regard to coal, and what he says in regard to coal is equally applicable to the fixed carbon in asphalts, for the same procedure is used with both materials:—

"The volatile matter and fixed carbon represent the relative proportions of gaseous and solid combustible matter that may be obtained from the coal by heating it in a closed vessel. This is done by heating a finely powdered sample in a small covered platinum crucible, in the flame of a Bunsen or Meker burner, for exactly seven minutes. The volatile matter consists mainly of the combustible gases—hydrogen, carbon monoxide, methane, and other hydrocarbons and some non-combustible gases, such as carbon dioxide and water vapor. The volatile matter does not include water present in the coal as moisture at 105° C. (221° F.).

"The residue of coke left in the crucible after deducing the ash is reported as 'fixed carbon.' The 'fixed carbon' does not represent the total carbon in the coal, as a portion of this element is driven out in combination with hydrogen in the volatile matter; furthermore, 'fixed carbon' is not pure carbon, but still contains several tenths per cent. each of carbon, hydrogen and oxygen; from 0.4 to 1.0 per cent. nitrogen; and about half the sulphur that was in the coal.

"It should be clearly understood that the terms 'volatile matter' or 'volatile combustible matter' and 'fixed carbon' do not represent any definite compound which existed in the coal before heating. The method of determination is purely arbitrary and variations of temperature and rate of heating will cause variations amounting to several per cent.; even with a strict adherence to the method recommended by the American Chemical Society, variations of three and four per cent. in both the volatile

matter and fixed carbon may occur in different laboratories. One of the most prominent factors in causing variations is the temperature at which the crucible is heated.

"It is especially pronounced in anthracite and semi-bituminous coal. It is not improbable for one laboratory to report 4 per cent. and another 7 per cent. volatile matter on the same sample of anthracite, or 14 per cent. and 17 per cent. respectively on the same sample of Pocahontas coal.

"The different percentages of volatile matter were actually produced by different conditions of heat treatment. Caution must, therefore, be observed in making comparisons of the volatile matter and 'fixed carbon' in proximate analysis made in different laboratories. Even determinations made at the same laboratory by the same analyst may vary to the extent of 0.5 per cent."

If such wide variations do occur with coals, what, then, should we expect when the method is applied to soft asphalts and even oils? As a chemist of one of the large asphalt companies, I have observed this fixed carbon requirement enforced to extremes and yet to no purpose or benefit to the consumer. The yield of fixed carbon cannot be controlled in the process of manufacture, unless through gross carelessness in coking material. In this case, the defects will be shown far more accurately by increased insoluble matter in the various reagents employed in bitumen analysis.

Some weeks ago the writer prepared two samples of bituminous material of different consistencies, dividing each sample into several portions. These were sent to several laboratories to make the fixed carbon tests. The operators selected were not the usual commercial laboratories, but chemists who are especially qualified and equipped for asphalt work, and regarded as our foremost experts in the branch of the profession.

The tabulated results of their work follow:--

Results on Fixed Carbon.

	Sample No. 213.	Sample No. 215.
Laboratory A	12.(illegible)	(illegible).
" B	13.62%	16.85%
" C	10.91%	13.13%
" D	12.52%	17.54%
" E	12.63%	17.20%
" F	17.10%	22.00%

Inspection of the figures shows a variation in fixed carbon on these same samples of over 6 per cent. in one case and nearly 9 per cent. in the other! When experienced operators such as the above differ by these amounts on identical samples, is there any wonder that with chemists generally the variations are even greater?

It is to be regretted that chemists do not study these tests before incorporating them in their specifications and extend to good materials and their honest manufacturers a just consideration. If fixed carbon in Baltimore is different from fixed carbon in Pittsburgh and, if in any one place the results are to vary from day to day, what possible value can the test have as indicating the value of a material? Furthermore, how is the manufacturer to test his products in every consumer's laboratory, to ascertain conditions prevailing in each of them?

Some days back it was our misfortune to have a shipment of asphalt rejected because the fixed carbon, as determined in the customer's laboratory, ran from one-tenth to three-tenths in excess of the prescribed limit. I had previously tested the batch from which this shipment was made, and found the fixed carbon considerably below the requirements of the specifications. Think of a scientist holding up a material on such a narrow margin as this, when even the most precise chemical methods are seldom within this limit of accuracy, especially as carried out in ordinary commercial testing. An absurd feature of the case is that another carload from the same batch was accepted as meeting the requirements, the inspecting chemist doubtless being unconscious of the variation he was experiencing in his own laboratory.

Suffice it to say that such a clause as Fixed Carbon, in its present empirical state, and coupled with a narrow and rigid interperation, is not only a discredit to the profession, but destroys the value of a sincere specification.

It has been stated that the principal object of the specification is to lay before the manufacturer in a clear, concise manner the requirements that are to be met. When he is unable to interpret these with a reasonable and standard equipment, the purpose of the specification fails.

The rapid development in bituminous highway work during recent years has been accompanied with an accumulation of inspection methods, desirable and questionable ones springing up together, and the many young chemists in this field of work doubtless look upon them as methods of established scientific value. Other chemists, with only time for routine work of testing, become advocates of such requirements as they might otherwise suppress. Furthermore, specifications of one city or municipality are frequently copied from those of another which, presumably, from a longer experience in bituminous work, is looked upon as a criterion in such matters.

And so, by these and other unstudied procedures, some asphalt specifications have been brought to this present empirical condition, and the time is at hand for chemists in this branch of the science to co-operate in weeding out the tangled field of laboratory methods. No one chemist should, and no true scientist will, decide that check results in his own laboratory establish the reliability of a test or method of analysis. Such is at least to be expected.

A true scientist will endeavor to ascertain what the procedure shows in the hands of others, presuming, of course, average qualifications in experience and skill.

If, as a result of such study, "Fixed Carbon" is found to be of value, then it will be of interest to all concerned to adopt definite procedures and agree on the imitations of accuracy. If it cannot be developed into real scientific test, capable of yielding concordant results in the hands of all qualified chemists, then it should by mutual consent be abandoned.

In its present empirical condition, it cannot be of any possible assistance in determining the quality or even the uniformity of a product but, on the other hand, its employment frequently works injustice to valuable materials.

Until the status of the "Fixed Carbon" test is better established, would it be any more than fair to manufacturers to omit such a requirement from bituminous material specifications?

Postmaster-General Samuel, of London, Eng., has appointed a committee of scientists to investigate the subject of wireless telegraphs and report on possible improvements for the service on land and sea. The Right Honorable Charles Edward Henry Hobhouse, chancellor of the Duchy of Lancaster, is chairman of the committee.

THE SELECTION OF MATERIALS FOR MACADAM ROADS.*

By Logan Waller Page,
Director U.S. Office of Public Roads.

OF all the factors which go to make up the perfect macadam road, there is undoubtedly none more potent than that of the suitability of the material which enters its construction. A road may be located, drained and constructed along the very best lines and according to the most approved methods and be a total failure if the material of which it is built has been poorly chosen. It is perhaps not too much to say that large sums of money are wasted annually in this country because too little importance is attached to this phase of the road problem. The engineer is then, at the very outset, confronted with the important problem of selecting the most suitable material for his work, and on the care with which he performs this task depends in a large degree the success or failure of the road he is to build. The purpose of the present paper is to discuss in some detail the methods which may be used in approaching this problem, with special reference to the value of laboratory tests as an aid in the selection of suitable materials for roads.

There are two ways in which the engineer may avail himself of the information necessary to a proper selection of a road material. The first and only certain one is to make an actual service test on the material under observation, and under the same conditions of traffic and climate to which the proposed road will be subjected. This method is, of course, impractical except in certain rare instances, due to the length of time which must elapse before definite results can be obtained. The second method is, by means of short-time laboratory tests to approximate as nearly as possible the destructive agencies to which the material will be subjected on the road, supplementing the knowledge thus gained by a study of the results already obtained in practice on material of a similar nature.

The laboratory testing of road building materials originated in France over forty years ago, and was introduced into this country by the writer in 1893, when he became Director of the Road Material Laboratory of the Lawrence Scientific School at Harvard University. The United States Government became interested in this work shortly afterwards, establishing, in 1900, a laboratory in the Department of Agriculture, at Washington. This laboratory is now a part of the Office of Public Roads, and has thus been able to give much assistance throughout the country in regard to the proper selection of material for macadam roads.

The three most important properties which a rock should possess in order that it may successfully resist the destructive agencies to which it is subjected are hardness, toughness, and cementing value.

Hardness, from the road builder's point of view, may be defined as the resistance which a rock offers to the displacement of its surface particles by friction. It is well illustrated in practice by the grinding action of iron-tired vehicles which tend to reduce to dust the rock fragments of which the road is composed. This property is determined in the laboratory by a special method, the essential features of which are as follows:—

A core 25 mm. in diameter is drilled from a sample of solid rock by means of a core drill. After being accurately weighed, it is held in a perpendicular position against a cast steel disc revolving at the rate of thirty-three revolutions per minute, while crushed quartz sand of a standard size is fed upon the disc to act as the abrasive agent. After one thousand revolutions of the disc, the core is again weighed, the loss calculated, and a measure of the hardness of the rock thus obtained.

Toughness, or resistance to impact, is a measure of ability of a road material to resist the pounding action of traffic such as is caused by the shoes of horses, etc. It is determined in the laboratory in the following way:—

A cylindrical test specimen of the rock 25 mm. by 25 mm. is taken from the core used in the hardness test, and subjected to the impact of a two-kilogram hammer through a spherical end plunger in a machine especially designed for the purpose. The test consists of a one-centimeter drop of the hammer for the first blow, followed by an increase in the drop of one centimeter until failure of the test piece occurs. The height of blow at failure is taken to represent the toughness of the specimen.

The combined effect of the mechanical agencies causing wear is very effectively determined by means of the Deval abrasion test, which has been the standard for over thirty years, and which is conducted essentially as follows:—

Five kilograms of the rock to be tested is broken so as to number as nearly as possible fifty pieces, and is placed in an iron cylinder, mounted in such a way that the axis of the cylinder is inclined at an angle of thirty degrees with the axis of rotation of the machine. After ten thousand revolutions of the machine at the rate of thirty-three per minute, the material is taken out and sieved through a 0.16 centimeter sieve, the material passing being that used in calculating the percentage of wear.

The cementing value of a road stone is that property which causes the fine rock dust to act as a cement and thus bind the coarser fragments of which the road surface is composed into an impervious shell. A laboratory test to determine this property was devised several years ago by the writer, and is conducted substantially as follows:—

Five hundred grams of the material to be tested is broken to about pea size, and placed, together with a sufficient quantity of water, in an iron ball mill. Five thousand revolutions of the mill reduces the mixture to the consistency of a stiff dough, which is moulded by means of a hydraulic moulding machine into cylindrical briquettes 25 mm. by 25 mm. in size. After drying twenty-four hours, these briquettes are tested by impact in a machine especially designed for the purpose. A one-kilogram hammer falling upon an intervening plunger, which in turn rests upon the test piece, is allowed to drop from a height of one centimeter until failure of the specimen occurs. The number of blows causing failure is used to represent the cementing value of the material.

It will readily be seen from the foregoing that a very accurate preliminary idea of the properties of a road stone may be obtained by means of laboratory tests. Many years' experience in testing these materials have made it possible to adopt certain standards of excellence which, when used intelligently and in conjunction with the other factors in the case, are of much value in selecting suitable materials for water-bound roads.

The results of laboratory tests alone, however, are not sufficient to judge of the suitability of a rock for road

*Read at American Road Congress, Detroit, Mich., Sept. 29 to Oct. 4, 1913.

building purposes, unless supplemented by additional information as to, (1) the character and volume of the traffic to which it is to be subjected; (2) climatic conditions under which it is to be used, and, (3) its name and general character, including, if possible, its mineral composition. In addition to the above, consideration in any specific instance should be given to such matters as the availability of the material, especially with reference to cost, transportation facilities, etc.

The value of taking these factors into consideration will be briefly illustrated below.

It is a well-known fact that a given road rock is far from being equally well suited to different traffic conditions. A high-grade trap rock would be as unsuitable as it would be uneconomical on a road subjected to light traffic, in that the dust worn off would not be sufficient to bind the coarser fragments together, and the road would consequently ravel. On the other hand, the comparatively soft limestone would be well adapted for the light traffic road would quickly pound to dust if subjected to conditions which would hardly affect the trap.

As a general rule, it may be said that the ideal rock for any particular road should be just so hard and tough that the fine material worn off by the action of traffic would be sufficient to supply that lost by the physical agencies of wind and rain. By correlating the information obtained by observing the behavior of the various rock types under different traffic conditions, with the results of laboratory tests on material similar in character, it has been found possible to determine quite definitely under just what conditions any given material would be most suitable, even before it had ever been used in road construction.

Many years of observation of the behavior of the various road building rocks in service has demonstrated the fact that, as a general rule, certain classes of material possess for particular purposes distinctive advantages over others. It is obviously of advantage, therefore, to know the general type of the material under observation, in order that an intelligent comparison may be made between it and the material of a similar nature which has already been used. The different varieties of trap, for instance, such as diabase, basalt, etc., are generally considered to make the most satisfactory road material, especially when the traffic is heavy enough to supply by wear the dust lost from natural causes. The limestones, as a class, being softer and less tough, are, as a rule, better adapted for light traffic than the traps. Laboratory tests in these cases are, therefore, mostly of value in enabling the engineer to make a definite choice between a number of materials which in a general way might be considered as suitable for his work.

The granites, owing to lack of toughness and cementing value, are, as a rule, only suitable for the foundation courses in plain macadam construction. Here the value of taking into consideration the character of the rock tested may be illustrated by the fact that frequently granites are found by laboratory tests to have good cementing values, due to highly altered minerals, when, as a matter of fact, such material should not be used on account of the ease with which it disintegrates under traffic.

Foliated material, such as gneiss, schist, slate, etc., should never, of course, be used when better material is available. Material such as quartzite and marble should also be avoided, the first on account of its hardness and lack of cementing value, and the second because of its crystalline structure and general lack of durability.

The availability of various materials considered for use in road construction should, of course, be considered, and is highly important, especially from a financial standpoint. In considering this point, however, care should be taken not to lose sight of the other factors in the case. Experience has shown in innumerable instances where poor material has been used because it was cheap that money would have been saved in the long run by the use of a superior rock, even though shipped from a distance and costing considerably more at the outset. There are cases, however, where local material may be used advantageously. It is in such instances as these that engineering judgment, combined with laboratory results, is necessary for proper selection.

An accumulation of data resulting from the great number of tests made on road building rocks in the government laboratory has quite recently made possible some very interesting investigations concerning the relation between the properties of hardness and toughness. By plotting numerous values of these tests, it was found that, in a general way, hardness increases with toughness and that, whereas for low values of toughness the hardness was extremely variable, as the rock became tougher the hardness showed less and less deviation from an average of the plotted points. The significance of this fact is that the property of hardness appears to be invariably associated with that of toughness, although the reverse is not the case. It seems, therefore, that for a quick determination of the qualities of a road-building rock, the hardness test might possibly be omitted, since material which satisfactorily passes the toughness requirement invariably appears to be hard enough for use in road construction.

When rock is to be used in bituminous construction, the importance of some of the above-mentioned tests is diminished. The cementing value, for instance, may be practically disregarded when the use of an artificial binder removes the necessity for dependence upon a dust bond. A tough rock is, of course, preferable, and more especially when the surface is to withstand the shock of heavy traffic, but both toughness and per cent. of wear become less important in the body of the road with bituminous construction when the surface is maintained by occasional surface treatments to preserve a wearing mat with a hard and tough aggregate.

Since public health and comfort have universally demanded an abatement of the dust nuisance, and economic maintenance is correlated with their demands, a few words on the selection of dust preventives and road binders cannot be out of place in a discussion of materials for macadam roads. The selection of a form of treatment or construction must be governed by a full consideration of the volume and character of traffic which the road surface is called upon to carry. In rural sections where a macadam road is subjected principally to the average farm traffic and a relatively small number of automobiles, a surface which is in good condition at the outset may be economically and satisfactorily maintained by an occasional application of one of the lighter dust laying tars or oils. The purpose in a case of this character is simply to presrve an already good surface by keeping the products of wear saturated with a material that will prevent them from being removed from the road surface. This purpose is readily best accomplished by a product that is not possessed of marked binding qualities —a material that will not pick up nor "ball" when mixed with dust only. Hygroscopic salts and other non-bituminous dust preventives have also served the above

purpose successfully where climatic conditions favor their particular characteristics.

The value of a simple dust preventive decreases, however, with an increase in the volume of automobile traffic, and a more permanent form of wearing surface then becomes necessary. Up to a certain limit, and particularly on park roads, this character of traffic is successfully provided for by means of an annual surface treatment of oil or tar covered with cleaned screenings or fine gravel. For cold surface treatment, the oils which give particular satisfaction are the natural or partially refined products which, through laboratory tests, are shown to consist of low-boiling constituents carrying in solution a relatively high amount of heavy adhesive asphaltic base. For most successful surface treatment, it is essential that an oil shall develop decided adhesive qualities in the residue from the standard volatilization test at 63° C. Tar products should be free from water, and it is believed that their value for surface treatment increases with the decrease in the free carbon content.

When the traffic becomes of such a character and magnitude as to cause a too rapid deterioration of a surface mat, the macadam must be constructed or resurfaced with a heavy binder as an integral part of the upper two or three inches of the wearing surface. The selection of a binder, whether it be a tar or asphalt product, now becomes dependent on several factors, among which the method of construction, character of the aggregate, and climatic conditions are most important. For instance, a dense aggregate may permit of the use of a lighter tar than will a poorly graded one; or a lighter tar or softer asphalt product would be specified for northern latitudes rather than for use in the south. A single standard for all materials and conditions can not, therefore, be established, but with the various factors in mind a specification can be drawn to cover the consistency and desirable chemical characteristics. In fact, in the purchase of road materials for whatever purpose it should be to the advantage of the producer as well as a protection to the consumer, that a definite specification be required. All shipments when received should be submitted to laboratory tests that will insure fulfilment of these specifications.

LONDON'S WATER STORAGE AND SUPPLY

In the annual report of the Metropolitan Water Board, of London, England, it is shown that the board has under its control subsidence and storage reservoirs of a capacity of some 15,000,000,000 gallons. The normal consumption of the 6,688,555 people within the board's area is more than 200,000,000 gallons per day. For the year ending March 31st, 1913, the total amount of water supply was 86,248.9 million gallons, or 387.9 million tons. The average daily consumption per head was 35.49 gallons, compared with 36.49 gallons in 1911-1912. The usual daily allowance could be supplied from the reservoirs if they were all filled to their utmost capacity, for eleven weeks; and as a rule the board keeps in store a supply sufficient for forty days. The southern and western districts of the city are supplied from the waters of the Thames, the southern district consuming the largest of all portions of the city—e.g., 25.45 per cent.; the new River district is furnished from the River Lee, the Chadwell springs, wells in the Lee Valley, and the Thames, and the eastern district from the Lee River principally, to the extent of 69.05 per cent., and its remaining percentage from the Thames.

PRODUCTION OF PETROLEUM IN CANADA.

The following interesting information concerning the production of petroleum is given in the report on Economic Minerals and Mining Industries, recorded by Mr. J. McLeish, and issued by the Department of Mines, Ottawa:—"At the present time the principal oil fields in Canada are situated in the peninsula of south-western Ontario, between Lake Huron and Lake Erie. The first oil was found in Lambton County in 1862, and active production has been continued ever since. Until 1907, the Lambton County fields in which there has been about 11,000 producing wells were by far the largest producers; since then, several new districts have been opened up, the most prominent ones being the Tilbury district in Kent county and the Onondaga district in Brant County. The oil districts are all situated within an area underlain by Devonian strata, usually on an anticlinal axis, and the petroleum is largely obtained from horizons in the Onondaga formation at depths varying in the different localities. When the wells are first drilled, the natural pressure is usually sufficient to force the crude oil to the surface, sometimes producing what are known as gushers. After the flowing period, the oil has to be pumped. While some of the smaller districts became exhausted in a few years, many of the pools being only a few hundred feet wide and perhaps a quarter of a mile long, others have continued to furnish oil for a long period. Four refining companies are operating in Canada distilling about 10 million gallons of Canadian crude oil per year, but the greater part being distilled at these refineries is still being imported from the United States. The total production for Canada for the year 1912 was 243,336 barrels valued at $345,050. In New Brunswick, in the district lying 11 miles to the south of Moncton, oil is being pumped in small quantities from the holes which produce the gas of this district. Although the production so far is not large, drill holes are continually being sunk, and it is hoped that very shortly a stronger and more continuous yield will be the result. In Alberta, although oil has not been encountered in commercial quantities, prospecting for it is being carried on vigorously, and there is every probability that this province will be added to the list of producers at a very early date. In connection with the oil industry in Canada, mention should be made of the existence of extensive deposits of bituminous shales and tar sands. Beds of bituminous shales, as at present recognized, are found in Gaspe, New Brunswick and Nova Scotia. Those in New Brunswick are without question the most important. They occur in the counties of Albert and Westmorland and extend in an easterly and westerly direction over a distance of 40 miles. During the past 10 months extensive exploration, by means of diamond drilling and surface work, has demonstrated not only the quantity but the quality of these valuable deposits. It is anticipated that in the near future a plant, with a capacity for an initial daily treatment of 2,000 tons of shale, will yield approximately 80,000 gallons of crude oil per day. Tar sands are known to occur in Alberta along the Athabaska River for a distance of upwards of 100 miles north and south of Fort McMurray. Although the existence of these deposits has been recognized for many years, no steps have as yet been taken to accurately determine their possibilities."

The estimate of $1,500,000 as the net manufacturing profits of the Spanish River Pulp and Paper Mills for the current year will be noted for reference a year hence. The corresponding profits for the combined companies in the year ended June 30th were approximately $350,000, so an increase of something more than 300 per cent. is anticipated.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Water Waste in Cities 743
Permanent Highways Urged by Counties 743
Municipal Control of Public Utilities 744

Leading Articles:

Notes on Provincial Land Surveying 729
Restoring the Transcona Elevator 730
The Adoption of Fuel Oil 731
Brick for Country Roads 733
Panama Railroad Cross-Ties 735
Skip-Hoists 736
Fixed Carbon Test Empirical 738
The Selection of Materials for Macadam Roads 740
Production of Petroleum in Canada 742
Convention American Road Builders' Association 744
Statical Analysis of Reinforced Concrete Arch Bridge 746
Notes on Electric Furnaces 750
Extinguishing of Fires in Oils and Volatile Liquids 752

Coast to Coast 754
Personals 756
Coming Meetings 756
Railway Orders 758
Construction News 76
Technical and Municipal Societies 94

WATER WASTE IN CITIES.

Last week the subject of excessive waste was broached in these columns in connection with the water consumption of one of our Canadian cities. It is a subject that should have more attention in many cities and towns, as in some of them there appears to be little or no effort at conservation. It is not implied, of course, that the aim should be to have consumers economize in the legitimate use of water, but rather to show that cases are prevalent where, so long as there is water in the reservoir, the profligate waste goes on unchecked. Misjudgment in this respect has frequently caused alarm and danger.

Considering the fact that the majority of water supplies throughout the country have to be pumped once, and sometimes twice, that many of them are filtered, and some of them chemically treated, water should cease to be regarded "as free as air," as it is in reality a manufactured product with manufacturing costs accompanying it.

It is interesting to note the procedure in Philadelphia, not many years ago regarded as the most pronounced in water wasting of the larger cities. A year ago a water waste campaign was established. It was begun by securing an ordinance allowing the installation of water meters. This was followed by a Water Conservation Show, where meters and other water-saving appliances were exhibited. A large force of inspectors, under good supervision, began a house-to-house inspection, and during the year practically the entire city has been covered twice in this way. Hundreds of thousands of leaky fixtures were located and repaired.

An exhaustive campaign for the detection and repair of street leaks has been going on. This work is made possible largely through the use of the pitometer and the microphone, and is done for the most part between midnight and 4 a.m. The night flow in most districts is a good measure of unwarranted waste, and through the use of the microphone water running far below the surface can sometimes be distinctly heard, when the noise of daily traffic is absent.

By the elimination of undue waste of water, Philadelphia has added materially to its water pressure, both for fire and home purposes. That the campaign for its conservation has been successful is demonstrated by the reduced amount of water pumped. In West Philadelphia, where the work has been very thoroughly done, the daily pumpage has been reduced from 45-48 million gallons to 32-35 million gallons within a year. An interesting index of the smaller demand on the pumping stations is the fact that they are burning 3,000 tons less coal than for the corresponding month of last year.

PERMANENT HIGHWAYS URGED BY COUNTIES.

Following the two sessions recently held by the Public Roads and Highway Commission, at Ottawa and Belleville, a third sitting took place in Hamilton on Nov. 11th, which has undoubtedly added much to the body of information to form the basis for action toward a provincial system of road-making and maintenance on the most approved plan. The general feeling at the Hamilton meeting was that the main roads should be made provincial highways, to be constructed and maintained by the Provincial Government, under the supervision of a highways commission. It was recommended that the construction be of a permanent nature, suitable for present-day traffic

and the traffic that is likely to follow the construction of these permanent roadways.

In the matter of financing the construction of such provincial highways, it was recommended that the property benefited by such roads should be assessed 25 per cent. of the cost, to be spread over a reasonable number of years. The cities, towns and villages that are connected up with the provincial highways also to pay 25 per cent. of the cost, to be apportioned on the basis of population, the balance of 50 per cent. to be paid by the Provincial Government. The meeting, however, was strongly of the opinion that the Dominion Government should assist by paying a portion of this 50 per cent.

It was further urged that a reasonable tax be placed upon motor-driven vehicles in the Province, the proceeds of this tax to be used for the maintenance of Provincial roadways, this maintenance also to be under the supervision of the government highways commission.

Regarding the secondary roads and feeders to the Provincial highways, a more comprehensive system was urged. These roads should be county roads, and financed as at present by the Government paying one-third of the cost, the counties to be assisted by the commission in the selection of roads best adapted for feeders.

Such opinions were embodied in a resolution jointly presented to the Commission by the Board of Trade, the Manufacturers' Association and the Automobile Club. Unlimited confidence seems to be reposed in the ability of the Provincial authorities to make and maintain roads that will bring the producer and consumer more closely together for the benefit of the Province generally. It is the feeling among practically all counties that the responsibility of such an undertaking is of so great an extent that the Provincial Government should assume a portion of it, if the roads of older Ontario are to meet with material improvement.

MUNICIPAL CONTROL OF PUBLIC UTILITIES.

The National Municipal League, which held its 19th annual meeting in Toronto last week, entered into a thorough discussion of municipal enterprise, and municipal government, and closed with a very important paper by Dr. Delos F. Wilcox, of New York, on the "Rights of Local Municipal Control as Against State or Provincial Control of Public Utilities." The speaker drew his arguments from the experiences of nearly every important city in the United States. Dr. Wilcox is a prominent authority upon public utilities, having been recently associated with the Public Utilities Commission of New York, as an expert on franchises.

Local control, according to Dr. Wilcox, is becoming more and more essential every year to the successful administration of the affairs of cities and larger towns. He believes that in America there is a tendency towards too great a centralization in the control of public utilities, and that certain features of exclusive state regulation tend to make the municipalization of utilities more difficult.

After reviewing the arguments in favor of State control, in which he showed how local telephone and electric railway systems often overlap municipal boundaries and even transcend State boundaries and how the development of hydro-electric power has necessitated wide fields of distribution, thus almost demanding State control, Dr. Wilcox showed that most public utilities are primarily urban in character and are developed primarily in relation to one or more urban centres. It was necessary to localize the control of these, therefore, as much as possible. The more powerful private corporations operating public utilities become, and the more widespread their services, the more important it is that they should be directly answerable to the local communities which they serve.

With regard to the control and financing of the extensions of public utilities in a city, Dr. Wilcox said: "I believe that a public utility within a given urban community is a natural monopoly, and that one of the first and essential obligations of such a monopoly is to extend its services to meet all the legitimate needs of the community. In practically every city," he continued, "where there is a street railway situation, one of the greatest difficulties is found in the absence of public control in the matter of extension. There is nothing which the people of a growing city so insistently demand as extensions of street railway systems, and there is no point where the street railways more strenuously refuse to recognize public initiative and control than in the building of additional lines. A few cities have covered the problem of extensions more or less successfully in their franchise contracts. This is notably the case in Chicago and Cleveland, and the principle is recognized in the new subway contracts in New York."

CONVENTION—AMERICAN ROAD BUILDERS' ASSOCIATION.

In our issue of Oct. 2nd, (page 537) we presented the tentative programme of the Tenth Annual Convention of the American Road Builders' Association, to open in Philadelphia on December 9th.

Owing to a few important changes that have been made in the programme, it is published herewith as now arranged. It deals with twelve important subjects introduced by papers by the leading highway commissioners, engineers and experts. Discussions are being previously prepared.

Subject A.—Organization.

1. Highway Officials, Their Duties and Powers.

2. Division of Expense, Responsibility and Authority Between Nation, State, County and Town.

3. The Relation to Each Other of the Contractor, Engineer and Inspector.

4. Details of Arrangements for the Use of Convict Labor.

Subject B.—Construction.

1. Determination of the Amount of Realignment, Grading and Drainage to Be Done in Connection With Road Improvement.

2. Factors Governing a Proper Selection of Road or Street Pavement.

3. Details of the Construction of the Various Kinds of Roads and Pavements.

Ten-minute papers on the following subjects: Earth Roads; Sand-Clay Roads; Gravel Roads; Water-Bound Macadam; Bituminous Macadam and Bituminous Concrete; Brick; Concrete; Wood; Granite and Asphalt Block; Sheet Asphalt.

4. Unit Price and Lump Sum Contracts and Percentage Work.

5. The Testing of Material for Road and Street Construction.

Subject C.—Maintenance.

1. Sub-Organization for Securing Efficient Maintenance.

2. General Methods of Repairs and Renewals.

3. Bituminous Surface Treatment and Dust Prevention.

Among those who are to take part in the proceedings are the following: Chas. J. Bennett, State Highway Commissioner of Connecticut; E. M. Bigelow, State Highway Commissioner of Pennsylvania; A. H. Blanchard, Professor of Highway Engineering, Columbia University, New York, N.Y.; Henry L. Bowlby, State Highway Engineer of Oregon; Frank W. Buffum, State Highway Commissioner of Missouri; John N. Carlisle, State Highway Commissioner of New York; Wm. H. Connell, Chief, Bureau of Highways and Street Cleaning, Philadelphia, Pa.; Geo. W. Cooley, State Engineer of Minnesota; F. L. Cranford, Road Contractor, Brooklyn, N.Y.; Major W. W. Crosby, Chief Engineer, Maryland Geological Survey; A. W. Dean, Chief Engineer, Massachusetts Highway Commission; Fred E. Ellis, Road Contractor, Peabody, Mass.; A. B. Fletcher, State Highway Engineer of California; S. D. Foster, Chief Engineer, Pennsylvania State Highway Department; R. B. Gage, Chemist, State Highway Department of New Jersey; John S. Gillespie, Road Commissioner of Allegheny County, Pa.; L. R. Grabill, Superintendent of Suburban Roads, District of Columbia; H. C. Hill, Engineer, Lane Construction Co., Meriden, Conn.; A. R. Hirst, State Highway Engineer of Wisconsin; Prevost Hubbard, Consulting Chemist, Institute of Industrial Research, Washington, D.C.; Jos. W. Hunter, Deputy Commissioner, Bureau of Township Highways, Pennsylvania State Highway Department; A. N. Johnson, State Highway Engineer of Illinois; C. A. Kenyon, President, Indiana Good Roads Association; Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment, New York, N.Y.; James H. MacDonald, former State Highway Commissioner of Connecticut; T. H. MacDonald, State Highway Engineer of Iowa; W. A. McLean, Chief Engineer of Highways and Commissioner of the Ontario Public Roads and Highways Commission, Toronto, Ont., Canada; R. A. Meeker, State Highway Engineer of New Jersey; Harold Parker, Vice-President, Hassam Paving Co., Worcester, Mass.; Robert J. Potts, Professor of Highway Engineering, Agricultural and Mechanical College of Texas, College Station, Tex.; Dr. Joseph Hyde Pratt, State Geologist of North Carolina; Jean de Pulligny, Engineer-in-Chief, Board of Public Works of France, and Director of the French Mission of Engineers to the United States; John J. Ryan, Secretary, Road Builders' Association, Albany, N.Y.; Frank F. Rogers, State Highway Commissioner of Michigan; Chas. W. Ross, Street Commissioner, Newton, Mass.; Paul D. Sargent, Chief Engineer, Maine State Highway Commission; Herman H. Schmidt, Chief Engineer, Bureau of Highways, Borough of Brooklyn, New York, N.Y.; Henry G. Shirley, Chief Engineer, Maryland State Roads Commission; Francis P. Smith, Consulting Chemist and Paving Engineer, New York, N.Y.; Robert C. Terrell, Commissioner of Public Roads of Kentucky; Geo. W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn, New York, N.Y.; Wm. D. Uhler, Assistant Engineer, Bureau of Highways and Street Cleaning, Philadelphia, Pa.; P. St. J. Wilson, State Highway Commissioner of Virginia.

EFFECT OF HIGH PRESSURES.

CURIOUS and unlooked-for manifestations have of late been observed from the application of very high pressure. It used to be considered that heat was the only medium which would separate compound substances into their simple elements, but it has now been found that pressure is equally effective and more convenient in some respects. Salts decompose spontaneously into their component acid and metals, water yields its elementary gases, and heat consolidates into coal.

The application of very high pressures seems to be producing a positive revolution in the chemical industry, and is briefly referred to in Railway and Locomotive Engineering. Only a short time ago, the report circulated that Haber had succeeded in causing elementary nitrogen and hydrogen to react at a pressure of 300 atmospheres (4,410 pounds) and at temperatures varying between 900 and 1,080 degrees F. A remarkable reaction belonging to this category was likewise discovered by Ipatiew, who succeeded in precipitating metals from their sale solutions by hydration under high pressure. Thus, starting with cupric sulphate, he obtained finely distributed copper and sulphuric acid. There is another interesting reaction in the decomposition of water under high pressure and at high temperatures in the presence of a metal, as, for instance, iron, which binds the oxygen separated. At the same time, hydrogen of very high purity is yielded. This new method of producing pure hydrogen is of especial interest at the present time, since this gas is used for many technical purposes in various departments. Among the various modes of production that have been announced of late, the new method is probably the cheapest. The production of artificial coal under high pressure is also one of the recent inventions. Cellulose or peat is heated up with water to 612 degrees F., under a pressure of more than 100 atmospheres (1,470 pounds) in apparatus especially constructed for the purpose, the resultant being a product identical with mineral coal, both from a physical and a chemical point of view. At 558 degrees F. the process requires 80 hours, at 612 degrees F. only 8 hours are necessary for the transformation.

MOTOR TRAFFIC IN CANADA.

Over 12,400 more motor vehicles were in use in the Dominion on November 1st than at the end of last year, according the figures compiled by the Automobile Club of Canada. The following are the totals for each of the provinces, including private and commercial vehicles and motor cycles:—

	1912.	1913.
Quebec	3,597	4,706
Ontario	11,939	15,255
New Brunswick	289	789
Manitoba	3,043	5,016
British Columbia	4,666	7,044
Nova Scotia	867	1,300
P. E. Island	...	...
Saskatchewan	3,742	6,513
Alberta	2,835	3,640
Yukon	5	15

It is rather remarkable that the largest gains among the motor vehicle using provinces were made at the two ends of the continent—in New Brunswick and the Yukon, where the increases were over 300 per cent.

STATICAL ANALYSIS OF REINFORCED CONCRETE ARCH BRIDGE

DESCRIPTION OF A RAILWAY BRIDGE OF SPECIAL DESIGN — AN ANALYSIS OF ITS STRESSES AND DEFLECTIONS — RESULTS OF TEST LOADING

By V. J. ELMONT, B. Sc., A.M. Can. Soc. C.E.

THIS bridge carries a single-track railway over the River Werra. In order to allow for future navigation it was found necessary to bridge the river in one span of 174 feet.

As will be seen in the illustrations (Figs. 1, 2 and 3) the bridge has two arches, arranged above the bridge floor; they are calculated and constructed as arches without hinges, for which kind of structure the soil (coarse gravel) was very well suited, the maximum pressure on it being only 5,000 to 6,000 lbs. per sq. ft. Above the clearance line of the cars the arches are stiffened sideways by T-shaped struts (see Figs. 2 and 4) which, together with the arches, form a strong truss. The free space between the arches is 14′ 5″, the depth of the arches at the crown is 5′ 3″ and at the springing line 8′ 2″; the rise is 34 feet.

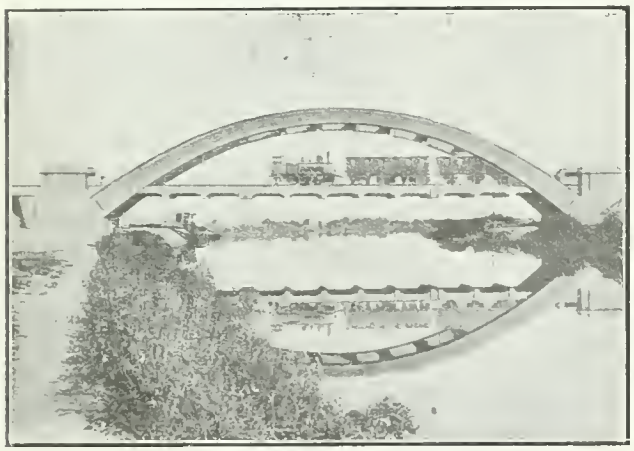

Fig. 1.

The bridge floor is suspended from the arches by means of rods, carefully anchored in the arches and floor beams. The slab which forms the direct support for the ballast, in which the cross-ties for the rails are embedded, is 5½″ thick and is carried by four longitudinal beams, which again rest on the floor beams spaced 13′ 7″ centre to centre. These are 2′ 7″ wide in the middle, tapering to 1′ 7″. This form was adopted in accordance with the requirements of the specification, viz., that the actual tension stress in the concrete should not exceed 275 lbs. per sq. in.

In order to avoid stresses in the floor produced by variations of temperature, it is divided into three parts, the two end sections being rigidly connected with the arches, while the middle section hangs freely and engages with the end sections by means of indentations; the floor will thus act as a horizontal cantilever girder for wind forces, having a simply supported part at the middle resting against two cantilever arms at the sides.

The abutments (Fig. 5) are formed by widening the arches below the bridge floor, and connecting them by a slab towards the river.

The falsework used in the construction of the bridge was given an overheight at the crown of the arches of 2″, diminishing towards the ends. It was found that the settlement of the falsework during the concreting amounted to 1⅜″ at the crown, and when the falsework was removed after the concrete had hardened for five weeks a further settlement of 7/16″ took place.

Fig. 2.

Statical Analysis.—The following maximum stresses were allowed: Concrete in compression, without regard to temperature stresses, 500 lbs. per sq. in.; concrete in compression, including temperature stresses, 650 lbs. per sq. in.; concrete in tension, including temperature stresses, 275 lbs. per sq. in.; steel in tension, including temperature stresses, 14,000 lbs. per sq. in. The calculation of the bridge floor does not include any special features.

The depth of the arches was first computed by repeated approximate figuring to d_c = 5′ 3″ at the crown and d_s = 8′ 2″ at the springing line, with a width of 3′ 7″, and then tested by the exact formulæ for arches without hinges. The dimension d_x for the interspacing point with the abscissa x measured from the crown was taken from the formula

$$d_x = d_0 + 4\left(\frac{x}{l}\right)^2\left(d_s - d_0\right),$$

where l is the theoretical span; it has been proved that a good variation of the cross sections is obtained by this equation.

The form of the centre line of the arches follows a funicular polygon to the dead load of the structure, which can be calculated from the above expression for d_x. The differential equation for the centre line is $\frac{d^2y}{dx^2} = \frac{g}{H}$, where g is the load per unit length and H the horizontal pressure. By integration

$$\frac{dy}{dx} = \frac{1}{H}\int g\,dx + C; \quad \left(\frac{dy}{dx} = 0, \text{ giving } x = 0 \text{ and } C = 0\right)$$

$$y = \frac{1}{H}\int dx \int g\,dx + C_1;$$

$(y = 0$, giving $x = 0$ and $C_1 = 0)$.

Fig. 3.

In calculating the ordinates at the various points of the centre line the integrations are replaced by summations and the rise of the arches chosen as 34 feet; the ordinates and the horizontal pressure can then be obtained from the equation for y. H for this bridge is 345 tons.

The arches, having no hinges, are statically indeterminate in the third degree. The general form of the equations by which the three unknown quantities (X_a, X_b and X_c) are calculated, are with the usual notation

$$X_a\delta_{aa} + X_b\delta_{ba} + X_c\delta_{ca} = \Sigma P_m\,\delta_{ma} + \delta_{at},$$
$$X_a\delta_{ab} + X_b\delta_{bb} + X_c\delta_{cb} = \Sigma P_m\,\delta_{mb} + \delta_{bt},$$
$$X_a\delta_{ac} + X_b\delta_{bc} + X_c\delta_{cc} = \Sigma P_m\,\delta_{mc} + \delta_{ct};$$

δ_{at}, δ_{bt} and δ_{ct} being the influences due to variations of temperature.

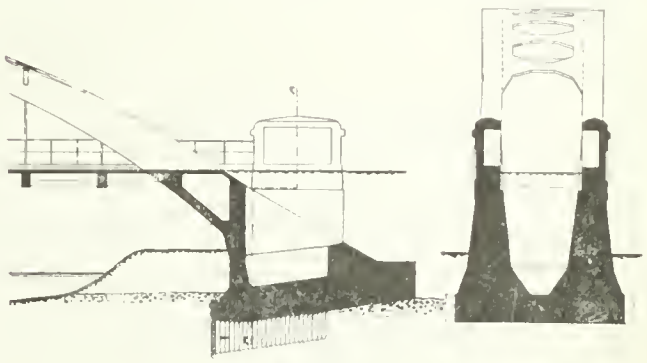

Fig. 5. Section A-A

From the theory of arches without hinges it is known that a very practicable statically determinate auxiliary system is obtained by introducing the normal force X_c, the transversal force X_b and the bending moment X_a at the crown of the arches as the statically indeterminate quantities and allowing them to act upon the arch from a point O (see Fig. 6) in the symmetrical axis of the arch determined by

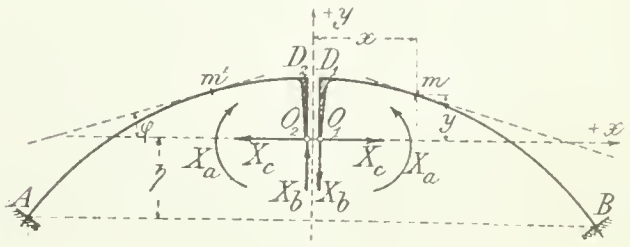

Fig. 6.

$$\delta_{ba} = \delta_{ab} = 0$$
$$\delta_{ca} = \delta_{ac} = 0$$

The equations for x will then be

$$X_a\delta_{aa} = \Sigma P_m\,\delta_{ma} + \delta_{at},$$
$$X_b\delta_{bb} = \Sigma P_m\,\delta_{mb} + \delta_{bt},$$
$$X_c\delta_{cc} = \Sigma P_m\,\delta_{mc} + \delta_{ct};$$

as $\delta_{cb} = \delta_{bc} = 0$, on account of the symmetry, and the statical determinate auxiliary system will be two curved beams with one fixed and one free end. (Fig. 6).

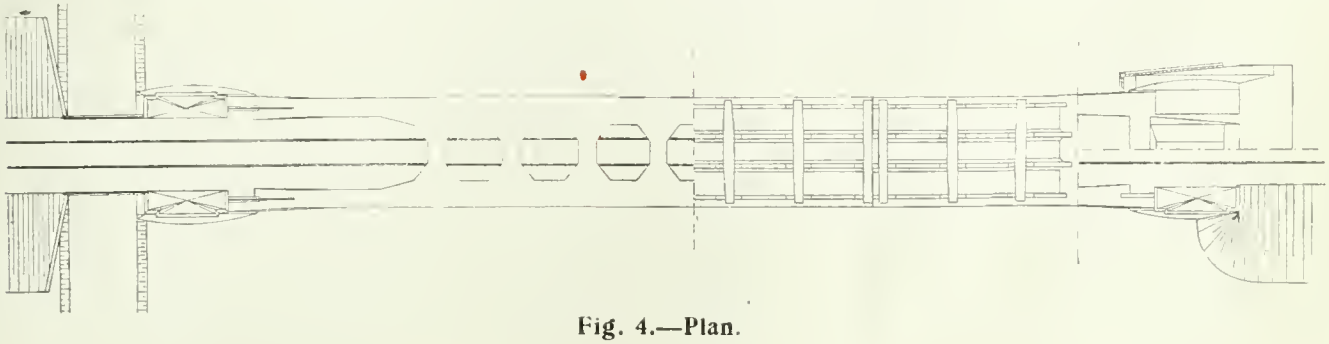

Fig. 4.—Plan.

The maximum bending moment and normal forces due to the live load in the various sections of the arches, are calculated by means of influence lines. The equations for the influence lines for the bending moment (M) and normal force (N) in the point m of the arches are:

$$M_m = M_{o,m} - X_a - X_b x - X_c y,$$
$$N_m = N_{o,m} + X_b \sin \phi - X_c \cos \phi;$$

$M_{o,m}$ and $N_{o,m}$ being the corresponding values in the auxiliary system, ϕ the angle between the x axis and the tangent at the point (Fig. 6), taken positive in the direction from the x axis to the y axis and the positive direction of the tangent taken toward the right. It will thus

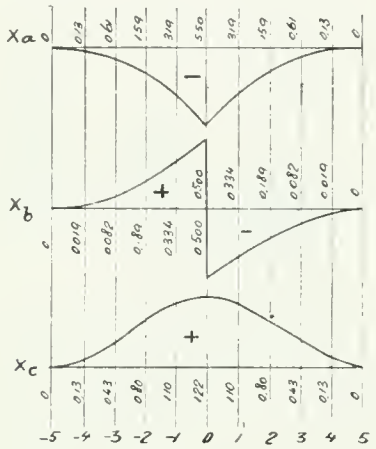

Fig. 7.

be seen that it is first necessary to find the influence lines for X_a, X_b and X_c, the equations of which, from the above given reduced equations, are:

$$X_a = \frac{\delta_{ma}}{\delta_{aa}}; \qquad X_b = \frac{\delta_{mb}}{\delta_{bb}}; \text{ and,} \qquad X_c = \frac{\delta_{mc}}{\delta_{cc}}.$$

wherein the different δ's are readily calculated by means of the so-called "v" forces. The influence lines for the quantities X are shown in Fig. 7, and the influence lines for the bending moments in Fig. 8.

A variation of the temperature of ± 40° F. was taken into consideration; the bending moments and normal forces produced by this change are:

$$M_t = - X_c y; \; N_t = - X_c \cos \phi,$$
$$X_a \text{ and } X_b \text{ being } = 0, \text{ and } X_c = \frac{\epsilon E t l}{\delta_{cc}}$$

in which ϵ is the elongation per unit length per 1° F., E the modulus of elasticity, t the variation of the temperature and l the span.

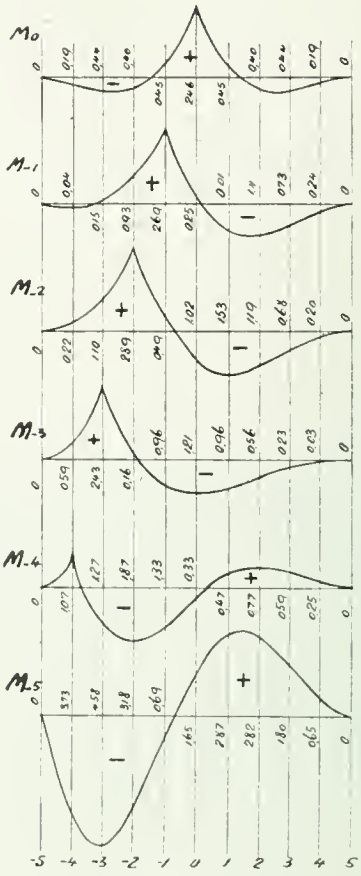

Fig. 8.

In Table I. is given the bending moments and normal forces due to the live load (M_p and N_p), to the dead load (M_g and N_g), and to the change of the temperature (M_t and N_t).

Table I.—Bending Moments (M) and Normal Forces (N).

Point.	0	1	2	3	4	5
Max. M_p	+ 34.8	+ 55.4	+ 61.7	+ 42.6	+ 40.4	+127.5 yard tons
N_p	+ 26.3	+ 33.9	+ 21.8	+ 12.7	+ 32.2	+ 42.5 tons
Min. M_p	— 30.0	— 38.7	— 59.0	— 52.2	— 63.0	—163.5 yard tons
N_p	+ 38.4	+ 30.1	+ 43.7	+ 62.3	+ 49.0	+ 40.6 tons
M_g	+ 32.3	+ 27.2	+ 12.0	— 14.7	— 52.8	—105.0 yard tons
N_g	+333.0	+337.0	+349.0	+369.0	+397.0	+435.0 tons
M_t	∓ 56.9	∓ 47.9	∓ 21.1	± 26.1	± 93.3	± 181.0 yard tons
N_t	± 21.0	± 20.8	± 20.1	± 19.0	± 17.8	± 16.3 tons
Max. M_{p+g}	+ 67.1	+ 82.6	+ 73.7	+ 27.9	— 12.4	+ 22.5 yard tons
N_{p+g}	+359.3	+370.9	+370.8	+381.7	+429.2	+477.5 tons
Min. M_{p+g}	+ 2.3	— 11.5	— 47.0	— 66.9	—115.8	—268.5 yard tons
N_{p+g}	+371.4	+367.1	+392.7	+431.3	+446.0	+475.6 tons
Max. M_{p+g+t}	+124.0	+130.5	+ 94.8	+ 54.0	+ 80.9	+203.5 yard tons
N_{p+g+t}	+338.3	+350.1	+350.7	+400.7	+447.0	+493.8 tons
Min. M_{p+g+t}	— 54.6	— 59.4	— 68.1	— 93.0	—209.1	—449.5 yard tons
N_{p+g+t}	+392.4	+387.9	+412.8	+412.3	+428.2	+459.7 tons

From Table II., which gives the maximum stresses, it will be seen that the maximum compression stress in the concrete is 459 lbs. per sq. in., due to dead + live load, and 610 lbs. per sq. in. when the influences due to temperature variations are added. The allowable compression stress is nearly reached in all sections, while the tension stress in the steel has the maximum value of only 6,700 lbs. per sq. in., and the tension in the concrete 196 lbs. per sq. in.

Table II.—Maximum Stresses in Lbs. per Sq. In.

e = at extrados i = at intrados

Point.	Stresses due to p+g		Stresses due to		
	Compression in concrete	Tension in steel	Compression in concrete	Tension in steel	Tension in concrete
Crown 0	e 445	i compr.	e 570	i 980	i 69
1	e 459	i compr.	e 552	i 700	i 46
2	e 405	i compr.	e 435	i compr.	i compr.
3	i 440	e compr.	i 472	e compr.	e compr.
4	i 452	e compr.	i 567	e 1400	e 94
Springing line 5	i 380	e 420	i 610	e 6700	e 196

In order to prove the correctness of the results derived by the above described method of calculations, a careful test loading was arranged. Three railway trucks, weighing about 48 tons each when loaded with potash

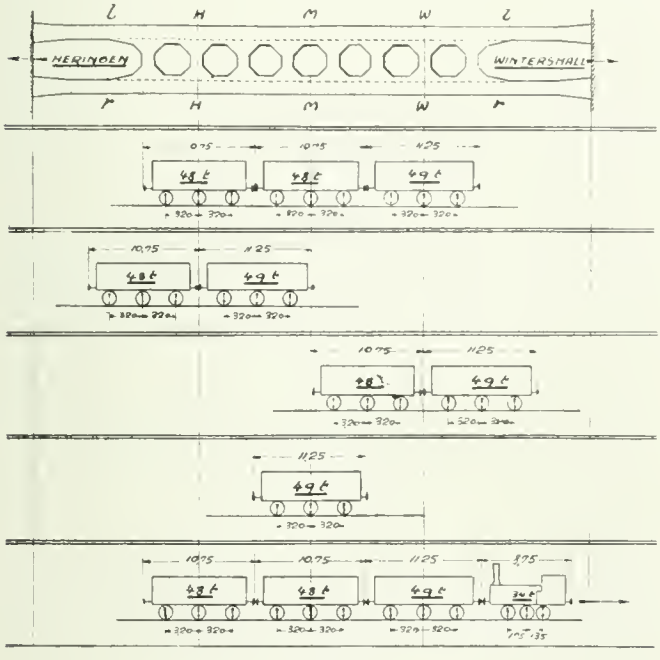

Fig. 9.

salts, and a locomotive weighing 34 tons, were used. Five different cases were examined (diagrammatically shown in Fig. 9):

(1) Three trucks placed symmetrically at the middle of the bridge.

(2) Two trucks, standing at the point at which the roadway is divided.

(3) The same as 2, at the opposite end.

(4) One truck at the middle.

(5) The whole train crossing the bridge at full speed.

The deflections were measured by means of wooden levers magnifying five times. Measurements were taken at both sides (called l and r in Fig. 9 and Table III.) in three vertical planes lettered H, M and W. The instruments were arranged in these three planes, not only under the bridge floor (called b) but also directly under the arches (a), so that the deflections were measured at twelve points in all. In Table III. are given the calculated and measured deflections. The results show a remarkably close agreement between them in all points, proving the possibility of computing correctly structures of this type. The modulus of elasticity derived from the test is 4,200,000 lbs. per sq. in., which is double that usually assumed in calculation. It must be remembered, however, that the concrete was five months old, and of

Fig. 10.

exceptionally good quality, being a 1:6 mixture of natural ballast from the Werra River with cement. Cubes of the same mixture gave a crushing strength of 5,100 lbs. per sq. in. after 28 days.

Table III.—Deflections in 1/25 of an Inch.

Loading Case	Side of Bridge	Location of Point	H Calculated	H Measured	M Calculated	M Measured	W Calculated	W Measured
1	l	a	+1.0	+1.0	+2.1	+2.2	+1.0	+0.7
		b	+1.4	+1.2	+2.9	+3.2	+1.4	+0.9
	r	a	+1.0	+1.0	+2.1	+2.2	+1.0	+1.2
		b	+1.4	+1.2	+2.9	+3.0	+1.4	+1.4
2	l	a	+2.5	+2.3	+1.0	+1.4	—1.5	—1.2
		b	+2.8	+2.0	+1.3	+1.3	—1.5	—1.2
	r	a	+2.5	+2.0	+1.0	+1.2	—1.5	—1.2
		b	+2.8	+2.2	+1.3	+1.4	—1.5	—1.2
3	l	a	—1.5	—1.2			+2.5	+2.4
		b	—1.5	—1.4			+2.8	+2.7
	r	a	—1.5	—1.2			+2.5	+2.6
		b	—1.5	—1.2			+2.8	+2.6
4	l	a			+1.7	+1.7		
		b			+2.5	+2.3		
	r	a			+1.7	+1.6		
		b			+2.5	+2.5		
5	l	a			+2.1	+2.4		
		b			+2.9	+3.2		
	r	a			+2.1	+2.4		
		b			+2.9	+3.2		

The deflections were calculated as bending moments produced by the "v" forces. The general expression for the "v" force, acting in the point m of the arch, is

$$V_m = \lambda M_m \frac{\sec \phi_m}{E J_m},$$

where λ is the distance between the points for which the "v" force is calculated (here 1/10 of the span), M_m is the bending moment, E the modulus of elasticity, J_m the moment of inertia at the point m, and ϕ the angle as defined above. In Fig. 10 is shown the influence line for the deflection at the crown; the figures written on the ordinates give the deflections in 1/25,000 of an inch for a force of one ton.

NOTES ON ELECTRIC FURNACES, WITH SPECIAL REFERENCE TO AN INDUCTION FURNACE.

THIS title has been given to the following paper, read at the 36th general assembly of the S.A.I. E.E., at Johannesburg on September 18, 1913, and written by Dr. W. Glucksman, D.Sc.:—

Before going into details of the induction furnace, I think it advisable to point out briefly the following facts. When heating a furnace by electricity the increase of temperature is due to the transformation of the electric energy into heat, either by the spark or by the arc which traverses the electrodes, or by a conductor according to the well-known law of Joule, i.e., proportionally to the resistance of the conductor and to the square of the intensity of the current. In accordance with the two means of the energy transformation we have (*a*) electric arc furnaces and (*b*) electric resistance furnaces. The electric current utilized under such conditions gives us the means of attaining far higher temperatures than are possible in the ordinary combustion furnaces, and has the valuable property of being easily regulated so as to maintain or vary the required temperature with a remarkable degree of precision. The use of electricity enables us also to concentrate the whole calorific energy in a relatively restricted space. In this connection I shall only remind you of Moissan's experiment, in which he concentrated 200,000 calories per second in the volume of one litre of titanic acid. Finally, the direct transformation of electric energy into heat is one of the most interesting properties of electricity, and it is owing to this property that we are able, in particularly advantageous conditions to utilize such natural sources of power as waterfalls.

In the manufacture of steel by means of an electric furnace one can start from cast iron and obtain as a result of the process any desired grade of steel, or if a more economical apparatus is available, we can use the electric furnace only in the last stage of manufacture. Naturally, to obtain the desired result we have to use one of the metallurgical processes ordinarily employed. In this paper we shall treat the electric furnace only as a handy apparatus for the manufacture of steel, for instance, without dwelling on its further valuable properties, which enable it to obtain results which cannot be obtained by any ordinary Siemens-Martin furnace.

Principal Types of Electrical Furnaces.—As I have stated above, two types of electrical furnaces are so far known, (*a*) arc furnaces and (*b*) resistance furnaces.

(*a*) *Arc Furnaces.*—Three different classes of arc furnaces are in use at present:—

1. Furnaces in which the bath communicates with one pole of the electric supply, the arc striking between the bath and one or several superior electrodes.

2. Furnaces in which the bath does not communicate with the electric source. The current enters through one or more electrodes and goes out through one or more other electrodes, after having produced as many arcs as there are pairs of electrodes.

3. Furnaces in which the arc is completely localized between the electrodes and is independent of the bath, the latter being heated by radiation.

The following are the types for the three categories of arc furnaces mentioned: The Siemens, Keller, Moissan, Stassano and Chaplet.

(*b*) *Resistance Furnaces.*—In the resistance furnaces heating is due exclusively to Joule's effect: $j = C^2 Rt$. Two classes exist. In the first the electric current passes directly into the metal to be melted; in the second the current passes into an auxiliary conductor, which heats the metal by conduction. These two classes are represented by Gin's canal furnace and the induction furnace. The idea of the induction furnace is due to Ziani de Ferranti, who patented it in Great Britain as far back as 1885. Ferranti's furnace is composed of an iron armature which has the form of a frame, and round one of its branches is wound a conductor, through which passes an alternating electric current. The secondary winding consists of a single spiral in short circuit, which amounts to a ring surrounding the other vertical branch of the frame. This ring is made of cast metal, is traversed by an induced current (the intensity of which is nearly equal to the primary current multiplied by the number of windings of the coil), and thus the transformation of electric energy into heat is made with the actual material to be heated. The Kjellin and Rhodenhauser furnaces are made on this principle.

Gassie's Induction Current Furnace.—The rapid progress of electric siderurgy revolutionized every metallurgical process. As yet we have no electric furnaces for smelting on the Witwatersrand gold mines, but the day is approaching when the electrification of the smelting furnaces will be an accomplished fact. It may be opportune to describe Gassie's induction furnace recently installed in Saint Jacques (France) with such striking success. This particular furnace is characterized by the low position of its induction coil, and principally by the use of specially selected materials in order to reduce to a minimum all eddy currents, loss due to hysteresis and dispersion. With this in view the armature was made of soft steel (silicon steel), which has a great resistivity and a very low coefficient of hysteresis.

The envelope of the masonry and also the parts which support the whole are made of non-magnetic steel, which contains 23 per cent. of nickel. The tub is naturally formed of several parts, insulated from each other, in order to avoid a closed metallic circuit through which only a portion of the current would pass. The refractory lining is made of either quartz in case of acid treatment or of dolomite and tar in case of a basic treatment. The core is formed of four branches, each composed of four bundles of sheet iron, separated from each other by a one inch air space for cooling purposes. Each bundle contains 105 pieces of sheet iron isolated from each other by a sheet of asbestos. The core weighs 12 tons. Its construction was a lengthy and delicate process, in view of all the precautions which had to be observed to avoid internal short circuits. The induction coil is composed of naked copper strips 1/8 inch thick by 3 15/16 inches long, assembled in twos to form a complete winding of 18 to 22 turns. An opening of 3/16 inch was left between each strip for the circulation of air for cooling purposes.

The Gassie's furnace avoids the use of circulating water for cooling, which is used in all other electric furnaces. Also the use of naked copper permits of easy variation in the number of turns in the coil. The simple alternating current of 16 cycles is provided by an inductor alternator of 400 kw., the load factor varying from 0.6 to 1. The excitation is provided by the power station at 250 v. The line which connects the alternator with the furnace measures some 60 feet. It is made of 12 copper cables of 0.19 inches cross section, spaced from each other in all directions by about 11.25 inches, the adjacent conductors being of opposite polarity. A room adjoining the furnace contains all regulating and measuring ap-

paratus, amongst which has to be mentioned an integrating wattmeter, which enables us to read at any moment the power consumed and also the power used for each operation of the process. The pressure in the primary does not exceed 300 volts and the intensity varies from 1,200 to 1,400 amperes.

Some Interesting Particulars During Reduction Operations.—The furnace under review treats 1.2 tons of steel. The chemical analysis during treatment can be made with perfect ease as compared with the old combustion furnace. The whole process, which can be started at a moment's notice. lasts two or three hours, and the energy consumed varies from 300 to 500 kw. hours per ton according to the metal treated.

Efficiency of Electric Furnaces.—It is most important to ascertain the efficiency of the electric furnace as compared with the coal or coke combustion furnace and to find the relative cost of electrical and fuel heat. In order to do so, we must consider in one way or another the amount of heat each type of furnace will generate, and what amount of electric energy will be required to be transformed into heat to produce as much as, say, one pound of coal would yield when being burnt. It is well-known that one kilowatt hour is equal to 3,415 British thermal units, and if we admit that one pound of best Transvaal or Natal coal on burning will give 12,000 to 14,000 British thermal units, we find that one pound of coal will be equal in calorific value to about 4 kw. hours. The first comparison seems not in favor of electric power, as we have to pay over a half-penny per unit, but in localities where water power can be developed cheaply, and also where the cost for transport of coal is high, electric power will be at once cheaper than coal. But the above comparison is superficial, incomplete and misleading, if we neglect consideration of the utilization of the heat generated. It should be borne in mind that the utilization of heat differs in an electric from that in a combustion furnace. The largest part of the heat generated in an electric furnace is actually utilized in heating the materials in the furnace, whereas in the combustion furnace this is not the case, particularly in one which requires a high temperature, the greatest portion of the heat being simply wasted and but a very small part actually utilized.

Before going into details I shall explain what I understand by the *efficiency* of a heating apparatus, such as a furnace. The efficiency is the ratio of heat units actually utilized in heating the contents, to the total heat units supplied either in the form of coal or electricity. In this connection the following table, prepared by Prof. Richards, will be of great interest, as it shows the typical efficiencies of the different furnaces:—

Crucible steel furnace	2 to 3%
Reverberatory furnace	10 to 15%
Regenerative furnace	20 to 30%
Shaft furnace	30 to 50%
Electric furnace	60 to 85%

These figures apply both for melting or smelting. A few words of comment will explain the above-mentioned table. In the crucible and reverheratory furnaces the greater part of the heat is carried away in the hot escaping gases. In the shaft furnace the heat is largely absorbed by the solid materials, mostly in the upper portions of the furnace. The furnace gases which are produced in electric smelting are very much less in volume than in combustion furnaces. Another point to be considered is the amount of atmospheric air that passes through the combustion furnaces in excess of that actually required to burn the fuel, which increases the already great loss of heat; and lastly, there is a serious loss due to incomplete combustion of fuel. All shut-downs, which are mostly inevitable, tend to lessen the efficiency of combustion furnaces, but the same does not apply to electric furnaces, as the supply of electrical energy is simply cut off. Thus, comparing the relative costs of electric and fuel combustion from the point of efficiency or useful work done, the electric furnace proves to be cheaper.

Experiments have been made, and it was established by actual measurements, that a much larger proportion of the heat generated electrically is transferred to the furnace charge than it is possible in a combustion furnace, in which the carrier of heat consists of a larger volume of gas, and in spite of all regenerative (Siemens) methods for smelting work, the method of heat transference by the individual hot gas molecules to the metal baths is a faulty one indeed. In the electric furnace, however, the main portion of heat is generated in the space intervening between the electrode and the slag, which space is less than an inch in width. The bottom surface of the electrode is at the volatilization temperature of the carbon, and thus a considerable portion of heat passes to the smelting charge by radiation, by means of carbon vapor. The carbon vapor, which starts from the electrode, is impinging continually on the surface of the slag, and is consumed by the slag oxides. In this way both fused materials, metal and slab, themselves form additional producers of heat. They further serve as resistance in the path of the current, and the layer of slag converts a very large amount of electricity into heat. The distribution of heat in the electric furnace is a long way the more economical. A most energetic reaction takes place in the space between the overheated particles of the slag, the electrodes and the constituents of the metal bath, which is the reason of the immense success of the operation. The rapidity of the work is due to the high current density, the enormous heat production in a narrow space, and the very great rapidity of the chemical reactions. All this produces an energetic mechanical flow of the liquid particles in the slag and the metal, which has a most favorable influence upon the desired change of constitution.

There will probably be many sceptics as to whether the electric furnace will supplant the different combustion furnaces mainly for smelting now in use on the Rand, but to those I would point out that at the end of 1910, France had only one electric furnace, and hardly twelve months later the number grew to thirty-five. Electricity has won the day everywhere, in spite of conservative opposition, and ere long war will be declared on the old combustion furnace, and I would recommend everyone to be on the side of the electric furnace.

The development of the natural gas areas in New Brunswick is proving a boon to the Intercolonial Railways. In the shops at Moncton it is used exclusively for the generation of power. The steady and reliable heat makes it an ideal fuel for the blacksmiths' forges, furnaces and gas engines. Being immediately ready for use there is no time wasted in "firing-up." Over 30,000,000 cubic feet of gas were used in September, and in the winter months 50,000,000 feet per month will be necessary to meet the railway's requirements, and results show considerable saving in expenditure. It is not generally known that this gas is used for the lighting of the railway's passenger cars all over the line.

EXTINGUISHING OF FIRES IN OILS AND VOLATILE LIQUIDS.

A PAPER dealing with the difficult problem of extinguishing fires in oils and in volatile liquids, has been written by Edw. A. Barrier, of the Department of Inspection, Associated Factory Mutual Fire Insurance Companies, Boston, for the American Society of Mechanical Engineers, New York. In his article, Mr. Barrier says that our most common extinguishing agent, water, works rather unsatisfactorily, and frequently disastrously, where fires of this kind occur; but concedes that it is still the only one available where heroic measures are required. However, two or three other materials have been introduced as extinguishers which have given promising results, and Mr. Barrier's paper is devoted to a discussion of these materials and to the conditions under which they prove most efficient.

It is only fires in volatile liquids where these are not miscible with water, in which water is of little or no effect, save to wash the burning liquid out of the building, where it may be consumed completely, or, if the quantity of liquid is small, where it may be extinguished by the brute cooling effect of a large quantity of water sprayed upon the fire. Where the liquid (such as denatured alcohol, wood alcohol, grain alcohol, acetone, etc.) is miscible with water, water may, of course, be used effectively. For non-miscible liquids, soda and acid are somewhat more effective, though non-infallible, extinguishers. However, only two principles can be relied upon in the extinguishing of fires in volatile oils—e.g., either to form a blanket of gas or of some solid material over the burning liquid so as to exclude the oxygen of the air, or to dilute the burning liquid with a miscible and non-inflammable extinguishing agent.

Mr. Barrier proceeds by discussing sawdust and bicarbonate of soda as blanketing types of extinguishers.

Ordinary sawdust is an excellent extinguishing agent for certain volatile liquids, especially those of a viscous nature. In the fall of 1912, experiments were performed by the inspection department of the Associated Factory Mutual Fire Insurance Companies, and fires in lacquer and gasoline in tanks were extinguished with sawdust with results both surprising and satisfactory.

The liquids were placed in three tanks 30 in. long, 12 in. wide and 16 in. deep; 48 in. long, 14 in. wide and 16 in. deep; and 60 in. long, 30 in. wide and 16 in. deep. The sawdust was applied with a long-handled, light but substantially built snow shovel having a blade of considerable area. In every case the fires were extinguished readily, especially in the two smaller tanks which were about as large as any ordinarily employed for lacquer in manufacturing establishments.

The efficiency of sawdust is greater on viscous liquids than on thin liquids; because it floats more readily upon the former. The sawdust is not easily ignited; but, when ignited, both burns without flame, and does not generate sufficient heat to reignite the liquid. Again, the character of the sawdust, whether from soft or from hard wood, is not an important consideration; neither is the amount of moisture contained in it; and thus the drying out of the sawdust when kept in manufacturing establishments for a time, does not effect its efficiency. However, the experiments showed that the admixture of bicarbonate of soda increases greatly the efficiency of sawdust, both by shortening the time of extinguishing and by decreasing the amount of material necessary. A further advantage of the admixture is that it decreases the possible danger resulting from the presence of sawdust in manufacturing plants. It would be difficult, probably impossible, to ignite the mixture through any chance carelessness.

Though the efficiency of the sawdust is greatest on viscous liquids, such as lacquers, heavy oils, etc., it was tested very satisfactorily also upon ignited gasoline, both contained in the smallest tank and spread upon the ground. Tests of the mixture conducted in larger tanks upon ignited thin liquids were unsatisfactory; since the sawdust sinks before the whole surface can be covered, and the exposed liquid reignites.

Another agent to which attention has been devoted in recent years is carbon tetrachloride. It is non-inflammable, non-explosive, and readily miscible with oils, waxes, japan, etc. When mixed with inflammable liquids, it renders them non-inflammable, provided a sufficient quantity is added. The specific gravity of its vapor is about 5½ times that of air; consequently it settles very rapidly. As an extinguishing agent, it both acts as a blanqueting agent—covering the burning liquid with gas or vapor—and dilutes the inflammable liquid, rendering it non-inflammable.

The use of carbon tetrachloride as an extinguisher has been explored chiefly by certain manufacturers producing extinguishers which use liquids; but the claims made for these extinguishers are, for the most part, grossly exaggerated, declares Mr. Barrier. None of these is more efficient than carbon tetrachloride, and none is the equivalent of ordinary water extinguishers for general use on such materials as cotton, wool, paper, oily waste, etc. However, Mr. Barrier allows that, on volatile liquids, oils, etc., carbon tetrachloride has shown very satisfactory results under some conditions, and allowing for the skill of the operator and the nature of the fire. For example, in tank fires the length of time that the liquid has been burning is an important factor; for, where the sides of the tank have become heated, the only way in which the fire can be extinguished is to squirt the liquid forcibly at the sides. To squirt it directly into the liquid makes extinguishing much more difficult, if not impossible.

A second important consideration is the height of the liquid in the tank. Where the liquid is low, the sides form a pocket which retains the vapor and aids considerably in smothering the blaze. When the tank is nearly full, however, this condition does not exist, and it is then very difficult, if not impossible, to extinguish a fire in a highly volatile liquid, such as gasoline; and only the most skilled operators are successful in these cases. Further, the size of the tank or the extent of the fire if upon the floor is, as would be expected, of considerable importance. In tanks larger than about 28 in. by 12 in., more than one extinguisher and operator working at a time are necessary to extinguish a fire in such materials as gasoline. In one test where a tank 60 in. by 30 in. was used no less than seven operators were necessary, and even then it was only with the greatest difficulty that the fire was put out.

Mr. Barrier points out that his remarks apply to carbon tetrachloride as generally sold in the ordinary one-quart extinguishers, and proceeds to consider the probability of greater efficiency from a larger extinguisher. This, however, would have to be specially designed to make it readily portable by mounting on a truck or some similar means. The writer then discusses a few systems recently installed in which an elevated tank containing carbon tetrachloride was connected with automatic

sprinklers or perforated pipes located in hazardous rooms where volatile and inflammable liquids are in use. So far as is known none of these systems has as yet been called upon to extinguish a fire, but there appears to be no reason why such a system should not provide excellent protection in special cases. In such systems it would be necessary to consider the safety of the workmen and furnish ready means of escape, since carbon tetrachloride is an anesthetic and where thoroughly sprayed through the air as from an automatic sprinkler it would probably produce rapid results.

The nature and effect of the fumes given off when carbon tetrachloride is thrown upon a fire is a subject which has received a great deal of discussion. When the liquid comes in contact with a fire the vapor is partly decomposed resulting in the evolution of a considerable quantity of black smoke which is undoubtedly finely divided carbon. Pungent gases are also produced which appear to be mostly hydrochloric acid with possibly a small amount of chlorine. Since carbon tetrachloride contains no hydrogen from which hydrochloric acid could be formed this substance must be produced by the action of chlorine on the gases arising from the burning material or upon the moisture of the air.

The fumes of carbon tetrachloride although of a very pungent nature do not produce any permanent injury under ordinary conditions where the operator can make his escape after he has inhaled all that he can stand, but they are a distinct handicap in fighting a fire and are one of the objectionable features to carbon tetrachloride as a general fire extinguishing agent. In large rooms or where a small quantity of carbon tetrachloride is sufficient to extinguish a fire the gases are of course less objectionable.

Mr. Barrier concludes his paper with the consideration of the method of extinguishing fires in oils and volatile liquids, recently proposed and experimented, e.g., the use of frothy mixtures. He considers the idea as a favorable one, the tests thus far reported having indicated satisfactory and promising results. The principle of this process the writer shows to be by causing two liquids to mix in a tank where foam is produced, by making the tank air-tight and then forcing the foam out by carbon dioxide under pressure and conveying it to the fire by means of a line of hose. However, no experiments have, as far as is known, been conducted in this country; and German scientists have not disclosed the exact nature of the liquids used. Yet, Mr. Barrier concluded with the statement that this method of extinguishing fires in oils and volatile liquids will undoubtedly prove to be by far the most efficient of any that has as yet been suggested.

NATIONAL ASSOCIATION OF PURCHASING AGENTS.

This new organization was formed in New York City on October 16th. Its membership will include purchasing agents and buyers representing some of the largest industrial corporations, railroads, steamship lines, street railways, gas and electric companies in New York, New Jersey, and Connecticut, The association has already a membership exceeding one hundred. H. T. Leeming, of Thos. A. Edison, Inc., is President, and E. B. Hendricks is Secretary-Treasurer.

The double-track electric railroad which is being built between Tokyo and Yokohama will be the most up-to-date in the Orient when finished early next year.

RAILWAYS AND MOTOR TRACTION.

THE following extracts from a paper by Mr. W. W. Hoy, general manager of South African Railways, read at the recent conference in London (Eng.) on motor traction, will be of interest in showing the possibilities of freight service to districts which, under ordinary conditions, would not have a railway line laid for many years.

In the course of his remarks, Mr. Hoy stated that the progress that has been made in constructing and perfecting road motor vehicles has been keenly followed by the South African Railway authorities, and the use of motor transport is regarded as a system especially suited to South African conditions, and should prove of great value for developing outlying districts sufficiently until the traffic offering justifies the construction of a line of railways, when the motor vehicles would be available for use in the development of other districts.

Attention was drawn to the fact that the South African railways are state-owned and motor services as feeders to the railways can be worked as branch services, the organization being as far as possible on railway lines.

Mr. Hoy pointed out how at one depot the postmaster controlled the motor staff and running details of service, whilst at others, duties were performed by the station master, thus ensuring economy.

As regards the most suitable type of vehicles, Mr. Hoy said, speaking generally, he was of opinion that for cross country freight traffic, powerful paraffin tractors with large and wide wheels would be most suitable. In most cases rubber-tired vehicles for heavy goods traffic could not be regarded as a practical proposition where transport had, in some cases, to be done at the rate of 4d. per ton per mile.

The average working costs for a paraffin tractor and trailers Mr. Hoy gave as follows:—

Average daily run (in miles), 15 to 30.

Average cost per car mile, including 20 per cent. depreciation, 4 per cent. interest, rent, insurance and supervision charges, 4s.

Cost per ton per mile, 5d.—3d. 15 to 30 miles.

Miles per gallon of fuel, 1.5 m. p.g.

Costing per car mile, 4s. 9d.

INCREASING PRODUCTION OF CEMENT.

According to the statistics contained in the report of Mr. J. McLeish on Economic Minerals and Mining Industries of Canada, the total production of cement in British Columbia in 1911 amounted to 401,000 bbls. valued at $601,500; in 1912 to 511,539 bbls., valued at $767,038; in Alberta for 1911 it amounted to 512,176 bbls. at a value of $1,241,535, for 1912 to 821,165 bbls., at a value of $1,775,898; in Ontario, for 1911, the production attained to 3,090,786 bbls., valued at $3,741,039, for 1912 to 3,044,713 bbls., valued at $3,372,897; and in Quebec, for 1911 the outlay was 1,614,730 bbls., worth $1,963,439, while for 1912 it was 2,714,685 bbls., worth $3,134,499. In each province is shown an increase in both production and the value thereof.

Eight years of labor and the expenditure of nearly $30,000,000 had their fruition on November 4th, when the water of the Los Angeles aqueduct, drawn from the high Sierras, 260 miles eastward, was turned into the big San Bernardino reservoir, 23 miles north of the city. Caravans of automobiles took crowds out to the reservoir, which was the scene of the initial features of a two days' celebration.

COAST TO COAST.

Regina, Sask.—The G.T.P. is operating another 100 miles of its new line through British Columbia.

Fredericton, N.B.—The Foundation Company, Limited, has completed its work on the Highway Bridge, and is shipping its plant to its next centre of labor.

Vancouver, B.C.—The matter of the formation of a water commission to take charge of the supply to Vancouver, as well as to the outlying municipalities, is being considered by Provincial Water Commissioner Young.

St. Thomas, Ont.—The three transformers for the new hydro-electric sub-station on the armory property, are being installed. This station is to supply several industries in the southern part of the city, and will relieve greatly the load on the main station.

Nelson, B.C.—Mr. W. P. Tierney, contractor for this portion of the C.P.R. Railway, announces that by December 15th the Kaslo and Slocan line, which is to provide railway connection between Kaslo, Slocan, the Arrow Lake and the coast, will be in operation.

Medicine Hat, Alta.—The new power plant was in operation the 23rd, 24th and 25th of October, and in the course of a few days will be put into permanent operation. In the Construction Department 2-10 K.W., 2-5 K.W., 2-2 K.W. transformers were installed.

Camrose, Alta.—While proceeding with drilling for natural gas at Camrose, the contractors have struck a 15-foot seam of coal. The coal is said to be of splendid quality, and was encountered at a depth of 400 feet. The contract for gas drilling calls for a depth of 1,500 feet.

Sault Ste. Marie, Ont.—Strenuous endeavor is being made to make sure the passing of the new drydock by-law. The $25,000 guarantee deposit has been placed in the Bank of Commerce. The people seem anxious to secure the new $10,000,000 industry, to which they will give a bonus of $20,000 per year for 20 years.

Edmonton, Alta.—On November 17th, 200 miles of new railway on the Canadian Northern Railway's western division were placed in operation. Of these 200 miles, 150 are in Alberta, and the remainder in Saskatchewan. These new stretches of railway provide new services between Alsask and Hanna, and between Drumweller and Hanna, in Alberta, and from McRorie to Elrose, Sask.

Ottawa, Ont.—Mr. J. D. McArthur, contractor for the Hudson Bay Railway from Le Pas to Port Nelson, stated while in the capital that over 159 of the 420 miles to be graded have been completed; and that before the season's operations cease, steel will have been laid on 130 miles of the grade. At the end of next season, Mr. McArthur hopes to have reached Port Nelson with the grade.

Port Arthur, Ont.—It is expected to complete the connection of the Sudbury-Port Arthur section of the C.N.R. before the end of December, and, if necessary, a freight service may be run over the line during the winter. The first passenger train will run some time during the summer of 1914. To lay the line from Ruel to Port Arthur, a distance of about 500 miles, will have taken approximately two and a half years.

Fort William, Ont.—The Mission River has been officially declared open for navigation. Captain McAllister, harbor-master, and W. P. Merrick, harbor engineer, performed the ceremony by placing the spar buoys marking the channel from the mouth of the river out into the deep lake water. The dredging of this channel was started early in the spring, and has resulted in a passage 600 feet wide, 25 feet deep, and extending over 1,400 feet.

Medicine Hat, Alta.—The report of the city health officer on the water supply, dated October 31st, declares that analysis of city water has shown it to be almost entirely pure. There are contained only small quantities of harmless salts and lime, aside from traces of silica, aluminum and oxide of iron. The colon bacillus (typhoid germ) was entirely absent, while the bacterial count was 118 per cubic centimeter, which is remarkably low.

Redcliff, Alta.—Mr. R. Wray, superintendent of the Gas and Light Company, has stated that within a few days the south end of the town will be connected with the new gas well on the river bank, and will be supplied with a uniform pressure equal to that enjoyed by the rest of the city. This year, moreover, the company expect to accomplish the laying of 26,340 additional feet, or five miles, of pipe, and the gas building is now practically ready for occupancy.

Medicine Hat, Alta.—Two new gas wells were completed during the month of October, one in the West Industrial Site and one in Harlow Fuller Subdivision, and up to date these wells are satisfactory, the Harlow Fuller well being an especially good one, the capacity being over 3,000,000 cubic feet for 24 hours and the rock pressure approximately 550 pounds per square inch. A well in Block 5, Cousins & Sissons' Subdivision, is under course of construction at the present time.

Galt, Ont.—It is expected in Galt that the C.P.R. double-tracked main line will have reached there before 1915. The track is already in operation between West Toronto and Erindale; and work is proceeding satisfactorily to Guelph Junction. Tracks have been laid, but the new roadbed has yet to be ballasted. The work, however, cannot be carried much further than Galt next season; for several natural difficulties, such as rock cuts and deep gullies, will force construction to progress much less rapidly. Considerable time will be required before the road has reached Woodstock and London.

Winnipeg, Man.—A special announcement to the Winnipeg "Weekly Beacon" from Mr. Collingwood Schreiber, the Dominion Government's chief engineer, says: "The golden spike of the Grand Trunk Pacific Railway will be driven near Fort Fraser, B.C., early next summer. By April the grading of the line will be completed." Less than 300 miles remain to complete the connection of the Transcontinental Railway. Either the Duke of Connaught or Premier Borden is to drive the final spike; and old No. 1 engine, of the G.T.R., still on duty as a shunter in the east, will pull the first through train over the new road from old Ontario to the Pacific Coast.

Ford, Ont.—This new city is distinguished by the fact that the foundation for a mammoth producer-gas engine has been finished here. The engine is to supply power for the Ford Motor Company plant in Detroit. The length of this latest creation in power plant engine building is 73 feet and its overall width is 32 feet. The crank shaft is 32 inches in diameter, 25 feet long, carrying an 80-ton fly-wheel and a 2,500 kw. generator; armature and the connecting rods weigh 10,300 pounds each. The generator is capable of carrying a 25 per cent. overload, and the engine has a capacity of 5,000 i.h.p. Work on this new power plant is being rushed as the capacity of the present generating apparatus is much over-taxed.

Victoria, B.C.—As a result of the settlement of the earth beneath the pavement on Oxford Street, between Linden and Moss Streets, the big brick sewer constructed along that street three years ago has caved in, the pavement above has collapsed, and damage which will require an expenditure of approximately $8,000 to repair, has been done. The street, when the roadway improvement was made, was graded up

to the requisite level, and apparently this new earth, with the action of the water which has drained beneath the pave-base has settled the earth, the pressure on the sides of the brick sewer beneath causing the cave-in on that work. The lack of support beneath the pavement has allowed that part of the street work to settle.

Montreal, Que.—Mr. R. P. B. Motley, the chief engineer of bridges for the C.P.R., said, in reference to the Lachine bridge construction, that three years had been necessary for the work owing to the fact that the traffic over the bridge on the single track was not delayed for a moment throughout the entire time of erection. In reality there were two bridges, each of single track, and by well-considered methods the structure was erected in sections—traffic being shifted from up stream to down stream until the bridge was completed. The bridge is now open for double-track service, and will be of immense convenience and benefit in the operation of traffic in and out of the Montreal terminals. The Lachine bridge adds another to the many engineering triumphs the C.P.R. has realized since its inception—the necessities of the original survey, especially in the West, compelling the company to build almost countless bridges as it went along, which early gave the company a deep interest in efficient designing and bridge building.

Saskatoon, Sask.—Engineer Clark has reported to the city council concerning the flow of quicksand on Long Hill slide the following: "The driving of the steel sheet piling was completed on Saturday, October 25th, and during the following week excavation was being made through the quicksand layer down to clay for the purpose of placing boulders. This had been accomplished for about one-half the total length when towards the east end of the piling the layer of sand became thicker and apparently dipped into the face of the hill. The removal of part of the top dry soil which was necessary in order to determine the conditions existing, allowed the running sand to flow so freely that excavation was at once stopped and arrangements were made to drive sheet piling to prevent a further flow of sand until the excavation could be made. The seriousness of this situation is understood when it is explained that the sand was apparently flowing from underneath the end of the retaining wall. The work of driving the sheet piling is well under way. Mr. Clark, however, would not state positively that the driving of sheet piling will stop the flow permanently.

Vancouver, B.C.—The work on the new station in connection with the terminal improvement scheme for the C.P.R. is progressing favorably. It is expected that the east section of the new depot will be ready for occupancy by Feb. 1st. The new building will, when erected, be an imposing structure, with massive Corinthian columns adorning the facade, and with stone cornices and trimmings enhancing its general appearance. The building will extend almost two blocks along Cordova Street, from the middle of the block between Seymour and Richards to Granville Street. It will be of the most up-to-date and substantial construction, strongly reinforced with steel, with concrete floors and solid pillars. The retaining wall in front of the depot, built in order that the tracks may be raised five feet from the present level, is now nearly finished. A railing to separate the passenger tracks from the yards and freight lines will surmount the wall. The change in the grade will result in a greater elevation for the entire station layout, leaving the other tracks on the present level. The girders for the station shed, which will jut out from the main building, are now being placed in position.

Victoria, B.C.—The Provincial Government has expended this year the gigantic sum of $4,000,000 on road extension and improvement work, according to the recently issued statement of the Hon. Thomas Taylor, minister of public works. The present length of roads and trails in British Columbia is 18,000 miles; and the sum required for maintenance has increased, and will increase, rapidly, owing to the additional mileage, and to new conditions which have arisen during the past few years. Upon bridges, which are generally classified under the heading of road improvements, the sum of $900,000 has been expended by the provincial works department this year, with $50,000 for wharves, and $70,000 for road location work. On road machinery, of which the most up-to-date types have been secured, the expenditure was $100,000. The road construction of particular interest was, however, the Banff-Windermere road. When it is finished there will be in existence a fine, circular 500-mile auto highway running from Calgary through to Banff, across the boundary line to Castle Mountain, south to Sinclair, further south to Fort Steele, thence east through Southern Alberta, and north again to Calgary via the Alberta roads, parallel to the Calgary-Macleod Railway line. Every link in this great highway is now in use except between Castle Mountain and Sinclair, a distance of seventy-two miles, of which about thirty-five miles of roadwork has been completed, leaving less than forty to finish next year. It is generally believed that with a sufficient appropriation from the Legislature next year, and good working conditions, the highway link referred to will be finished before the end of 1914. Great progress has been made in connecting the different district trunk roads into one main road to traverse the province, over $100,000 being spent upon the Hope-Princeton connection, while through the Similkameen, Grand Fork, Greenwood, Ymir, Fernie and Cranbrook districts, splendid progress has been made with standardization work.

Vancouver, B.C.—Mr. Sidney Billington has written an interesting sketch concerning the opening up of the Fort Fraser district and the linking up of the Transcontinental line between the east and the west, now rapidly nearing completion. The following is an abridged quotation: "Boundless farm, forest and mines in the northern interior of British Columbia will be thrown open to hundreds of thousands of settlers next year when the transcontinental line of the Grand Trunk Pacific Railroad will have direct communication between Prince Rupert, the western terminus, and the eastern maritime seaboard. The only remaining link to be completed is represented by a comparatively few miles in British Columbia, and there is every assurance that the contractors will complete their stupendous task before the end of the summer of 1914. With few exceptions, indeed, the grading is now completed and the worst of the canyons which disputed the progress of the bands of steel have been spanned. Mineralogists and agricultural experts are agreed that the section of British Columbia through which the line passes contains tremendous values which will amply repay those who undertake the development. Logical trade centres are being established along the route, and many of these will be invaluable to miner and agriculturist alike. A disputed point is, however, the possibility of too many townsites being instituted. With Fort Fraser, the situation is entirely different. It has no opposition. The town is growing up on absolutely fixed lines, and will draw on the largest stretch of agricultural country anywhere in British Columbia. Anything that will grow outside the tropics has been raised to perfection in the Fort Fraser district, and the average crops per acre are large enough to show highly satisfactory returns, giving handsome profits on the time and capital expended. And now, where a year ago stood a pre-emptor's hut, a town is daily growing into an active commercial centre. With an unlimited supply of water power for hydro-electric purposes, Fort Fraser will attract many large industrial concerns, which, being on the ground, will have the advantage over freight rates and be enabled to successfully compete with the manufacturers in east and south."

PERSONAL.

LEONARD W. RUNDLETT, city commissioner and city engineer of Moose Jaw, Sask., has tendered his resignation, to take effect January 1st, 1914.

FRANK B. GILBRETH, consulting engineer, New York City, addressed a large meeting of the Engineering Society on November 12th on one of the numerous phases of the subject of "Scientific Management."

GEORGE SERVICE, consulting engineer, of Toronto, has become associated with the Dominion Power and Transmission Company, Limited, Hamilton, taking charge of the construction of their new steam plant.

C. J. McLAUGHLIN, of the United States Department of Health, Washington, is working in conjunction with Dr. J. W. S. McCullough, Provincial Officer of Health for Ontario, in the preparation of an exhaustive report on the "Pollution of Boundary Waters" to be made to the International Waterways Commission in the course of a few days.

JOHN B. ARMSTRONG, for several years in charge, as chief engineer of construction, of the building of the Hudson Bay Railway, has tendered his resignation to the Government. He purposes engaging in contracting. It is stated that J. PORTER, who has been on the construction of the National Transcontinental Railway, will succeed him.

OBITUARY.

The late Mr. JAMES MELVILLE ROBERTSON, A.M.I.C.E. and A.M. Can. Soc. C.E., who was accidentally killed by the discharge of a rifle at Sylvan Lake, Alberta, on the 14th of September last, was the only son of Mr. and Mrs. James Robertson, of Bonneybridge, Stirlingshire, Scotland He was 27 years of age, and received his earlier education and training for the profession in Glasgow, Scotland, being a graduate of the Glasgow West of Scotland Technical College, and afterwards a pupil of Messrs. Wharrie & Colledge, Civil Engineers, Glasgow. His experience subsequently has been principally on Canadian railways. By his great zeal for his work and thoroughness in the execution of his duties, he rapidly gained the confidence of his employers, and at the time of his death held the position of resident engineer on the construction of an important part of the Alberta Central Railway, which included the building of the large bridge across the North Saskatchewan River at Rocky Mountain House, Alta. He was a young man of sterling character, with bright prospects for the future, and made for himself many professional associates.

THE AMERICAN INSTITUTE OF ARCHITECTS.

The 47th annual convention of the American Institute of Architects is to be held in New Orleans, La., on Dec. 2nd, 3rd and 4th.

1914 CONGRESS, AMERICAN HIGHWAY ASSOCIATION.

Knowing well the benefit of the impetus to good roads throughout surrounding territory which the American Road Congress affords the city in which it is held, some fifteen of the leading cities of the United States are vigorously contending for the 1914 Congress. While no decision has yet been reached, it is indicated that the contest is principally between Atlanta, Denver and New Orleans. It is stated that San Francisco, Spokane and Los Angeles are campaigning vigorously to secure the Congress for 1915, the year that the opening of the Panama Canal will be celebrated on the Pacific Coast.

THE DRIVING OF MOUNT ROYAL TUNNEL.

The Engineering Alumni Association of the University of Toronto held its first meeting for the season on Monday evening, November 17th. Mr. S. P. Brown, Managing Engineer, Montreal Tunnel and Terminal Company, addressed the meeting on the "Mount Royal Tunnel." His talk was well illustrated by numerous slides, descriptive of the engineering features of the work, and comparative of this great undertaking of the Canadian Northern with the Pennsylvania Tunnel and the New York East River Tunnel. About three hundred members of the Engineering Alumni Association were in attendance, while the Toronto Branch of the American Institute of Electrical Engineers were also present to the extent of about twenty members.

CANADIAN SOCIETY OF CIVIL ENGINEERS, VICTORIA BRANCH.

On Nov. 13th, the Victoria Branch was addressed by Mr. H. A. Icke, who spoke upon "Some Disregarded Stresses in Reinforced Concrete Design." The next assembly is the annual meeting on Dec. 11th, when Mr. F. C. Gamble will give an address, entitled "Some Engineering Works in British Columbia." The annual election of officers will also take place at this December meeting.

ANNIVERSARY DINNER.

The University of Toronto, Engineering Society, announce the date of their Annual Dinner as Friday evening, December 5th. The event is being held in honor of Dean Galbraith, this being the fiftieth anniversary of his entrance to the University of Toronto as a student, and the thirty-fifth anniversary of the founding of the School of Practical Science, which, seven years ago, became associated with the University of Toronto as the Faculty of Applied Science and Engineering.

COMING MEETINGS.

AMERICAN INSTITUTE OF ARCHITECTS.—Forty-seventh Annual Convention, to be held in New Orleans, La., December 2nd, 3rd and 4th.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.—Annual Meeting will be held in New York, December 2nd to 5th. Secretary, W. H. Reed, 154 Nassau Street, New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The Annual Meeting will be held in New York, December 2nd to 5th, 1913.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—Annual Meeting to be held in New York, December 10th to 13th. Secretary, C. D. Odsen, Polytechnic Institute, Brooklyn, N.Y.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—Seventh Annual Convention will be held at Great Northern Hotel, Chicago, December 29th to 31st. Secretary, I. W. Dickerson, Urbana, Ill.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found sommaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20758—November 7—Approving location Glengarry and Stormont Ry. Co.'s line from mileage 0 to 24.05.

20759—November 6—Relieving C.P.R. from providing further protection at crossing of Godfrey Avenue, Winnipeg, Man.

20760—October 30—Refusing application of S. J. Blair, Calgary, Alta., for an Order staying proceedings under Order No. 19075, dated April 16th, 1913, and for permission to re-open matter of application of C.P.R. for authority to construct branch line for Northern Electric and Manufacturing Co., Limited, Calgary; but that Order authorizing construction of said spur be not construed as giving effect to said consent as will any way prejudice Applicant from hereafter claiming that Ry. Co. cannot construct said spur over land of Applicant without first taking expropriation proceedings under provisions of Railway Act.

20761—October 30—Granting application city of Calgary, Alta., for an Order directing C.P.R. to provide suitable level crossing where Calgary and Edmonton Ry. intersects 32nd Avenue: crossing to be constructed in accordance with Standard Regulations, and at expense of city.

20762—November 5—Granting application Rural Mun. of Fort Garry, Man., for an Order directing C.N.R. to provide proper culvert under its tracks where same cross Waller Avenue; culvert to be constructed at expense of said Rural Mun. of Fort Garry.

20763—November 5—Granting application Rural Mun., Fort Garry, Man., for an Order directing C.N.R. to provide crossing over said Ry., at Southwood Avenue, said municipality, at expense of municipality.

20764—November 4—Amending Order No. 20018, dated August 14th, 1913, by providing that cost of maintenance of watchman employed at crossing of Anderson Street, town of Grenfell, Sask., be apportioned as follows:—60 per cent. by C.P.R. and 40 per cent. by municipality of town of Grenfell.

20765—October 31—Directing that C.N.R. file with Board within ten days from date of this Order, plan in triplicate of a freight shed 30 x 40 ft., to be erected at St. Albert, Alta., Ry. Co. erect same within 30 days after approval of said plans.

20766—November 5—Granting application of Rural Mun. of Fort Garry, Man., for an Order directing C.N.R. to provide crossing over its tracks at Chevrier Boulevard, at expense of said municipality of Fort Garry.

20767—November 5—Granting application Rural Mun., Fort Garry, for an Order directing C.N.R. to provide crossing at Waller Avenue, at expense of said municipality of Fort Garry, Man.

20768—November 1—Dismissing application city Saskatoon, Sask., for an Order for leave to construct highway across C.P.R., at Avenue J, said city, by carrying Avenue J across at rail level.

20769—November 1—Granting application city of Saskatoon, for an Order to construct highway across C.P.R., at rail level, at Avenue I, said city, at its own expense.

20770—October 31—Finding and adjudging that title of Ry. Co. (Calgary and Edmonton Ry.), is sufficient and effective as against municipality of city of Edmonton, Alta., and should Peace Avenue be opened up, such opening would be subject to seniority of Ry. Co.'s title and construction.

20771—October 31—Finding and adjudging that title of Calgary and Edmonton Ry. Co., is sufficient and effective as against Mun. city of Edmonton, Alta., and that should Athabasca Avenue be opened, such opening would be subject to seniority of Ry. Co.'s title and construction.

20772—November 7—Rescinding Order No. 20624, dated October 22, 1913.

20773—November 8—Extending, until January 15th, 1914, time within which C.P.R. install bell at crossing of Port Burwell Road, at mileage 32.7 Port Burwell Branch.

20774—November 7—Authorizing C.P.R. to construct spur for loading ties from a point on southerly limit of right of way on its main line, White River Subdivision, Lake Superior Division, at mileage 44.32 from Chapleau, Tp. 43, Dist. Algoma, Ont.

20775—November 6—Authorizing C.P.R. to construct spur for Frontenac Floor and Wall Tile Co., Limited, Kingston, Ont., from a point on northerly limit of right of way, at mileage 101.58, Ont. Division, Kingston Subdivision, in Lot No. 8, Con. West of Great Cataraqua River, Tp. Kingston, Co. Frontenac, Ont.

20776—November 8—Authorizing C.P.R. to construct Lacombe Easterly Branch of Calgary and Edmonton Ry. Co., across thirty-nine (39) highways, mileage 180.61 to 221.11.

20777—November 8—Approving location C.P.R. station in Lot 16, Con. 5, Tp. Tay, Co. Simcoe, Ont., at Port McNicoll, at mileage 88.32 on Port McNicoll Subdivision, Ont. Division.

20778—November 10—Rescinding Order No. 20638, dated October 22nd, 1913.

20779—November 10—Authorizing C.P.R. to open for traffic portion of Lacombe Easterly Branch from Consort, at mileage 139, to Monitor, at mileage 149.

20780—November 8—Directing that, on or before June 1st, 1914, the C.P.R. install improved type of automatic illuminated electric bell at crossing of public road east of Mountain Grove Station, Ont., at mileage 44.65 on Havelock Subdivision, and thereafter maintain bell at its own expense; 20 per cent. of cost of installing be paid out of "The Railway Grade Crossing Fund," remainder by Ry. Co.

20781—November 10—Authorizing C.P.R. to open for traffic Lacombe Easterly Branch from Coronation to Consort, Alta., a distance of 32 miles: Provided that, pending completion of diversions, speed of eastbound trains approaching crossings at mileages 132.6 and 136.3 be reduced to 10 miles an hour, and bells be rung continuously between whistling posts and crossings. 2. Rescinding Order No. 17852, dated October 25th, 1912.

20782—November 8—Approving plan showing Logan Drain where it crosses G.T.R. in village of Blyth, Ont.

20783—November 7—Authorizing G.T.R. to construct and maintain, at its own expense, Bridge No. 62, mileage 152.25 from Black Rock, carrying 20th District of its Ry., over public road between Lot 12, Huron Road Con. and Lot 83, Maitland Con. Tp. Goderich, Co. Huron, Ontario.

20784—November 10—Approving location C.N.O.R. Parry Sound-North Bay line through Tps. Gurd, Nipissing, Himsworth and Ferris, Districts Parry Sound and Nipissing, Ont., from mileage 209.52 to 233.90, from Toronto.

20785—November 11—Approving revised location C.P.R. from mileage 5.08 to 7.16 and from mileage 9.68 to 11.51, Schreiber Subdivision, Lake Superior Division.

20786—November 11—Authorizing G.T.R. to construct siding into premises of Andrew Malcolm Furniture Co.,

Limited, town of Listowel, Co. Perth, Ont.; and to change location of existing track south of the proposed siding.

20787—November 10—Approving location C.N.O.R. Parry Sound-North Bay line through Tps. Burpee, Burton, Mackenzie, Ferrie and Mills, District Parry Sound, Ont., mileage 170 to 190 from Toronto.

20788—November 10—Approving location C.N.O.R. Parry Sound-North Bay line through Tps. Patterson, Pringle and Mills, District Parry Sound, mileage 190 to 209.52 from Toronto.

20789—November 11—Authorizing Esquimalt and Nanaimo Ry. to construct spur at Cowichan Lake, B.C., across roadway to station at that point.

20790—November 10—Directing that C.P.R. reconstruct culvert on its Chalk River Subdivision, Eastern Division, Bridge No. 53.2 near Arnprior, Ont.: work to be completed by January 1st, 1914.

20791—November 11—Relieving C.P.R. from providing further protection at crossing of public road at Cluny, Alta., at mileage 116.2 on Calgary Subdivision.

General Order No. 113—November 5—Adopting and confirming conditions and specifications set forth in Schedule hereunto annexed, under heading "Rules for Wires Crossing Railways," as conditions and specifications applicable to erection, placing or maintaining or electric lines, wires, or cables across all Rys., subject to jurisdiction of Board: Part 1 being applicable where line is carried over railway; part 2 being applicable where line is carried under Ry. 2. Any Order of Board granting leave to erect, etc., wires, lines, etc., across railway and referring to "Rules for Wires Crossing Rys.," be deemed as intended to be a reference to conditions and specifications set out in that part of said Schedule which is applicable to mode of crossing authorized. 3. Every Order granting leave to erect wires across any Ry., unless otherwise expressed, be deemed an Order for leave to erect same under and according to conditions, etc., set out in schedule applicable thereto. 4. Rescinding Order No. 8392, dated October 7th, 1909, approving "The Standard Conditions and Specifications for Wire Crossings," and conditions and specifications adopted thereby.

20792—November 11—Recommending to the Governor in Council for approval, Rules and Regulations of T.H. and B. Ry. (private instructions to train conductors).

20793—November 12—Authorizing City of Edmonton, Alta., to construct its Electric Street Ry. across G.T.P. Ry. at intersection of Twenty-Seventh Street, between Armstrong Avenue, and Cochrane Avenue, subject to certain conditions. Cost of providing half-interlocking plant be borne one-half by city and one-half by G.T.P. Ry.

20794—November 12—Directing that, within six weeks from date of this Order, G.N. Ry., fence its right of way on property of H. E. Knight of Grand Forks, B.C.; Ry. Co. to be liable to a penalty of $25 a day for every day it shall be in default of complying with provisions of this Order.

20795—November 12—Authorizing, subject to condition that traffic on highway is not obstructed, G.T.R. to reconstruct bridge carrying Durham Road between Con. 1 North and Con. 1 South, through Lot 72, Tp. Brant, Co. Bruce, Ont., over 22nd District, Middle Division of its railway, at Mile Post 125.25, near Hanover.

20796—November 11—Approving plan and specifications of drain, known as "Teillier Award Drain," to be constructed under G.T.R. in Lot 2, Lake Shore Con., Tp. Rochester, Ont.

20797—November 12—Directing that within 90 days from date of this Order, C.P.R. install improved type of automatic electric bell at crossing of first public highway east of Britannia, Tp. Nepean, Co. Carleton, Ont., at mileage 3.9 on Chalk River Subdivision, and thereafter maintain same at its own expense: 20 per cent. of cost of installation be paid out of "The Railway Grade Crossing Fund," and remainder by Railway Company.

20798—November 12—Amending Order No. 19430, dated May 10th, 1913, to provide that floor of subway be constructed of 6-inch concrete slab to extend full length of subway, one-half of cost be paid my Mun. Surrey, B.C., and one-half by Great Northern Ry.

20799—November 13—Approving location Alberta Central Ry. Co.'s Sounding Creek-Moose Jaw line from a point in Sec. 24-27-26, W. 3 M., to a point in Sec. 24-25-18, W. 3 M., being from mileage 220 east of Red Deer, to mileage 277.75 east of Red Deer, Sask. 2. Authorizing construction of said line across fifty-six (56) highways, mileage 220 to mileage 277.75.

20800—November 13—Authorizing C.P.R. to construct, subject to terms of agreement, spur into premises of Dominion Wire Rope Co., Limited, in Lot Cadastral No. 922, city and parish of Lachine, Co. Jacques-Cartier, Que.

20801—November 13—Authorizing, subject to terms and conditions contained in resolution of town of Lasalle, C.P.R. to construct spur for Montreal Light, Heat and Power Co., across St. Patrick St., and Lot Cadastral No. 1021, Parish of Lachine, Que.

20802—November 13—Authorizing C.P.R. to operate spur for Massey-Harris Co., Limited, from a point on existing spur in lane in Block 68, city of Medicine Hat, Alta., into premises of Massey-Harris Co., Lots 35 to 38.

20803—November 11—Authorizing C.N.R to construct across and divert public road between Secs. 24 and 23, Tp. 26, R. 23, W. 3 M., Alsask Southeasterly Line, Sask. Company, at its own expense, install and maintain improved type of automatic electric bell at said crossing.

20804—November 13—Authorizing, subject to an inspection by Department of Public Works for British Columbia after road is graded and gravelled its full length, V. V. & E. Ry. & Nav. Co., by means of an over-crossing, to construct across and divert Nicola-Princeton Highway, Lot 1775, Group 1, Yale Dist.

20805—November 1—Dismissing complaint and application of Edward A. Purcell, Saskatoon, Sask., alleging G.T.R. Ry. discriminates against his bus line in favor of Dunning Bus Line at Saskatoon.

20806—November 13—Refusing application of Rural Mun. of Fort Garry, Man., for Order directing C.N.R. to construct suitable crossing over its tracks across Fairfield Ave.

20807—November 13—Authorizing Director of Surveys for Alberta, to construct a diversion of road allowance in S.W. ¼ Sec. 32-18-14, W. 4 M., Alta., across C.P.R.

20808—November 13—Authorizing C.N.R. to divert Rue La Verandrye, city of St. Boniface, Man.; and take for purpose of such diversion, parts of Lots 572 and 574, D. G. S. 76 Plan 224 of said city, property of C. A. Gareau, subject to condition that company construct, as soon as new station is erected, a good 30-foot road alongside its right-of-way, from Rue La Verandrye to Rue Notre Dame, and grade said road properly leaving it in as good condition as Rue La Verandrye between Rue St. Jean Baptiste and crossing over tracks of Ry. Co.

20809—November 13—Authorizing C.N.O.R. to construct across and divert public road on Lot 38, Con. 18, Tp. Ferris, Stations 981 to 991. And rescinding Order No. 20060, Aug. 13th, 1913.

20810—November 13—Authorizing C.P.R. to construct, by means of grade crossing, its siding extension across public road at Worthington, Ont. 2. Authorizing, subject to terms of resolution, Ry. Co., to construct said sidings for Mond Nickel Co., Limited, Coniston, Ont., from a point on northerly limit of right-of-way, at Worthington, across public road and lands adjoining, in Lot 2, Con. 2, Tp. Drury, Dist Sudbury.

20811—November 13—Authorizing C.P.R. to construct extension to existing siding for Dominion Radiator Company, Toronto, Ont.

20812—November 13—Directing Municipality of North Cowichan, B.C., to move crossing of highway at mile-post 41—6½ feet from its present location to a point 1,350 feet south of mile-post 41. And rescinding Order No. 6642, February 27th, 1909.

20813—November 13—Amending Order No. 19506, dated June 7th, 1913, by substituting plan marked "A," dated September 2nd, 1913, for plan dated March 24th, 1913, approved by said Order.

Tarvia

Preserves Roads
Prevents Dust~

Lady Grey Road, Government Road, Ottawa, Ont. Canada's Mint in foreground. Parliament Buildings in background. Tarvia Modern Pavement finished Aug. 1, 1913.

A New Principle in Road Building

IT has long been recognized by engineers that one of the greatest causes of the destruction of macadam roads by traffic has been the internal movement caused by the passage of heavy loads. The endless shifting and creeping of the lower courses of stone causes a grinding and pulverization which destroys the stone and breaks the bond.

To reduce this internal movement engineers have buried the larger stone under successive layers of finer stone. This fine stone forms dust more rapidly but the dust serves to protect the foundation of the road by acting as a cushion. Modern traffic makes the use of such dust cushions quite impracticable, for the automobiles not only stir up the dust but create entirely new conditions by scouring the surface of the road and breaking the bond with the backward thrust of their driving wheels.

The possibility of making roads automobile-proof by using Tarvia as a binder from top to bottom of the wearing-course during the construction of the road has now been satisfactorily demonstrated. The Tarvia fills the voids and forms a tough, durable matrix in which the stone cannot shift or grind. Consequently it has become possible to use large stone in a much greater proportion of the construction. The fine screenings and stone chips are used only on the surface as a finishing coat.

Traffic wearing away the surface strikes the layer of large stone in the tarvia matrix and makes little or no impression upon it. The large stone pulverizes but slowly and cannot be torn loose by automobile wheels. It does not change contour, sheds water instantly, is free from dust, costs but a trifle more to build than ordinary macadam, costs much less to maintain.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+ —Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Assiniboia, Man., pavement	Nov. 25.	Oct 30.	86
Calgary, Alta., machinery, etc.	Dec. 31	Nov. 13.	88
Edmonton, Alta., iron posts	Dec. 1.	Nov. 13.	88
Fort William, Ont., harbor and river improvements in Mission River	Nov. 21.	Oct. 30.	84
Gull Harbor, Man., extension to wharf	Dec. 4.	Nov. 13.	82
Hervey Junction and La Tuque, Que., ties	Nov. 27.	Nov. 13.	76
Little Sands, P.E.I., breakwater	Dec. 3.	Nov. 13	82
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., coaling plants, etc.	Jan. 7.	Nov. 13.	86
Ottawa, Ont., hypochlorite of lime	Nov. 22.	Nov. 13.	78
Richard's Landing, Ont., wharf and warehouse	Dec. 2.	Nov. 13.	86
Toronto, Ont., steelwork for bridge	Nov. 25.	Oct. 16.	84
Toronto, Ont., pumping engines, &c.	Nov. 25.	Oct. 16.	84
Toronto, Ont., pavement, etc.	Nov. 22.	Nov. 13.	80
Victoria Harbor, B.C., wharfs.	Dec. 9.	Oct. 30.	84
Winnipeg, Man., water supply		Oct. 16.	86
Yorkton, Sask., electric machinery	Dec. 22.	Nov. 13.	86

RAILWAYS—STEAM AND ELECTRIC.

Brandon, Man.—One of the most important items on the business agenda at the last meeting of the Brandon board of trade, was the consideration of the action of Le Pas board of trade in preparing a petition to the Dominion Government, praying for the compulsory building of connecting railway lines with the Hudson's Bay. The Brandon board of trade passed unanimously a resolution endorsing the Le Pas petition.

Bridgeburg, Ont.—If the line projected by the C.N.R. to operate from Toronto to Buffalo, is built to Bridgeburg, it is believed that a new bridge and possibly a tunnel will have to be constructed at Fort Erie.

+—Calgary, Alta.—The contract for the temporary station to be erected right away on the C.N.R. property near the end of the line at Elbow River, was awarded to CARTER-HALLS AND ALDINGER of Winnipeg; and it will be completed within the next three weeks. The building will be frame and ironclad; and one freight shed about 500 feet long will be erected at the present time.

Calgary, Alta.—The plans for the new permanent C.N.R station to be erected on the north side of the Elbow River, are ready; and the chief bridge engineer at Calgary has received information that tenders will be called soon for the letting of contracts.

Edmonton, Alta.—The surveyors are making the preliminary survey of the route of the Alberta and Great Waterways Railway from Edmonton to Fort McMurray. W. R. Smith, chief engineer of the Edmonton, Dunvegan and B.C. line, is directing operations. The arrangements made with J. D McArthur and associates, contractors, call for the commencement of work before the end of the year. Construction will commence on a portion of the original route which is to be maintained.

Fort William, Ont.—The application of the city to the Dominion Railway Commission to compel the C.N.R. to build a station at Fort William was considered at the session of the Commission held recently at Port Arthur. Mr. Spence, a member of the staff of the Commission, was appointed to go over the situation and to report in two weeks.

Fort William, Ont.—It has been decided finally by the Fort William council that the city will operate its street railway as a separate unit, thus leaving Port Arthur to direct the section within its own limits. However, the one fare for the two cities, compulsory by legislation, will continue.

Moncton, N.B.—The I.C.R. proposal in connection with the abolition of level crossings has been discussed by city council and Board of Trade committee. The I.C.R. general manager, Mr. Gutelius, was present and several details of plan were considered. Mr. Gutelius said that the wharf track route, as advocated by some, who opposed the present plan, is out of the question. The council will meet again to deal with the matter.

Montreal, Que.—In connection with the improvement of the Grand Trunk terminals at Montreal, city engineers have furnished estimates for elevating the tracks from Bonaventure Station to Point St. Charles, which approximate $5,500,000. It has also been made known that the widening of the old Wellington subway is a part of the city's programme.

Ottawa, Ont.—A charter will be sought at the next session of Parliament by the Ontario Lake Front Terminal Railway, which proposes to build a line from a point on the C.P.R. between Havelock and Central Ontario Junction, to Cobourg, by way of Campellford, and from the latter town to Brighton.

Ottawa, Ont.—Application will be made at the next session of parliament for an act to incorporate the Pacific, Peace River and Athabasca Railway Company, Limited. The company desire power to construct a line of railway which will total about 1,500 miles.

Owen Sound, Ont.—At the last meeting of the Owen Sound council, it was decided to request the Ontario Hydro-Commission to furnish estimates on a Guelph to Owen Sound radial line. A committee, consisting of Mayor Lemon, Ald. McQuaker and Town Clerk Gordon was appointed to deal with any details in connection with the project.

Port Arthur, Ont.—Concerning the application of the C.N.R. to build a spur line from its line of railway along Hester Street, Port Arthur to Fort Street, and to cross several of the city's streets and also the electric street railway on Algoma Street, the Dominion Railway Commission decided that an order would take effect when satisfactory arrangements were made by the interested parties.

St. Catharines, Ont.—A by-law to bonus the C.N.R. to deviate its route to run through St. Catharines, is to be submitted to municipal ratepayers in January, 1914.

Toronto, Ont.—The city council has decided to have an agreement prepared covering the proposed street railway deal; and if this is not ready in time to submit to the people as a by-law on January 1st, to have a synopsis covering the situation prepared and submitted on that day as a plebiscite.

Vancouver, B.C.—Mr. J. J. Hill of the Great Northern Railway has stated that there is not the slightest probability of the railway from Vancouver to the Yukon being built with money supplied by the Standard Oil Company.

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Vancouver, B.C.—A shorter route for the Kettle Valley Railway from Okanagan to Mitchell has been planned and filed with the authorities at Ottawa. The proposed line will run from Coldwater Summit to Osprey Lake, near the headquarters of Deep Creek, which flows into Okanagan Lake near Peachland. The construction of a line from Peachland to Osprey Lake would save a long detour and open up a stretch of new territory north of Hope Mountain road. The route of the Kettle Valley Railway as mapped out originally, merely skirted the shores of the lower end of Okanagan Lake on the west side, branching from Penticton in a northwesterly direction and following the course of Five-Mile Creek to Tulameen. Under a recent arrangement the railway will go further north than in the earlier plans and will serve Summerland.

Victoria, B.C.—The British Columbia Electric Railway are calling for tenders for the construction of an interlocking tower at the Esquimalt and Nanaimo railway crossing on the Esquimalt road, near Russell station.

Winnipeg, Man.—The South Fort Rouge ratepayers are requesting the city council to urge the matter of electrification of the C.N.R. cut off in Winnipeg.

GARBAGE, SEWAGE AND WATER.

Edmonton, Alta.—Superintendent Parsons, of the water power station, has written to the city commissioners to advocate the adoption and installation of water meters throughout the city in order to check waste and to put all consumers on an equal footing.

Galt, Ont.—The water commission has decided that a greater storage capacity is required at the pumping station, and will build a new reservoir. The present storage supply is 150,000 gallons, and it is planned to increase this to 800,000 gallons. The present intention is to let the board of works undertake the excavating, so that the stone taken out may be used for road purposes.

Hamilton, Ont.—Contracts have been awarded THE SMART-TURNER MACHINE COMPANY by the National Builders' Supply and Concrete Brick Company, Quebec, for the supply of one duplex pump; by Messrs. H. D. Smith and Company, Winona, Ont., for one duplex pump; by the Hamilton Bridge Works, for a duplex power pump; by the St. Lawrence Paper Mills, Thorold, for one centrifugal pump; by W. A. Freeman Company, Limited, Hamilton, for one duplex pump; by the Gananoque Electric Light and Water Supply Company, for one centrifugal pump; by the Lotbiniere and Megantic Railway Company, Lystar, Que., for one duplex pump; and by the London Cold Storage and Warehouse Company, for one duplex pump.

Hamilton, Ont.—Tenders will be received up till November 20th for the construction of pipe sewers on several portions of streets. Plans and specifications may be obtained from the office of the City Engineer. Signed, S. H. Kent, Esq., City Clerk, Hamilton.

Kamloops, B.C.—The water board meeting now at Kamloops, and afterwards at Ashcroft, has in consideration many difficult problems concerning the water solution for the interior district of British Columbia. Some claims for records for four times more water than is available in the best of seasons date back to 1865, and many are involved with litigation.

Ottawa, Ont.—It is understood that tenders will be called for immediately for the connection of a sewer system through the C.P.R. yards to the river.

Port Arthur, Ont.—1,400 feet of the city intake pipe must now be repaired owing to the tearing out of the entire section by the steamer G. R. Crowe, when entering the drydock on November 12th.

Stanbridge East, Que.—A project is in hand to build a waterworks system from Selby Lake to supply Dunham, Frelighsburg, Stanbridge East and Bedford. It will be submitted to each municipality for consideration.

Toronto, Ont.—In his report to the Committee on Works, Commissioner Harris discourages the proposal to supply city water to a subdivision, 1,360 feet beyond the municipality, in view of the 500 foot limit set by the city council.

Vancouver, B.C.—The Burrard Peninsula Joint Sewerage Commission has decided to call for tenders for the southern extensions of the China Creek trunk sewer on China and Canoe creeks. The tenders are to be in the hands of the commission by December 1st. As much of the work as is possible will be completed this winter.

Victoria, B.C.—The Esquimalt Municipal Council has approved the draft agreement with the city in regard to the main trunk sewer, which has been previously carefully considered in committee; and the Reeve was authorized to sign it.

Victoria, B.C.—The Oak Bay ratepayers voted on November 15th upon a by-law to borrow $150,000 for sewer purposes, and another for $35,000 for the laying of water mains. The work proposed, if carried out, will provide water and sewer connection for every subdivided lot in the municipality.

Victoria, B.C.—Decision in connection with the award of contract for concrete flow line on the Sooke Lake waterworks system has once again been deferred for a special meeting of council when it is expected Mr. Wynn Meredith will be present. The answers of the Graff Construction Company to questions put by Water Commissioner Rust have been forwarded by the company to the individual members of the council; but these are to be considered further by the members before the special meeting will be called. Mr. Rust's report in connection with the qualifications, financial and otherwise, submitted by the Graff Construction Company, reiterates the recommendation, which he and Mr. Meredith, the city's consulting engineer on the Sooke work, have made on previous occasions,—e.g., that, after due consideration of the company's representations, he cannot recommend that its bid be accepted; but rather that the city council should award the contract to the next lowest bidders, the Pacific Lock Joint Pipe Company.

Victoria, B.C.—Tenders will be received up till November 24th, 1913, for the fabrication and laying of 10¼ miles of 36-inch rivetted steel pipe, etc., on the Sooke water supply pressure conduit. Plans and specifications may be obtained from C. H. Rust, Water Commissioner, Victoria, B.C.

Victoria, B.C.—The city council has voted $8,000 to repair the damage occasioned through the collapse of the large brick sewer on Oxford Street, between Moss Street and Linden Avenue; but an investigation of the break has made it certain that the same causes which resulted in the cave-in on that section of the street prevail on other portions and also around on to the adjoining streets. The pavement shows signs of sagging in a number of places, indicating that the sinking of the soft bed on which the sewer was constructed is progressing, and it is only a question of a short time until a greater section of the sewer collapses and the pavement above subsides. It is predicted that to make a proper repair of the weak portion of the sewer work and replace the pavement will cost somewhere in the neighborhood of $30,000 or $40,000.

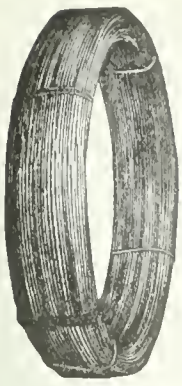
LIGHT, HEAT AND POWER.

Brantford, Ont.—Residents of Parkdale, Grandview and vicinity, Echo Place and Paris Hill have petitioned the Provincial Hydro-Electric Commission for service when the power shall have reached Brantford.

Brockville, Ont.—Tenders will be received for the supply of two 300 H.P. water tube boilers, and for an electric-driven turbine pump. Plans and specifications may be obtained from the Brockville Water and Light Department. E. J. Philip, manager.

Edmonton, Alta.—Before this city will enter into an agreement for the supply of gas, other cities will be asked to supply Edmonton commissioners and public works committee with copies of the agreements entered into by them, in order to serve as a guide to the committee for Edmonton in drafting an agreement or franchise.

Fredericton, N.B.—The Provincial Government will be requested by the city council to have the fence at the Provincial Normal School provided with lights similar to those around the Military Depot, installed by the Dominion Government.



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+—**Guelph, Ont.**—The contracts have been awarded by the Public Works Department to STEVENSON & MALCOLM COMPANY for plumbing, heating, ventilation, and wiring of the following new O.A.C. buildings; the husbandry building, at a cost of $13,783; the poultry building, at $8,375; the dining hall, at $11,781.

+—**Hamilton, Ont.**—The contract has been awarded the HAMILTON STANDARD UNDERGROUND CABLE COMPANY, for the cable on the Hydro system, at a cost of $53,674.85.

London, England.—It was announced last night that the Postmaster-General is prepared to consider applications for the construction of the second of the three high-power wireless stations of the Imperial chain. Bids may be made by any wireless company, syndicate, or firm of contractors who are able, by means of a practical demonstration, to satisfy the Postmaster-General of the efficiency of their system.

London, Ont.—Negotiations between the street railway and the Ontario Power Commission for the purchase of power have been completed: a contract has been sent to President H. E. Everett of the road at Cleveland, and, when returned to the city water commission, will be turned over to the local department.

London, Ont.—President Everett of the London Street Railway Company has returned, signed, the contract between the city and the railway company for the supply of hydro-electric power for the operation of the Sunday street railway system. The contract calls for $36 a horsepower for direct current and the company may pay a flat rate or a ready-to-serve service with a meter charge.

London, Ont.—Tenders have been called for the transforming machinery that will be necessary to convert hydro power into direct current for the street railway. The day fixed for the delivery of the power is now February 15th, instead of December 15th, as originally intended.

Moncton, N.B.—Among other matters discussed at the last meeting of the city council, was the lighting question, and general dissatisfaction was expressed about the service the city was getting from the Tramways Company, and a committee was appointed to look into the proposition of installing an electric plant at the new pumping station to supply the streets, pumps, and civic buildings with electricity.

Nelson, B.C.—By a large majority a money by-law was passed in Nelson by the property owners to purchase for $50,000 the Nelson Coke and Gas Company's plant. Nelson now owns the municipal power plant, waterworks, gas, street-making plant and is negotiating for the street railway system.

Ottawa, Ont.—Tenders will be received up till November 21st, 1913, for heating, plumbing and electric wiring for the Registry Office, Haileybury, Ont. Plans and specifications may be obtained from the Department of Public Works, Ottawa. H. F. McNaughten, Secretary.

Regina, Sask.—Mr. T. A. McNulty and Mr. Eugene Cost, president of the Canadian West Natural Gas Company, have submitted to the city a proposal to supply Regina with gas at a figure for large users of about 25 cents per 1,000 feet, and for domestic use of about 40 cents. Regina citizens will vote upon the proposal within a few weeks.

+—**Toronto, Ont.**—The Abitibi Pulp and Paper Company has placed an order with the CANADIAN ALLIS-CHALMERS COMPANY, LIMITED, for two high-lift turbine pumps for ground wood stock, each 4,000 U.S. gals. per min., against 116 feet head 200 b.h.p.; two high-lift turbine pumps for grinder pressure supply, each 450 U.S. gals. per min., 231 feet head 40 b.h.p.; and one high-lift turbine pump for mill water supply 4,000 U.S. gals. per min., 173 feet 250 b.h.p. There will also be two 14-inch centrifugal pumps for white water supply each 4,000 U.S. gals per min., 35 feet head and 75 b.h.p., and two 4-inch centrifugal pumps for slivers each 500 U.S. gals. per min., 20 feet head and 8 b.h.p. All these pumps will be driven by Canadian General Electric motors.

Vancouver, B.C.—It is planned to build at Vancouver a municipal electric lighting and power plant at a cost of $300,000. Current is to be generated by turbine engines driven with steam generated in oil burning furnaces. In addition, a gas plant is being considered.

Winnipeg, Man.—Tenders will be received up till November 25th for the manufacture and delivery of a quantity of waterproof insulated copper wire. Plans and specifications may be obtained from the office of the Light and Power Department, 54 King Street, Winnipeg, Man. Signed, M. Peterson, Esq., Board of Control, Winnipeg.

Winnipeg, Man.—Tenders will be received up till November 21st for the supply and delivery of one 500 k.w. motor generator set for the King Street sub-station. Plans and specifications may be obtained from the office of the City Light and Power Department, 54 King Street, Winnipeg, Man. M. Peterson, Esq., Secretary, Board of Control, Winnipeg.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—A petition from the people of East Calgary, asking that a new bridge be constructed across the Canadian Pacific Railway Company's irrigation canal at Seventeenth Avenue East, at the city limits, and that the road there be straightened out, has been received by the city commissioners, and will be given consideration by them.

Calgary, Alta.—The city council has passed the by-law calling for the paying by the city of half of the expense of the grading of Mission Hill, done by F. C. Lowes and Company.

Edmonton, Alta.—The Provincial Government is contemplating the construction of a bridge across Saskatchewan Avenue from Eighth Street to the Parliament buildings; and it is asking concessions from the city regarding overhead crossings on the avenue.

Edmonton, Alta.—The steel for the Fifth Street low-level bridge will arrive in Edmonton this month and in the beginning of December; and the erection crew will carry out the work according to contract. The government is loaning its plant, the city paying for repairs and maintenance while the machinery is in its employ.

Fort William, Ont.—A committee of six is to be chosen to lay out a propaganda for road building in the vicinity of Fort William next year. The city council recommended that two members of the board of trade, two from the real estate exchange, and two from the city council, be appointed to form this committee.

Hamilton, Ont.—The residents of Maple Avenue have raised money by private subscriptions to build a permanent road, the county to assist by paying two-thirds of the cost. Work has been commenced under the supervision of J. G. Wilson, County Superintendent.

Kingston, Ont.—Tenders will be received up till November 24th, 1913, for the construction of Dog Lake Bridge in the 11th concession of the township of Storrington, County of Frontenac. Plans and specifications may be obtained from the offices of the County Clerk and Consulting Engineer. Signed, G. C. Wright, C.E., Consulting Engineer, Kingston; J. W. Bradshaw, County Clerk, Court House, Kingston, Ont.

Minnedosa, Man.—Speaking at a public meeting in Minnedosa on November 7th, Sir Rodmond P. Roblin, Premier of Manitoba, announced that at the next session of the legislature a bill will be introduced authorizing the expenditure on a capital account of $2,500,000 for the purpose of improving the rural highways.

Toronto, Ont.—A report has been extended by Commissioner Harris to the Committee on Works, announcing the extension of Wilton Avenue from Yonge Street to the Kingston Road in course of a year or two. The Commissioner has also recommended the widening of Clara Avenue to 66 feet and its extension to Clendenan Avenue at a cost of $13,250.

Toronto, Ont.—The council of the Municipal Corporation has given notice that improvement works to sidewalks, pavements, curbing and sewers, will be constructed on portions of several of the local streets, and that it is intended to specially assess a part of the cost upon the land abutting directly on the said streets.

+—**Vancouver, B.C.**—The contract has been awarded MESSRS. ARMSTRONG MORRISON AND COMPANY of Vancouver for the building of substructure for the Kettle Valley Bridge, which will span the Fraser River at Hope. The structure will be 1,000 feet long and the estimated cost between $575,000 and $1,000,000.

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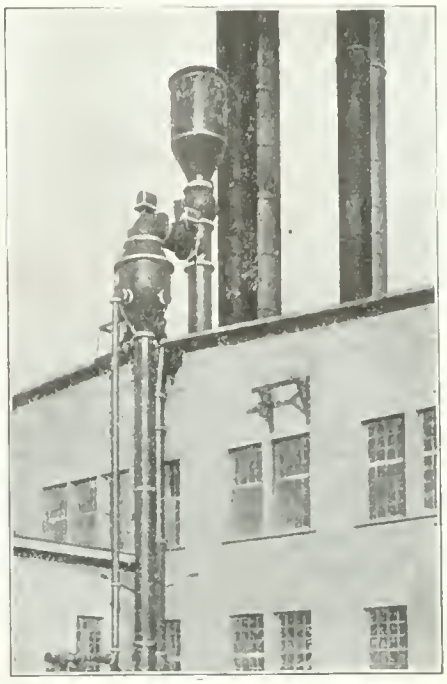

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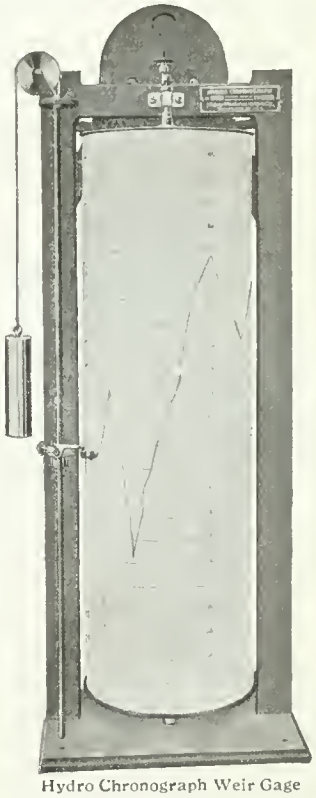

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INDUSTRIAL WORKS.

Marshville, Ont.—Tenders will be received up till November 27th, 1913, for the repair of Biederman drain in the townships of Wainfleet and Humberstone. Plans and specifications may be obtained from Reeve P. J. Willson, Forks Road, Wainfleet. Address, Marsnville P.O., Ont.

Montreal, Que.—Hon. Robert Rogers has confirmed the report that a large drydock will be erected in Halifax harbor, though he is unable to say whether the location will be on the Halifax or on the Dartmouth side until the matter has been decided by competent engineers. The work, however, is to be commenced almost immediately.

Ottawa, Ont.—Tenders will be received up till December 15th for the renewal of south pier at Burlington Channel, Ont. Plans and specifications may be obtained from the Department of Public Works, Ottawa R. C. Desrochers, Secretary.

Sault Ste. Marie, Ont.—The by-law, voted upon on November 17th, to grant a bonus of $20,000 a year, for 20 years, to the newly-organized Lake Superior Drydock and Shipbuilding Company, has been passed almost unanimously. The work will be commenced not later than April 1st, 1914.

Vancouver, B.C.—Mr. H. H. Stevens, M.P., for Vancouver, has had an interview with the Hon. Samuel Hughes in regard to the Vancouver Coal Harbor plans. Mr. Stevens urged that the causeway and ground plans be approved with as little delay as possible, and is satisfied that the minister will take early action in the matter.

MISCELLANEOUS.

New Westminster, B.C.—The city council has passed a by-law giving the Heaps Engineering Company a year's extension of time to fulfil the terms of their contract with the city for the lease of property on Lulu Island, under which they had to have a building, plant and stock in trade thereon to the value of $150,000 within a year of the signing of the lease. The company has so far expended $37,531 on their developments there and explained that had it not been for the world-wide money stringency would have been able to complete their contract.

+—Ottawa, Ont.—The contract has been awarded the POLSON IRON WORKS, of Toronto, by the Dominion Government for engines to be installed in the Lady-of-the-Lake, being built at Sorel. The cost of the engines will be $17,250.

+—Ottawa, Ont.—The contract has been awarded W. H. McGILLIVRAY, of Ottawa, by the Dominion Government for the construction of a building for Geodetic survey adjoining the Dominion Observatory, at a cost of $61,948.

Ottawa, Ont.—Tenders will be received on December 1st, December 3rd, and December 15th, respectively, for certain stores to be delivered at H. M. C. Dockyards at Halifax, N.S., and Esquimalt, B.C. Plans and specifications may be obtained from the Department of Public Service, Ottawa, Ont. C. J. Desbarats, Deputy-Minister.

Ottawa, Ont.—Mr. John Coates of London, England., in his report given by Controller Hinchey, recommends strongly the construction of a municipal gas plant at an estimated cost of $318,000 for the first unit. It is probable that the proposal will be voted upon in January. Whereas the city is practically paying $1.53 per thousand to the Ottawa Gas Company, the report shows that the city can supply gas at 85 cents per thousand.

Ottawa, Ont.—Tenders will soon be called by the Department of Marine and Fisheries for the largest and most modernly equipped ice-breaker that has yet been put into commission. It is to be used exclusively for the St. Lawrence route, and the conditions for the awarding of contract call for the building of the vessel in Canada.

▲—Toronto, Ont.—Tenders will be received up till December 2nd, 1913, for crushed limestone, cedar posts, Portland cement, etc. Plans and specifications may be obtained from Room 12, Department of Public Works, City Hall, Toronto, Ont. H. C. Hocken (Mayor), Chairman, Board of Control.

Trail, B.C.—A force of structural steel workers from Vancouver will be engaged for some time erecting steel for the new lead furnace building and for the installation of two large electric cranes. The work will be under the supervision of R. Tench, of the firm of Tench and Company, Vancouver.

Vancouver, B.C.—The civic board of work has sanctioned the proposed overhead new long-distance circuit of the British Columbia Telephone Company.

Vancouver, B.C.—Plans are under way at Vancouver to construct a big furnace for the manufacture of pig iron. The company, it is said, will have a capital of $15,000,000.

+—Victoria, B.C.—The contract has been awarded to the ERIE BASIN DRYDOCK COMPANY, of New York, by the Alaska Pacific Steamship Company for alterations to the newly-acquired steamers Admiral Dewey and Admiral Schley. The work consists of the installation of fuel oil-burning systems, winches, and other cargo-handling equipment, and the rebuilding of the interior of the vessels. The work will cost approximately $200,000, and is to be completed in 60 days.

Victoria, B.C.—Tenders will be received up till November 24th, 1913, for the construction and erection of metallic circuit telephone line of two wires, etc. Plans and specifications may be obtained from C. H. Rust, Water Commissioner, Victoria, B.C.

+—Winnipeg, Man.—The contract has been awarded the NEW YORK FOUNDATION COMPANY by the C.P.R. company for the straightening of the North Transcona elevator. Owing to the almost unprecedented nature of the undertaking, it is not known exactly how long the work will take.

Winnipeg, Man.—Tenders will be received up till December 15th for the supply of two 60 h.p. motor hose wagons, and one 75 h.p. motor aerial ladder truck. Plans and specfications may be obtained from the office of the Chief of the Fire Department, Central Fire Station, Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control, Winnipeg.

Winnipeg, Man.—The Winnipeg centre of the Royal Astronomical Society has instructed its secretary to write to Dr. King, head of the Dominion observatory at Ottawa, and to urge upon him the advantages of having the new telescope, ordered for Canada, located at Winnipeg.

CURRENT NEWS.

Calgary, Alta.—Mr. M. M. Biederman, superintendent of bridge construction for Frankman Brothers, of Winnipeg, the contractors, has stated that the bridge work on the C.N.R. line into Calgary will be completed within 40 days. Biederman has a crew of some 20 bridge workers and rapid progress is already being made on the bridge across the Canadian Pacific Railway tracks. It is thought that early next week the traveling crane will be able to run across it and begin work on the Bow River bridge. Owing to the fact that two girders were seriously damaged in a wreck last week, they will have to be returned to the manufacturer for repairs, which may slightly delay the work on the Bow River bridge. The two smaller structures are relatively unimportant and can be spanned, if necessary, by false-work and timber trestling sufficiently strong for general purposes.

Cornwall, Ont.—The St. Lawrence River Power Company's dredge "Zangle," which is to be used in dredging the Grasse River from Massena to the point where it enters the St. Lawrence, a distance of 7 miles, is in the drydock at Cornwall. A large steel box is being removed from beneath the dredge, so that less difficulty will be experienced in navigating the Grasse River to Massena to commence operations. It is expected that a start will be made upon the work this season, and that it will take about three years to complete the widening and deepening of the Grasse River so as to make it possible for the St Lawrence River steamers to navigate its waters and make a port at Massena.

Edmonton, Alta.—The concrete work is now finished on the bridge over the C.P.R. tracks at the south end of the high level bridge; and soon the entire structure will be complete.

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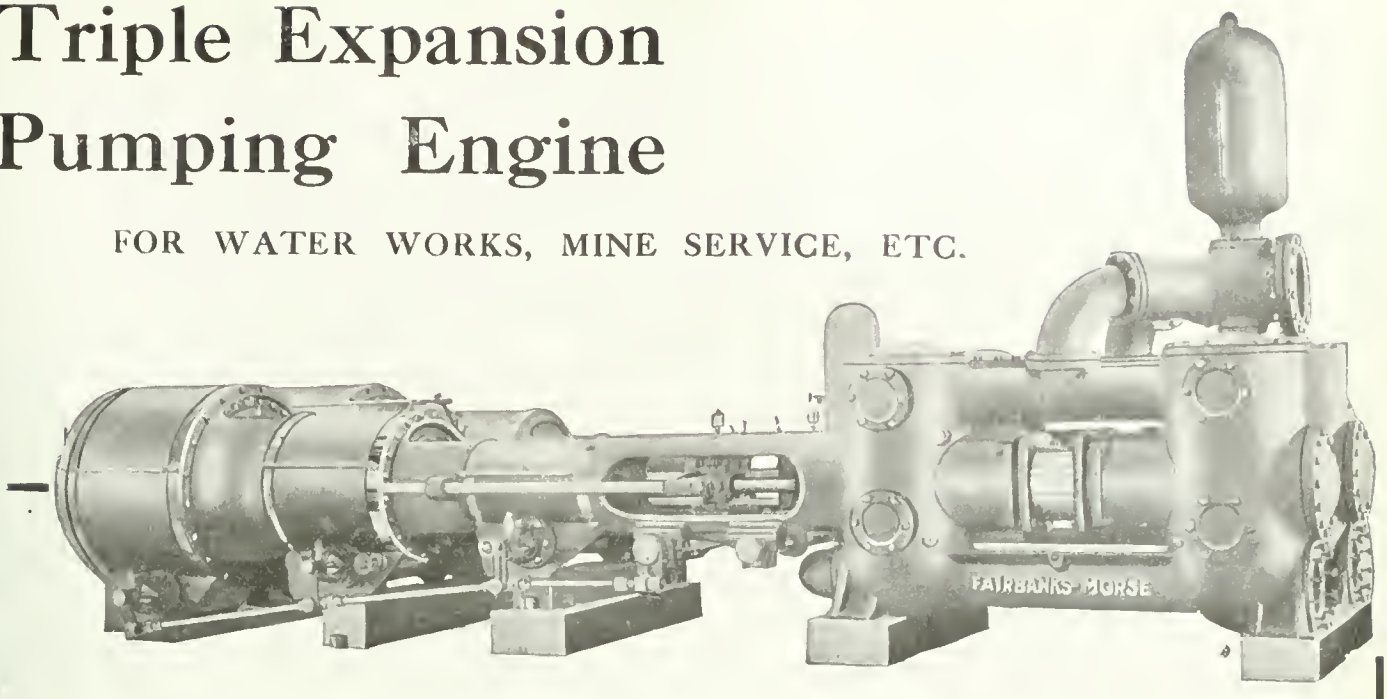
FOR WATER WORKS, MINE SERVICE, ETC.



The Fairbanks-Morse Triple Expansion Duplex Outside Centre Packed Plunger Pumping Engine shown here is very economical in the consumption of steam. The economy of operation makes this Pump preferable to all others in many situations.

The steam end is fitted with semi-rotative valves. The plungers being externally packed are always in sight and any leakage can be at once detected. All parts are easy of access. The stuffing boxes are large and deep, so that ample allowance of packing may be used.

This type of pump is heavily proportioned throughout in order to meet the demands of heavy service. It is designed to give long and satisfactory service at a minimum cost. It has a 24-inch stroke and a capacity of 2,500,000 gallons per 24 hours.

Departmentalising a Great Business

The marketing of one article is a very simple problem. As the number and variety of the products you sell increase, the complexity of your merchandising problem grows.

Our business has grown in the last dozen years from a comparatively few products into an enormous number of lines. This tremendous growth has necessitated the organizing of our business along departmental lines with able, efficient men at the heads of the various departments.

As organized now we can serve the mechanical field better than any house in Canada. In addition to being manufacturers, we are literally a large "departmental house for machinery and mechanical goods." This bringing together of a vast number of lines and classifying them according to departments is the kind of combination in industry that makes for efficiency, economy and better service.

It is just as great a convenience to Engineers, Contractors and Builders to be able to get their supplies from one House as it is to the general public to shop in a large, modern department store. In dealing with us you can get what you want "under one roof." Write, phone or call.

The Canadian Fairbanks-Morse Co., Limited

"The Departmental House for Mechanical Goods"

ST. JOHN QUEBEC MONTREAL OTTAWA TORONTO
WINNIPEG SASKATOON FORT WILLIAM CALGARY VANCOUVER

4

Fredericton, N.B.—By January 1st, the Dominion Government's Experimental Station a few miles below this city will have a pneumatic water supply plant, which is now being installed and will be completed by the end of this month. The water will be pumped from the well which was bored at the Experimental Farm this summer by Mr. Thomas Kent, of St. George. Superintendent W. W. Hubbard has had two tests made of the water by S. T. Shutt, the Dominion Government's chemist, at Ottawa, and they have shown the water to be of the very best quality. The tank is 26 feet long and 7 feet in diameter, with capacity of 7,000 gallons. It is estimated that 5,000 gallons per day will be required and this can be obtained by the pump working two hours a day. One twenty-four hour test has been made and 26,000 gallons were obtained in that time, and the water-level lowered only two feet in the tank.

Grandview, Sask.—One of the government elevators has been burned to the ground, including a loss of the entire elevator capacity of 30,000 bushels of wheat.

Grenfell, Sask.—On Monday, November 10th, the municipal electric light plant was put into commission, and is running with great satisfaction.

Guelph, Ont. City Engineer Holland has decided that the Neeve Street bridge shall not be opened to street car traffic for at least two weeks. Only three of the 13 beams are built on a solid earth base, and the cement should be allowed ample time to ripen, he claims, before traffic passes over it.

Hamilton, Ont.—Favorable progress is reported on the work of repairing the incline railway; and repairs have been completed in the engine house.

London, Ont.—The second track of the C.P.R. will not likely reach London before 1915. The company is now operating the double track between West Toronto and Erindale, and work is going ahead in a satisfactory manner as far as Guelph Junction. Tracks have been laid but the new roadbed is yet to be ballasted. Next year an attempt will be made to finish the line as far as Galt. Owing to the rocky nature of the country and severe natural difficulties, in the way of rock cuts and deep gullies, it is not thought that it will be possible to proceed much further in the entire season. Eventually the work will be brought on toward Woodstock and London.

Medicine Hat, Alta.—The laying of the Ansley spur, for which McCoy and Levine are contractors for the engineering work, is under way. The material is already on the ground

North Battleford, Sask.—A second extension of the C.N.R. has been commenced to run from North Battleford to Edam, the present terminus. The road is already graded from Edam to a point four miles northwest of Mervin, and it is expected the line will be constructed to Emmaville this fall. The other branch line construction from North Battleford to Blaine Lake on the east will be opened for through traffic within the next few days.

Ottawa, Ont.—It has been announced here that the substructure of the Quebec bridge has been completed save for the pointing of a couple of piers, and the erection of steel on the north shore has been commenced. This will necessitate the use of an immense "traveller" standing 300 feet over the rails and costing about half a million dollars.

Quebec, Que.—Mr. A. Leofred, president of the Aqueducts, Limited, of Quebec, states that there are more engineering projects under way at present in Quebec than has ever been the case. Recently, Mr. Leofred's company completed the construction of the Chaudiere curve at the south entrance to the Quebec bridge, which secures 5,000 h.p. water-power from the Chaudiere Falls. From this source the Quebec Electric Railway will receive power, and the railways will be supplied with water.

Regina, Sask.—On November 10th the Grand Trunk Pacific Railway opened to traffic its Regina boundary branch line between Regina and Northgate, Sask., a distance of 155 miles.

Regina, Sask.—The C.N.R. bridge across the Moose Jaw River at Main Street, has been completed, and steel is being laid.

Saskatoon, Sask.—The power rate for Saskatoon has shown a decrease for the month of October. The figure is 1.95 per kilowatt, while for September it was 2.07. There is every chance that another drop in cost of power production will occur in November; and it is hoped that the rate of from 1.46 per kilowatt to 1.71 per kilowatt per hour, prophesied some time ago by the city commissioners, will be reached in the near future.

Saskatoon, Sask.—It is announced that 50 miles of new line is soon to be opened on the Goose Lake division of the C.N.R. line, and indications are that in the spring of 1914 a more extensive program of extension work will be carried out by the company in and around Saskatoon.

Saskatoon, Sask.—The street car service commenced operating between Saskatoon and Sutherland, the C.P.R. town three and-a-half miles north-east of the city. The route of the new line is east along Eight Street, then north to Sutherland.

Smith's Falls, Ont.—The Smith's Falls Electric Power Company has completed extensive improvements to its plant at Sey's Rapids. A Westinghouse lighting machine, made in Pittsburg, capable of developing 365 horsepower and weighing over 10 tons, has been installed. It is to carry all the incandescent lights the company has or will have for some years, and will be operated by water power from the rapids.

St. Catharines, Ont.—The firm of Baldry, Yerburgh, and Hutchinson, contractors for section 2, Welland ship canal, are having 25 boilers brought from England in connection with its plant.

St. John, N.B.—At a special meeting of the St. John city council, the mayor announced that the board of trade would have a conference with the Minister of Public Works and the Minister of Marine and Fisheries and present several resolutions to them calling for the construction of 8 or 10 additional berths, the closing of the western entrance to the harbor, the building of a breakwater on the eastern end of Partridge Island, and other improvements.

St. John, N.B.—The council are considering the advisability of suggesting to the Federal Ministers that the services of an expert of international reputation be called upon to give an authoritative opinion on the present plans for developing the St. John harbor.

St. John, N.B.—Prominent C.P.R. officials have visited St. John and have inspected the local terminal facilities. Mr. Price, assistant general manager, stated that the arrangements at Halifax had been found satisfactory, and it is expected that the Empress steamers can be handled there this winter without much difficulty.

St. John, N.B.—Concerning the work on the St. John harbor improvements, the contractor, Mr. Norton Griffiths, of Ottawa, has stated that the work will be completed before the contract time, which is 1917.

The Pas, Man.—Mr. A. H. Detredeau, chairman of the board of trade, has been informed recently by Superintendent Franklin of the McArthur Contracting Company that he expects to lay steel as far as Setting Lake at mile 130 this fall. Ties are now being delivered from Edmonton and Rainy River; and work has commenced on the pier work at the Narrows bridge at mile 40. This winter, moreover, the contractors expect to build the abutments for the cantilever bridge at Manitou Rapids, which lies half way to Hudson Bay.

Thorold, Ont.—Operations on the lower extremity of No. 3 section of Welland ship canal have commenced.

Toronto, Ont.—C.P.R. officials have announced that the new south shore line of the company from Toronto to Glen Tay will be ready for the operation of a freight service before Christmas.

Vancouver, B.C.—Construction is in progress on a temporary retaining wall across False Creek, at the Main Street bridge, in connection with the reclamation work for the Canadian Northern Pacific Railway. The barrier is being built of rip-rap filled with loose rock. This is taken as a sign that the Canadian Northern Railway is endeavoring to rush along its terminal scheme. In the portion of False Creek to be used by the company for its terminals, filling-in has been proceeding for several months; and 500,000 cubic yards of material have been deposited.

Vancouver, B.C.—Some of the members of the Greater Vancouver Sewerage Board toured the Burnaby municipality and inspected prospective routes of sewers. Still Creek and Brunette River will be deepened so as to carry off surface water. Estimates of next year's work are to be prepared early, so that an early start may be made in the spring of next year.

Insuring Pumps

against their destruction by fire requires engineering knowledge that is not needed in insuring dwellings, stores, etc. We used the word "Pumps" only as an illustration. It requires sound engineering and expert insurance knowledge—combined in the one firm—to secure for any industrial or engineering firm the lowest possible insurance rates. Only a firm like ours—employing a staff of engineers—could appreciate your requirements—not only in fire insurance but also in special forms of insurance.

Correspondence solicited.

E. M. SELLON & CO.
LIMITED

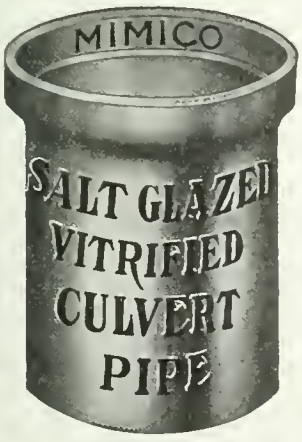
INSURANCE ENGINEERS
and Insurance Brokers

DIRECTORS
E. M. Sellon, M.I.E.E., Lawford Grant, M.I.E.E.
J. J. Creelman

136 St. James Street - Montreal

Cost of pipe = 20% cost of work
Saving by using poor pipe = 20%
Saving on total cost = 4%

IS IT WORTH WHILE?



If the sewer is to cost $10,000, for instance, MIMICO pipe would likely not cost more than $2,000, probably considerably less. Not more than $400 could be saved on this pipe cost by purchasing a poor grade of pipe. You would then have a poor sewer costing $9,600, when for $10,000 you might have had the very best sewer possible to build. Is it worth while to buy poor pipe? No! Then buy Mimico Brand and put an end to sewer troubles.

Prices on request.

Round Pipe and Square Dealings

The Ontario Sewer Pipe Co.
LIMITED

MIMICO, ONT.

Agents for Patented Vitrified Segment Block for Sewers over 24"

Renouf Publishing Co.

25 McGill College Ave.
MONTREAL

Practical Methods of Sewage Disposal.

For Residences, Hotels and Institutions.
By HENRY N. OGDEN, Mem. Amer. Soc. C.E., Professor of Sanitary Engineering, Cornell University, and H. BURDETT CLEVELAND, Assoc. Mem. Amer. Soc. C.E., Principal Assistant Engineer, New York State Department of Health.
8vo, vi. 132 pages, 52 figures. Cloth, $1.50 net.
Contains tables for use in constructing the different types of plants together with the necessary plans, sections, views, etc.

IN THREE VOLUMES

Applied Mechanics.

By CHARLES E. FULLER, Professor of Theoretical and Applied Mechanics at the Massachusetts Institute of Technology, and WILLIAM A. JOHNSTON, Professor of Theoretical and Applied Mechanics at the Massachusetts Institute of Technology.

VOLUME I. STATICS AND KINETICS.
8vo, xi. 379 pages, 212 figures. Cloth, $2.50 net.
A large number of problems, some simple others more complex, illustrating the application of the principles discussed in the text have been included and solutions have been given when it was deemed necessary to indicate the methods of applying the principles. It is the experience of the authors, that the student's power to clearly grasp the subject comes to a large extent, from his efforts to solve original problems.

VOLUME II. STRENGTH OF MATERIALS (in Preparation).

VOLUME III. GRAPHIC STATICS (in Preparation).

PUBLISHED RECENTLY

Logging.

The Principles and General Methods of Operation in the United States.
By RALPH CLEMENT BRYANT, F.F., M.A., Manufacturers' Association Professor of Lumbering, Yale University.
8vo, xviii. 590 pages, 133 figures. Cloth, $3.50 net.
The more important features of operation are covered in this book. Discusses at length the chief facilities and methods for the movement of timber from the stump to the manufacturing plant, especially logging railroads.
The greatest emphasis is laid on features about which there is not much written material available.

The Theory and Practice of Working Plans (Forest Organization).

By A. B. RECKNAGEL, B.A., M.F., Professor of Forestry, Cornell University.
8vo, x. 230 pages, illustrated. Cloth, $2.00 net.
Designed both for the student and the practicing forester. In preparing this book the author constantly kept in mind the experience which he gained while doing active work for the Forest Service in various parts of the United States.

Vancouver, B.C.—On his return to-day from London, Sir Richard McBride said he had been assured by Mr. Alfred Smithers, head of the G.T.P., that the line from Edmonton to Prince Rupert would be finished by midsummer. He had received similar assurances concerning the Canadian Northern from Sir William Mackenzie.

Vancouver, B.C.—The Provincial Government has taken over the telephone line between Heriot Bay and Shoal Bay, a distance of 52 miles. All of the work that remains to be completed is the cable across Okis Hollow Channel, and Contractor H. E. Elson hopes to have this completed shortly.

Victoria, B.C.—The city engineer has reported that the road crusher, "Champion," recently purchased in Vancouver, is ready for work. It is run by a 22 h.p. gasoline engine, with an output of 60 to 70 yards per day.

Victoria, B.C.—The big Lobnitz rock crusher has had a new oil-burning apparatus installed, and is again at work on the submerged rock off Hospital Point. When the Lobnitz crusher has completed her operations at this point, within the next few weeks, there will be a clear channel with a depth of twenty feet, whereas at the present there is only fifteen feet of water. The removal of this reef will give the coasting boats easy access to the Inner Harbor, and will obviate the necessity of manoeuvring, as is now the case when boats are leaving the C.P.R. or G.T.P. wharves. Just as soon as the whole of the rock has been crushed by the powerful machinery operated by the Lobnitz, the dredges will be set to work to clear the channel.

Victoria, B.C.—It is expected that the question of the C.N.P. Company's right-of-way through the Saanich Peninsula will be settled by arbitration proceedings in the usual way. Mr. R. S. Day and Mrs. James Reid have already been named as two of the arbitrators.

Victoria, B.C.—A bridge of substantial structure has been completed over the Nanaimo River. The frame is erected on concrete piers 150 feet long, and Howe truss. The piers are built with an idea of carrying steel, should this be found necessary any time in the future.

Victoria, B.C.—The arrival of the motor tractor for No. 2 Fire Engine is expected daily. A test is to be made, so that the apparatus may be accepted and taken over from the Seagrave Company at once.

Victoria, B.C.—Four million dollars have been spent this year in British Columbia in building new roads and trails. The most notable achievement was the progress made on the Banff-Windermere motor road.

Whitehorse, Y.T.—A bridge over the Wheaton River on the government river leading from Robinson to the mines of that district, has been completed.

Winnipeg, Man.—The C.N.R. land case will not be considered by the Exchequer Court until November 17th. The case on which the court is to sit arises out of the appeal of the Canadian Northern Railway for a decision as to whether a strip of land one and a half miles long and two hundred yards wide, should be subjected to expropriation, in which case it should be compensated for heavily. The railway company claims the expropriation would kill its terminals' scheme, and therefore the land has a highly appreciated value. The matter has created considerable interest, owing to the implication of the Dominion Government, the C.N.R., the city of St. Boniface, wherein the property is situated, and the G.T.P.

Winnipeg, Man.—The premier has announced that $2,500,000 is to be expended on roads in Manitoba this coming year.

Wolseley, Sask.—An addition is being constructed to the municipal light and power plant; and a 30 k.w. generator, a 2 k.w. exciter and a new switchboard are to be installed. A second unit will thus be provided so that in case of mishap to one unit the other will carry the load while repairs are being made.

Woodbridge, Ont.—The Pinegrove Bridge, which spans the Humber River, has been completed, and is now open for both vehicular and pedestrian traffic. The structure is constructed of reinforced concrete, with steel superstructure. It has a span of 60 feet, and cost over $5,000 to build. It is sixteen feet in width.

MONTREAL MARKET LETTER

Local iron and steel circles are still in a waiting mood. At the moment there is considerable activity. Merchants are all as busily employed as they can be in shipping out orders, and boats are leaving port with full cargoes. This does not of itself indicate any improvement in actual trade. Activity in shipment is a prevailing condition each year during November, inasmuch as buyers throughout the country are all anxious to lay in their supplies previous to the closing of navigation. In a general way the closing of navigation is assumed to take place at the end of November; although, as a matter of fact, some vessels are very frequently laid up before that time, while other vessels operate right into December. Ocean steamships frequently leave the port at the beginning of December; and a year ago the Harbor Commissioners made a trip through the port of Montreal on a tug on the first day of January. So far as commerce is concerned, however, no one ever counts upon inland navigation being open after the end of November.

Dealers are still watching the situation on the other side of the border where there is every evidence of prices going even lower than they are at the present time; and prices at the present time are considerably lower than they were some time ago. There has been a somewhat striking movement in the United States in the closing down of furnaces and steel plants; and as this will mean a reduction in production, there is a possibility that a further decline in the course of prices may be arrested. Meantime, any downward trend in prices is welcomed by the consumer, although producers on this side of the line are otherwise affected. It is reported this week that the Dominion Steel Corporation has accomplished its financing at London through the issuance of $3,500,000 of 5-year 6 per cent. notes.

NEW INCORPORATIONS.

Walkerville, Ont.—Fisher Motor Company, Limited, $600,000. C. F. Garaghty, F. E. Fisher, F. W. Vollans.

Fredericton, N.B.—Atlantic Oilfields, Limited, £600,000. A. J. Gregory, J. J. Fraser, Winlow; J. B. Gregory.

Hull, Que.—The Hull Iron and Steel Foundries, Limited, $250,000. A. H. Coplan, M. P. Walters, T. H. Birks.

Hamilton, Ont.—The Ore Extension Mining Company, Limited, $1,500,000. L. R. Lupton, D. Fretz, G. Laws.

St. Thomas, Ont.—St. Thomas Bronze Company, Limited, $200,000. P. R. Diamond, G. C. Jones, M. Alexander.

Pokiok, N.B.—Pokiok Land and Water Power Company, Limited, $99,000. A. R. Slipp, R. B. Hanson, H. B. Moor.

Ottawa, Ont.—The Morrison Construction Company, Limited, $100,000. K. A. Morrison, T. A. Burgess, L. Cote.

Vaudreuil Station, Que.—Vaudreuil Electric Company, Limited, $50,000. D. P. Gilmour, F. G. Bush, G. R. Drennan.

Winnipeg, Man.—Empire Waterworks Supply Company, of Canada, Limited, $100,000. G. Irving, G. F. Irving, G. F. de C. O'Grady.

Sault Ste. Marie.—The Lake Superior Dry-Dock and Construction Company, Limited, $1,500,000. J. S. Lovell, R. Gowans, W. Bain.

Victoria, B.C.—Automatic Coupling Company, Limited, $150,000. Vancouver Island Oil Company, Limited, $2,000,000. British Columbia Gypsum Company, Limited, $2,000,000.

Toronto, Ont.—The Ramsden Sand, Gravel and Brick Company, Limited, $100,000. C. H. Rooke, E. W. Bickle, F. E. Earle. Rock and Power Machinery, Limited, $500,000. A. Gilmour, A. Cochrane, W. C. Johnston.

Vancouver, B.C.—Hartley Iron Works, Limited, $50,000. Kallapa Mining Company, Limited, $250,000. White Rock Resort Development Company, Limited, $100,000. Pacific and Hudson Bay Development Company, $1,000,000. Delta Dredging Company, Limited, $100,000.

Montreal, Que.—Laurie Machinery Company, Limited, $25,000. W. Laurie, A. E. Woodworth, H. H. Scott. Canadian Bronze, Limited, $2,000,000. P. R. Diamond, G. C. Jones, M. Alexander. Canadian Water Purifying Company, Limited, $40,000. L. A. David, L. J. M. Dugas, L. E. A. D'Argy-Mailhiot. Glengarry Construction Company, Limited, $100,000. C. A. Pope, G. Barclay, W. B. Scott.

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TRADE MARK

Mountain Street, Winnipeg, Man., paved with Mexican Eagle Asphalt.

Mexican Eagle Asphalt is more cementitious than other asphalts.

Water will not readily injure it.

Exposure to sun and air will not cause its deterioration.

It has great cohesive strength.

It is more ductile and flexible than other asphalts.

Shocks will not crack it. It is very malleable.

We will supply asphalt having the proper penetration for your needs.

It is best adapted to Canada's climate —will not mark in hot weather—nor are snow or ice likely to crack it.

It has over 99 per cent. bitumen. Purest on the market—therefore free from deleterious matter.

It is so constituted that it will not be injured by the heat necessarily applied to melt it for paving operations.

Samples, prices, analyses, etc., on request.

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

TENDERS CALLED FOR

TENDERS FOR ANNUAL SUPPLIES,

DEPARTMENT OF WORKS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, December 2nd, 1913.

1. Crushed Limestone (all sizes).
2. Cedar Posts.
3. Portland Cement.
4. Hardware (Pipe Fittings, Valves, Tools and General).
5. Iron Castings, Manholes, etc.
6. Limestone Dust.
7. Lumber.
8. Lubricating Oil, Coal Oil, Gasoline.
9. Rubber Valves, Packing, Hose, etc.
10. Sewer Pipe Vitrified.
11. Sewer Bricks.
12. Sand and Gravel.
13. Street Tablets.

Specification and tender form for any of the foregoing may be obtained upon application at Room 12 (Purchasing and Accounting Section) of the Department of Works, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering as prescribed by City by-law, must be strictly complied with, or the tenders may be declared informal. Tenderers shall submit with their tenders the names of two personal sureties, approved by the City Treasurer, or in lieu hereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, November 18th, 1913.

TENDERS FOR IRON POSTS.

Sealed tenders addressed to the undersigned and endorsed "Tenders for Iron Posts," will be received at the Department of the Interior, up to noon of the 1st day of December, 1913, for the furnishing of fifteen thousand small and five hundred large iron posts for use on the survey of Dominion Lands, to be delivered at Edmonton on or before the 31st day of January, 1914.

Forms of tender and detailed information may be obtained from the Surveyor-General of Dominion Lands, Ottawa.

The tender must be accompanied by an accepted cheque on a chartered Canadian bank for the sum of two hundred dollars, payable to the order of the Deputy Minister of the Interior. This cheque will be forfeited if the party whose tender is accepted declines to enter into a contract to deliver the posts or fails to carry out the contract. If the tender is not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender

Newspapers copying this advertisement without authority from the Department will not be paid.

L. PEREIRA,
Secretary.

Department of the Interior,
Ottawa, October 31st, 1913.

Sealed tenders addressed to the undersigned, and marked on the envelope "Tender for 200-ton Mechanical Coaling Plants with Sandhouses," will be received at the office of the Commissioners of the Transcontinental Railway at Ottawa, Ontario, until 12 o'clock noon of the 7th day of January, 1914, for the construction and erection complete, in accordance with the plans and specifications of the Commissioners of six 200-ton Mechanical Coaling Plants with Sandhouses complete, to be erected at the following points on the line of the National Transcontinental Railway as set forth below, viz:—

One at Monk, P.Q.	.....	Mile 385.2
One at Bridge, P.Q.	.....	" 460.6
One at Fitzpatrick, P.Q.	.....	" 588.2
One at Parent, P.Q.	.....	" 705.3
One at Doucet, P.Q.	.....	" 806.4
One at O'Brien, P.Q.	.....	" 915.4

Plans may be seen and forms of tender and specifications obtained at the office of Mr. W. J. Press, Mechanical Engineer, Ottawa, Ontario, and at the offices of Mr. A. E. Doucet, District Engineer, Quebec, and Mr. T. S. Armstrong, District Engineer, Cochrane, Ont.

Persons tendering are notified that tenders must be made on the printed forms supplied by the Commissioners, and that each tender must be signed and sealed by all the parties to the tender, and witnessed, and be accompanied by an accepted cheque on a Chartered Bank of the Dominion of Canada, payable to the order of the Commissioners of the Transcontinental Railway, for a sum equal to five per cent. (5 per cent.) of the amount of the tender.

The cheque deposited by the party whose tender is accepted will be deposited to the credit of the Receiver-General of Canada as security for the due and faithful performance of the contract according to its terms. Cheques deposited by parties whose tenders are rejected, will be returned within ten days after the signing of the contract.

The right is reserved to reject any or all tenders.

By Order,

P. E. RYAN,
Secretary.

The Commissioners of the Transcontinental Railway.
Dated at Ottawa, Ont., November 3rd, 1913.

Newspapers inserting this advertisement without authority from the Commissioners, will be not paid for it.—50357.

TOWN OF YORKTON, SASKATCHEWAN.

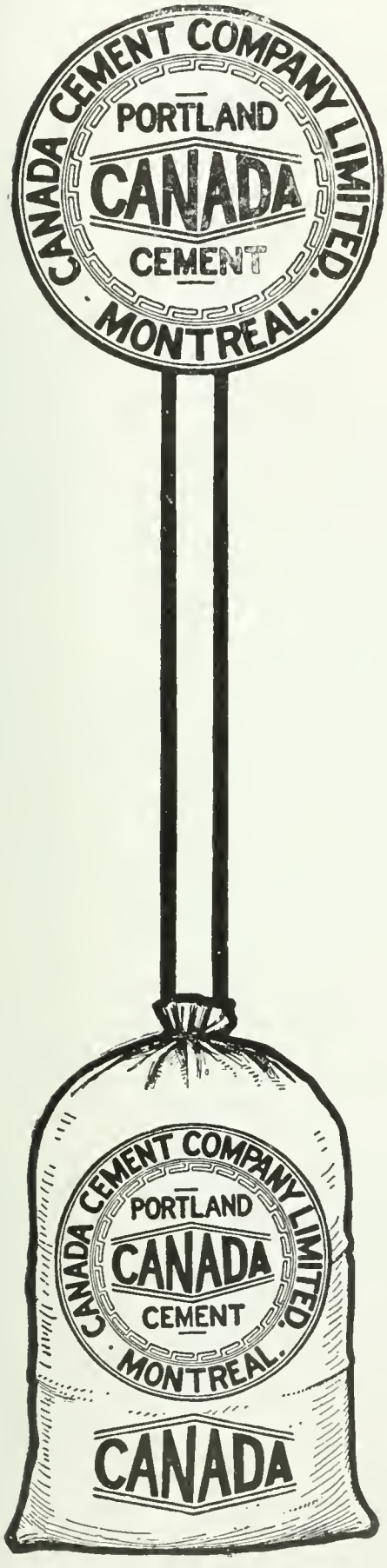
TENDERS FOR DIESEL ELECTRIC MACHINERY.

Sealed tenders marked "Tenders for Diesel Electric Machinery," addressed to T. F. Acheson, Secretary-Treasurer, Town of Yorkton, Sask., will be received up to 12 o'clock, Monday, 22nd December, 1913, for the supply and delivery of one 500 b.h.p. combined unit. Specifications and all information may be obtained upon application to M. M. Inglis, Electrical Engineer, Yorkton. The lowest tender not necessarily accepted and the right is reserved to reject any or all tenders.

T. F. ACHESON,
Secretary-Treasurer.

(For further Tenders see page 90).

PERMANENCE—



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The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

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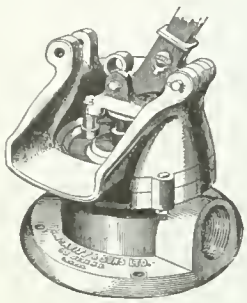
MONTREAL TORONTO WINNIPEG CALGARY

Second-Hand Machinery

Advertisements under this heading three cents per word per insertion, if not "displayed." Minimum 50 cents per insertion.



Contractors' Diaphragm Pumps

Especially adapted for use by contractors, pumping out excavations, cellars, trenches or sewers, discharging water containing sand, gravel, mud or any semi-fluid substance.

Send for our illustrated catalog

3" stroke 3" suction
Capacity 3500 gals. per hour

H. W. PETRIE, LIMITED
General Machinery Dealers **TORONTO, Ont.**

FOR SALE.—One 35 h.p. gas engine, in good condition, suitable for city or natural gas. Apply Box 1505, General Post Office, Winnipeg.

Tenders Called For

TENDERS FOR MACHINERY AND EQUIPMENT.

Tenders will be received by the Bowness Improvement Company at their offices, 202 Eighth Avenue West, Calgary, Alberta, until 5 p.m., December 31, 1913, for the following machinery and equipment:—

"L." One 200 k.w. Traction Motor Generator.
"M." One four panel Switch Board.
"N." One 250 k.v.a. Generator.
"O." One Vertical Single Acting Multi-Cylinder Gas Engine.

Bidders must enclose certified cheque in the amount of 5 per cent. of their tenders. Cheques of unsuccessful tenderers will be returned immediately after contracts are awarded. Specifications may be obtained from the engineer, and may be seen in the offices of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg, 62 Church Street, Toronto and 628 Transportation Building, Montreal.

The lowest or any tender not necessarily accepted.

T. L. TURNBULL,
Consulting Engineer,
202 Eighth Avenue West,
Calgary, Alberta.

TENDERS FOR PUMPING PLANT, ETC.

Sealed tenders will be received by C. F. Monroe, Township Clerk, for a pumping plant for use in the new Waterworks System of the Township of Stamford, County of Welland. The source of water supply being one or more 8-inch wells.

Tenders will also be received for Wrought Iron, Cast Iron and Steel pipes, in sizes from ¾ inch to 10 inch, with valves, Fire Hydrants, etc.

Quantities and other information may be obtained from J C. Gardner, Township Engineer, Niagara Falls, Ont.

Tenders must be in the hands of the Township Clerk not later than 2 o'clock p.m., Monday, December 1st, 1913. The lowest or any tender not necessarily accepted.

C. F. MONROE,
Township Clerk, South End P.O.

(For further Tenders see page 88.)

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

CITY OF MOOSE JAW.

WANTED—CITY ENGINEER.

Applications addressed to the undersigned will be received for the position of City Engineer for the city of Moose Jaw.

Apply, giving experience, reference and salary required.

E. B. BONNELL,
City Clerk.

Dated at Moose Jaw this 12th day of November, 1913.

FIRM OF PUBLIC WORKS CONTRACTORS require the services of a first-class civil engineer to take charge of engineering department on large canal contract in Canada. Must be thoroughly experienced in this particular class of work. State experience, age, salary required, and give references. All applications will be treated in strict confidence. Apply Box 178, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

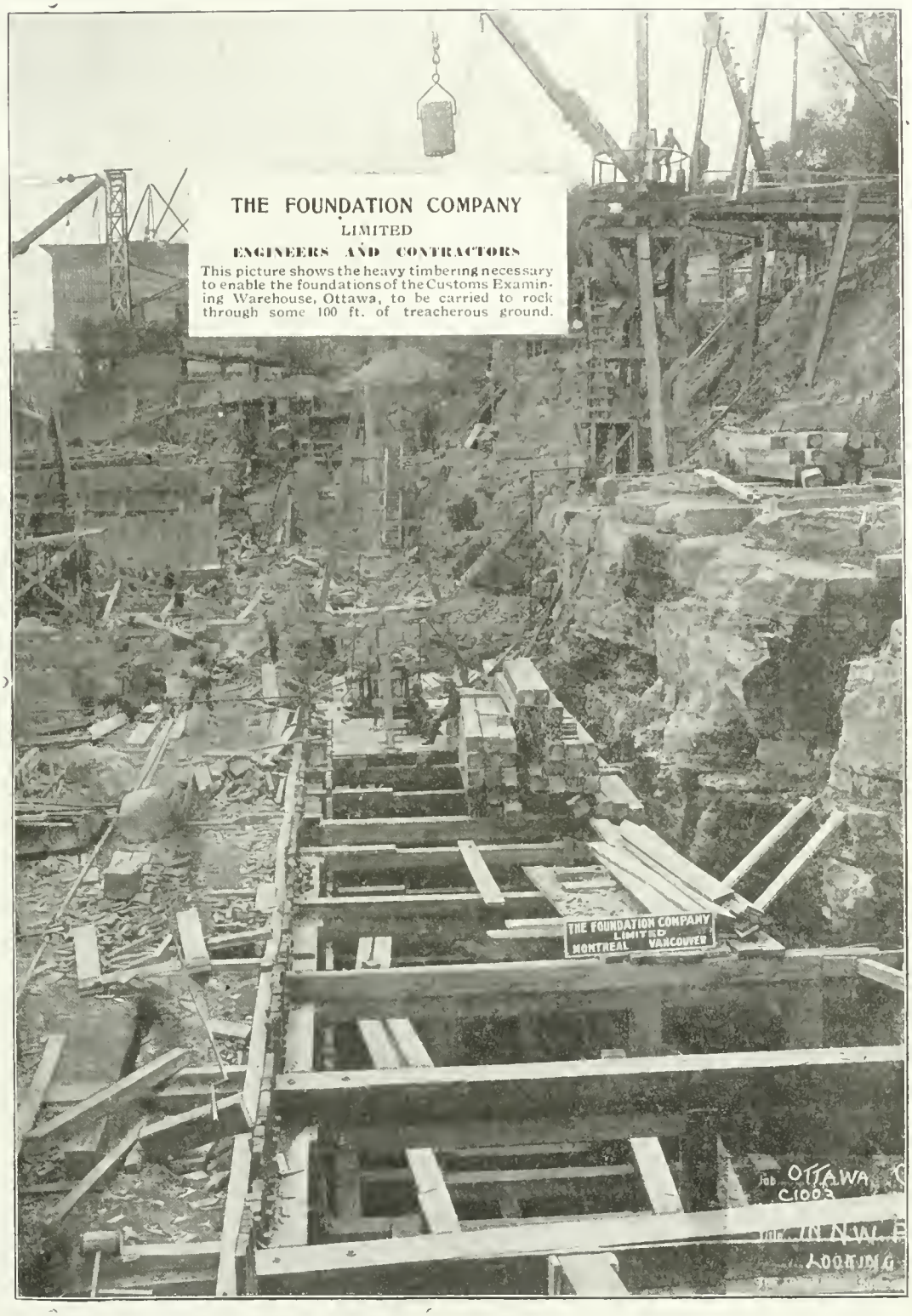
STENOGRAPHER.—Experienced in engineering correspondence, estimating and accounting, desires position, preferably as secretary. Gilt-edged references. Please address, Box 168, *The Canadian Engineer*, Toronto.

ENGINEER—Long experience in erecting and running steam and electrical installations of high capacity (in charge), desires position in the above, or as master mechanic. Technical knowledge. Just finished construction work. All round and skilful. Highest references. Box 176, *Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian patents Nos. 136942 and 136943 granted on November 21st, 1911, to Hans Nathusius, of Friedenshutte, near Morgenroth, Germany, for electric furnaces, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the inventions, and from whom full information may be obtained. Fetherstonhaugh and Smart, Castle Building, Ottawa, Canada; Russel S. Smart, resident.


THE FOUNDATION COMPANY
LIMITED
ENGINEERS AND CONTRACTORS
This picture shows the heavy timbering necessary to enable the foundations of the Customs Examining Warehouse, Ottawa, to be carried to rock through some 100 ft. of treacherous ground.
THE FOUNDATION COMPANY LIMITED
MONTREAL VANCOUVER
Job OTTAWA C1003

MARKET CONDITIONS

Montreal, November 17th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron, $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1 40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3 45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3 15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4 30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21.25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30-ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40· XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8 50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, November 19th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:— 40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3 55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40 60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot.....	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long ...	1.00	1.60	2.60	4.00	13.00
Double junctions.....	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand- Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3,40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, November 18th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3 16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7.16, $4.75; ½, $4.50, 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18, $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30 22, $4.30; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.25; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in. $3.35 base; machinery, $3 base; shares $4 50 base; share crucible, $5.50; cast share steel, $7.50; toe caulk, $4.50 base; tire steel, $3 base; cast tool steel, 1b., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Nov. 27, 1913

Contents of this issue on page 775

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

LAYING TORONTO'S SECOND INTAKE PIPE

PLACING 2400 FEET OF 6-FOOT PIPE ON THE BED OF LAKE ONTARIO, AND CONCRETING IT INTO PLACE — CONTRACTOR'S PLANT REQUIRED — SPEED OF CONSTRUCTION

IN June, 1911, the City of Toronto called for tenders for the laying of a 6-foot riveted steel pipe from the filtration plant, situated on Toronto Island, to a point in Lake Ontario, about 2,400 feet from the Island shore. Early in August of that year, the contract was awarded to Messrs. Roger Miller & Sons, Limited, Toronto. It was in the nature of a lump sum contract, varying from the original specifications to the extent of the substitution of steel for 6 by 8-inch wooden piling throughout.

General Progress of the Work.—During the autumn months of 1911, work was begun, the operations centering chiefly upon the excavation necessary at Toronto Island, beginning at the north end adjacent to the new pumping station, and extending toward the south shore of the Island. The excavation was first made to a depth of 15 feet below lake level, and was about 85 feet in width at the water line. Fig. 1, looking south toward the lake, shows the greater part of this Island excavation. The work entailed the removal of some 20,000 yards of excavation, principally sand.

Fig. 1.—Island Excavation and Lake Operations, Looking South from Filtration Plant.

This portion of the pipe line was designed to include a tank near the shore to serve as a manhole for pipe inspection. It measures 11 feet by 8 feet 6 inches, with a depth of 24 feet. The placing of this tank in its proper position was greatly facilitated by the use of coffer-dams, which were in progress simultaneously with the Island excavation, so that by the time the latter was finished the tank was in place, and pipe-laying was in no way delayed.

One length of pipe was put in by December, 1911, and connected up with the tank. The water was particularly low at the time, the top of the pipe being only 4 feet below water level. Pipe-laying operations were, therefore, necessarily discontinued as extreme weather set in.

With the opening of spring, the contractor's plant had been put in shape, and work began with the season. Owing to a revision of the plans by the city, necessitating the lowering of the pipe line through the Island to the same level as that extending from the tank outward into the lake, after three lengths of pipe were laid work was discontinued. The pipes and tank were taken out, and the excavation was extended to a further depth of 6 feet, bringing it to an average of 21 feet below the water line. The removed portions of the line were then re-set and connections made with the filtration plant, as shown in Fig. 2.

Remarkable progress was made with the work during the summer months of 1912, despite a good deal of adverse lake weather. The entire line was laid, steel piles driven, crib placed, and the whole length concreted out into the lake as far as indicated in Fig. 3. The pipe line was ready for use by the end of January, 1913, and the job was completed with the exception of a small amount of back fill, which was placed in a short time in the early spring.

Description of Contractor's Plant.—During the winter months of 1911-12, the contractors built the required plant for carrying out the work in the lake. To cope with the

numerous exigencies attending work of this nature, particular attention was devoted to the design and construction of mechanical details, and as a result, the greater part of the plant was built and assembled especially for the work. The advisability of the extreme care taken in this procedure was evidenced later in the successful continuity of operations, and the entire absence of delays due to lack of equipment, materials, etc.

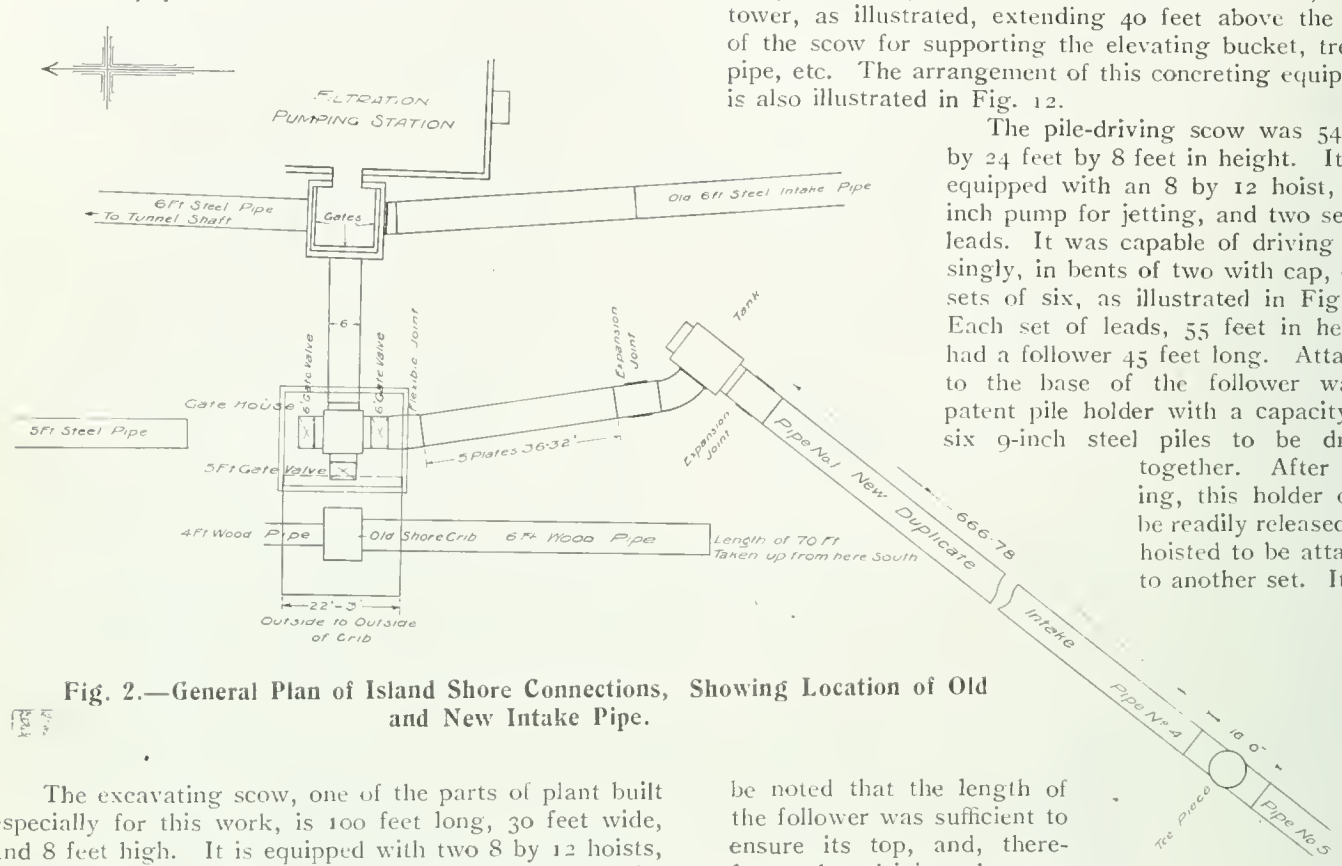


Fig. 2.—General Plan of Island Shore Connections, Showing Location of Old and New Intake Pipe.

The excavating scow, one of the parts of plant built especially for this work, is 100 feet long, 30 feet wide, and 8 feet high. It is equipped with two 8 by 12 hoists, operating two 1¼-yard clamshell buckets. One distinguishing feature is the installation of two 6 by 8 independent swinging engines. The booms used were 65 feet in length, and either derrick had a working capacity of 20 tons.

Another scow, used principally for deep water work, especially in connection with the placing of the crib at the end of the pipe line, and for the towing and placing of pipe sections, was also 100 feet by 30 feet by 8 feet. It was equipped with a steel derrick of 25 tons capacity, a 65-foot boom, a 9 by 12 hoist, and an 8 by 8 independent swinging engine. It had a clam of 1½ yards capacity. This scow, shown in Fig. 4, was also equipped with four sets of specially designed and patented thribble blocks and four powerful winches, used for manipulating the pipe sections.

The concreting scow, whose dimensions were 100 feet by 28 feet by 8 feet, is shown at work in Fig. 5. It was furnished with a derrick, an 8 by 12 hoist, a 1-yard clam, a 1-yard mixer, bins for sand and broken stone, and a tower, as illustrated, extending 40 feet above the floor of the scow for supporting the elevating bucket, tremie-pipe, etc. The arrangement of this concreting equipment is also illustrated in Fig. 12.

The pile-driving scow was 54 feet by 24 feet by 8 feet in height. It was equipped with an 8 by 12 hoist, a 6-inch pump for jetting, and two sets of leads. It was capable of driving piles singly, in bents of two with cap, or in sets of six, as illustrated in Fig. 10. Each set of leads, 55 feet in height, had a follower 45 feet long. Attached to the base of the follower was a patent pile holder with a capacity for six 9-inch steel piles to be driven together. After driving, this holder could be readily released and hoisted to be attached to another set. It will be noted that the length of the follower was sufficient to ensure its top, and, therefore the driving hammer being always above water.

The air scow was 30 feet by 18 feet by 5 feet. It was equipped with a hand derrick, jetting pump, and a 6-inch centrifugal pump directly connected to two separate engines. This pump served to remove the sand from in and around joints of the pipe sections when they were being connected up, the diver employing the suction pipe for this purpose whenever necessary in making his connections.

One important feature of these five scows was that each was equipped with an air compressor by means of which the divers were furnished with air.

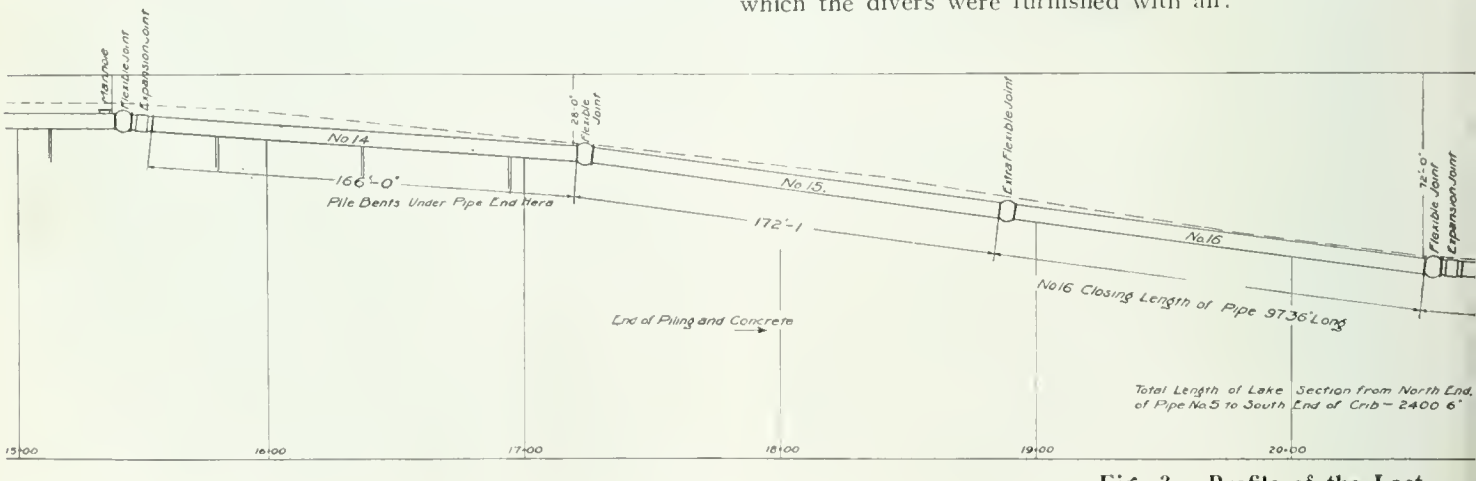


Fig. 3.—Profile of the Last

There were, in addition, several deck scows 70 feet by 24 feet by 6 feet for carrying materials such as piles, broken stone, etc. The sand required for concreting was taken directly from the bed of the lake.

Pipe Line.—The pipe line points in a southwesterly direction from the Island, as indicated in Fig. 2, which shows clearly the connections of the old and new pipe with the pumping station. The course follows the bed of the lake into about 110 feet of water. The last several sections showing its position as the decline assumes a steep gradient, is indicated in profile in Fig. 3.

The pipes were, as stated, of riveted steel, 6 feet in diameter. They were manufactured by the Canada Foundry Company, Toronto, and delivered to the city at John Street wharf. They were eighteen in number and were 166 feet in length, with the exception of several that were equipped with manholes, and were 168 feet long. Fig. 5 shows one of the sections, together with a tee, several of which were used, one at the crib, and another as shown in Fig. 2.

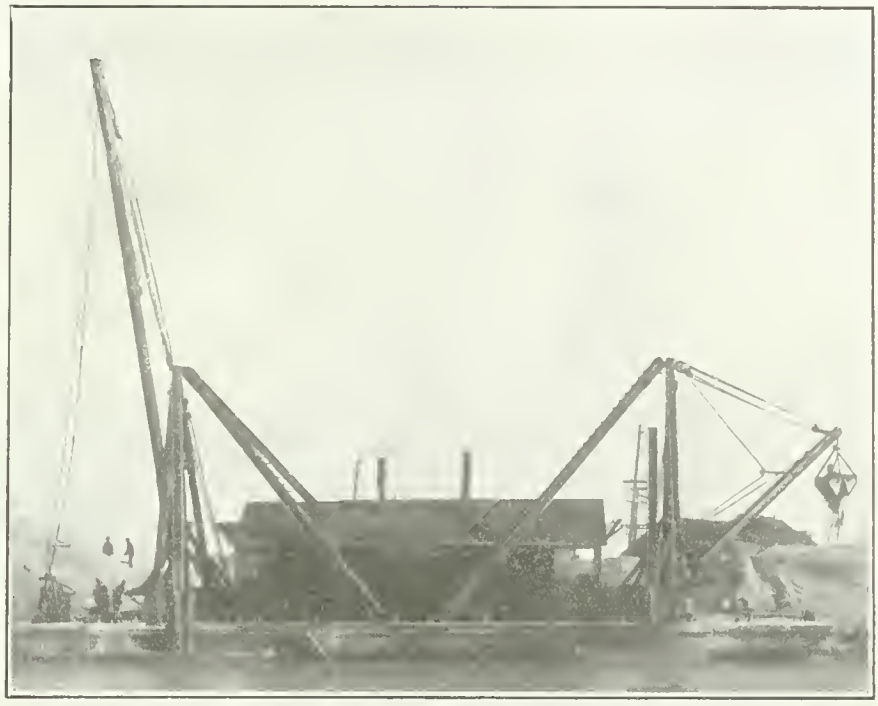
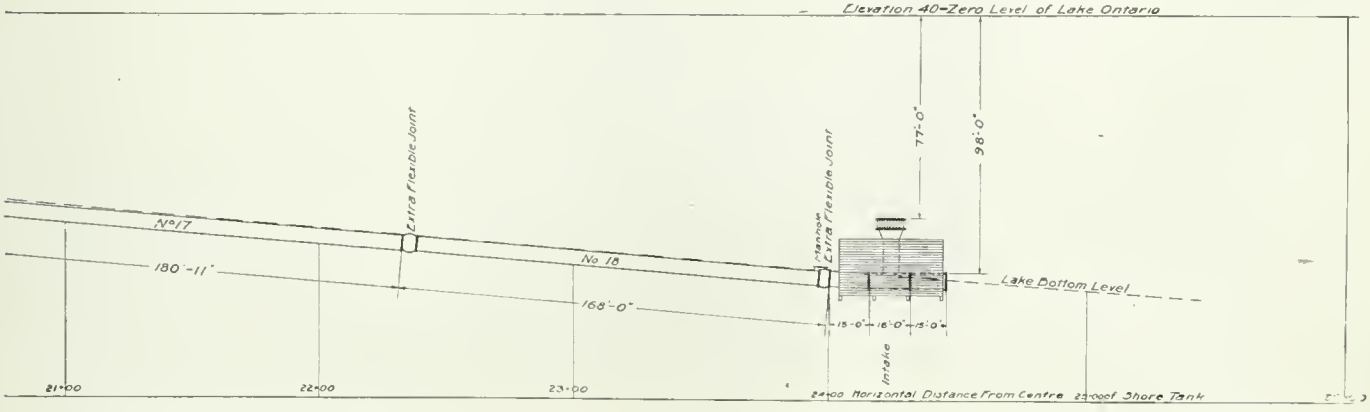


Fig. 4.—Scow Used for Deep Water Work and Pipe Laying.

Before placing the pipes in water, they were equipped with bulkheads at each end, and rolled into the bay. They were then towed into about 12 feet of water, where, after applying two 1¼-inch cables around each end, the bulkheads were removed sufficiently to allow the pipe to be sunk by the entering water. Then, the scow, equipped with the thribble blocks and winches, was floated over it and the pipe lifted into contact with the bottom of the scow. The whole was then towed out into its proper position in the lake, and the pipe lowered into line. Specially designed knuckle joints, facilitated the removal of cables after the pipe had been lined up and a few bolts inserted. The cable arrangement was such as to permit accurate and minute changes in the position of the pipe, so that the divers found no difficulty in fitting the sections together. There were forty-four 1¼-inch bolts in each connection. At each joint, also, there was a wooden gasket of well-seasoned pine, 1 inch in thickness, with joints carefully broken, and put together with copper nails.

A 72-inch flexible joint, made by the Canada Foundry Company, Toronto, was provided in the pipe line at every stage where there was an appreciable change of grade, until the point was reached where the lake bed descended rapidly, as shown in Fig. 3. From this point to the end of the line, a flexible joint was placed at the end of every pipe section. These joints each allowed a movement from the centre line of the previous pipe of 21° 30′. Expansion joints at regular intervals each allowed a play of 18 inches. They were equipped with a 2-inch rubber ring inserted between angles, and held in position by eight or nine bolts around the circumference of the joints. Fig. 7 shows a pipe connection equipped with a flexible joint, and shows an expansion joint also.

Several points of interest arose in connection with the manufacture and delivery of these pipes that might well be mentioned. The shipping of this 72-inch pipe had an important bearing on the manufacture, as it was specified in flanged lengths of 166 and 168 feet, and the shipping of these sections allowed all circumferential joints to be shop riveted. Further, calculations were made to insure the pipe being of ample strength for safe



Five Sections of the Pipe Line.

carrying on two points. Careful measurements were made of the track, siding, curves, etc., and the site of delivery was similarly inspected to insure convenient unloading and storage.

For each shipment four 40-foot heavy capacity flat cars were used, and each length, which weighed approximately 47 tons, was loaded on cradles and swinging bunks. Fig. 8 illustrates the position of a pipe section when ready for transportation.

Fig. 5.—General View of Concreting Plant.

The Crib and Intake. — The crib which surrounds the intake is a structure 40 feet square and 25 feet in depth. It was built at the John Street wharf to a height of 10 feet, and completed after launching. It was towed out of the bay through the Western Gap, where it was loaded with about 25 tons of stone, held in suspension by three cables and a steel derrick, and then the whole outfit was towed by three tugs into the lake. Fig. 9 shows the crib on its way to the end of the pipe line.

When above its proper location, special precautions were taken to produce uniformity in the operation of lowering and to provide accurate knowledge for those at the surface, of its progress as it was being sunk. This formed one of the portions of the work where greatest care had to be exercised in order to place the crib as nearly as possible to its ideal position with respect to the pipe line, the last section of which was unplaced until the crib was finally seated. The difficulty will be understood when it is remembered that the pipe line was approximately 110 feet below the surface at that point, and there were no "bench marks" to define its relative position. The structure had been divided into sections, as shown in Fig. 10. These were then filled with stone, which was successfully carried out by means of lowering the material in a cage directed by a tow cable to whatever section was being filled. The extremity of the cable was then transferred to another section by the diver. The centre section, surrounding the tee with which the pipe line terminates, was filled with concrete to eliminate all danger of displacement of the intake. This operation, carried on at such a depth, necessitated a tremie pipe of small diameter, owing to the excessive strain upon the upper portion of its length, when discharging the concrete.

The pipe line, as stated, ended in a tee, one flange connecting with the line, its mate provided with a bulkhead, and the third placed vertically and projecting out of the crib to the intake proper, which is flared to it, and is 8 feet in diameter. It is cylindrical in form, standing vertically with closed top, while its sides are formed by a number of steel bars, as illustrated in Fig. 10, which prevent the intrusion of suspended matter of any considerable magnitude. Further, the inner part of the intake is provided with a steel plate, placed vertically to prevent the longitudinal entrance of sticks of wood, etc.

Fig. 6.—A Section of Pipe, With Expansion Joint.

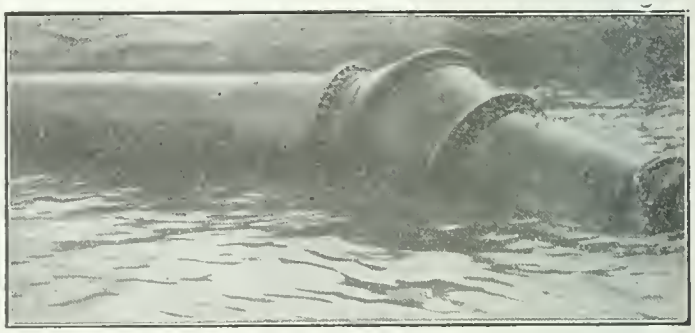


Fig. 7.—A 72-inch Flexible Joint Connected Up, and (at extreme right) An Expansion Joint.

Fig. 8.—A Pipe Section Ready for Transportation.

Piling.—Steel piles were used, it being felt that the work could not be satisfactorily done with the use of wooden piles, the depth of water, and of sand, the length of the line, etc.—conditions indicated that it would be almost impossible without tongue and grooving or some special manner of attaching one pile to its previously driven mates, to construct a permanent line. The steel piles were supplied by the United

States Steel Products Co., and were perhaps the first departure from the customary 6-inch and 12-inch steel piles previously used. They were of 9-inch section, 18 feet in length, and weighed 21.3 pounds per square foot. They were driven in panels of six (as shown in Fig. 11) for a distance of 1,800 feet on either side of the pile line (3,600 linear feet in all) or to such a point where it was deemed that the line was sufficiently low in the water to obviate all necessity of piling and concreting. A steel rod was placed across the top of the piles every 7 feet, it being ⅞-inch in diameter.

Fig. 9.—The Intake Crib, Enroute to Its Lake Position.

Concreting.—The concrete used was a 1:2:4 mix, and was placed with the use of a tremie pipe, the depth of concrete work varying from 20 to 55 feet. About 4,000 yards were used.

In connection with the shore tank, previously mentioned, the concreting of it into position was greatly facilitated by placing the forms before it was lowered into the excavation, and when properly located, it was then easily concreted.

Personnel.—The work was done for the City of Toronto, for whom Mr. R. C. Harris is Commissioner of Works, and Mr. George C. Powell, Deputy City Engineer. Mr. C. W. Allen was resident engineer on the initial part of the work, and was succeeded by Mr. A. U. Sanderson for the remainder. The contractors were, as stated, Roger Miller and Sons, Limited, Toronto, and we are indebted to Mr. A. E. Gibson, member of the firm, for most of the information and illustrations contained in this article.

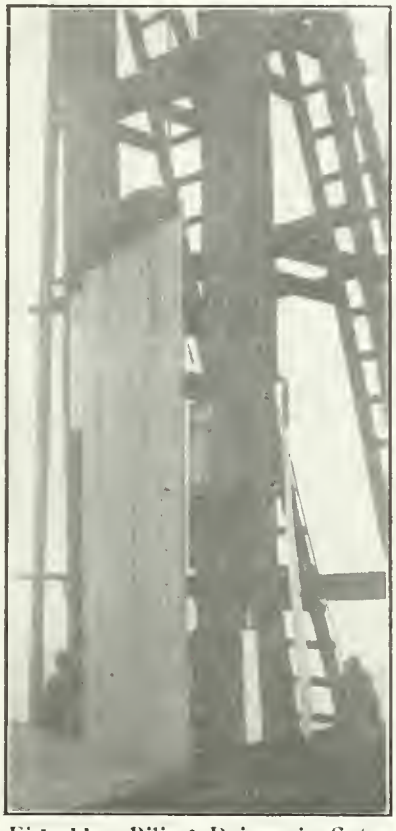


Fig. 11.—Piling Driven in Sets of Six at a Time.

LARGE CONTRACTS FOR WATER POWER PLANTS

In connection with the new enterprises of Dr. F. S. Pearson in Barcelona, Spain, known under the name of The Barcelona Traction Company, the Swiss turbine builders, Escher Wyss & Co., have secured large contracts for the supply of water wheels and pipe lines. Besides an auxiliary plant of 4,000 h.p., four large installations are being equipped by Escher Wyss & Company. Three of these utilize water from the River Ebro. The first installation comprises five units of 16,000 h.p. each under a head of 140 feet, and is nearing completion. For the second and third, the turbines are well under way. These installations comprise in one case four units of 15,000 h.p., under a head of 250 feet, and in the other, four units of 11,500 h.p., under a head of 165 feet.

The same company are supplying the water wheels and pipe lines for a high-pressure plant in the Pyrenees, built by a concern controlled by the Barcelona Traction Co. There are five turbines of 7,000 h.p. capacity each, under a head of 2,800 feet. They have obtained great experience in building plants for high heads, having built the famous Adamello power plant, operating under 3,000 feet head; the plant of the Rio de Janeiro Tramway, Light and Power Co., as well as the "Necaxa" plant of the Mexican Light & Power Co.; both these latter being enterprises of Dr. Pearson, like The Barcelona Traction Co., and developing over 100,000 h.p. each.

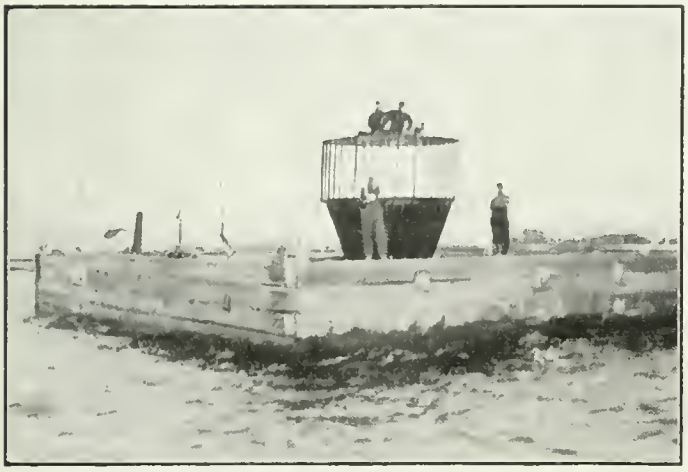


Fig. 10.—Illustrating Construction of Intake.

Fig. 12.—Front View of Concreting Dredge, Showing Elevating Apparatus, Etc.

SOME EUROPEAN PAVEMENTS—REPORT.

MR. E. H. THOMES, Mem. Am. Soc. C.E., assistant engineer, Bureau of Highways, Borough of Queens, New York City, has returned from a tour of inspection of roads and pavements in Europe, and has presented a report containing some good information on paving materials and paving methods in numerous localities. The following is a summary:—

Pavement Studies in Liverpool.—At Liverpool, City Engineer John A. Brodie is conducting measurements of pavement wear under actual traffic. Cast iron sockets are imbedded in independent concrete supports in the sidewalk, and sometimes an additional one in the centre of the street. In these sockets can be placed standards which carry a taut wire device or a stiff wooden straight edge with sliding T square and vernier scale for the accurate measurements of the road surface. Each apparatus is adjustable so that accurate measurements can always be taken under similar conditions.

The oldest example of pitch grouted macadam in Liverpool was laid on Princes Street in 1901 and has been in continuous use ever since without any repairs. It is still in very good condition, with a mosaic surface having a good contour excepting a few slight depressions; in places it has a slight surface flush of tar still showing life. The traffic here amounts to about 120,000 tons per yard width per year. An adjoining water-bound macadam in the same street has cost from 10 cents to 25 cents per square yard per annum for repairs. The following figures show the average depth of wear in inches per annum on Princes Street:—

For water-bound macadam .....0.54 in. per year
For tar treated water-bound macadam..0.35 in. per year
For pitch macadam .....0.15 in. per year

Mr. Brodie showed a very interesting object lesson of the relative wear of the pitchmac on Princes Street and the plain macadam adjoining. A section of each had been removed and the tar washed out and the mineral aggregate separated into sizes. The plain macadam stone was all rounded with a large percentage of fine stuff, showing the wear from the rubbing and grinding effects which extend to a considerable depth in ordinary macadam, especially in wet weather. The stone from the tar macadam showed only a slight wear and rounding on the surface stones, the rest had practically as sharp edges as when laid twelve years ago.

More satisfactory results with tar macadam seem to have been obtained in Liverpool and other places in Great Britain than in most other countries. The improved results here, as well as at a few places on the Continent, seem to be due to some extent to the good quality of tar used, which in some places appears to be better than that usually obtained in the United States. Moreover, Great Britain has a more moist and more uniform climate than New York, with less extremes of frost and heat with their deteriorating effects. Tar has been used for almost all bituminous macadam work abroad, but the American natural and artificial asphalt paving cements are being introduced into Europe and are meeting with favor. It is generally considered that natural asphalt is better than tar for paving under most conditions, but in many cases it is an open question whether the results justify the usual additional expense of the asphalt.

A good practice which is increasing in favor here and abroad is to use tar in the lower part and asphalt for the wearing surface. Tar is less affected than asphalt by dampness, ordinarily in foundations, it is cheaper and more easily manipulated and for a longer period before hardening, but the asphalt is less affected by the extremes of temperature on the surface and it seems to withstand traffic better and lasts longer. Tar has been used longer and in a greater variety of methods of paving constructions in England than in any other country, but failures have occurred in all places.

Pitchmac pavement was developed by Mr. Brodie and the bituminous binder is sold by S. R. Clare & Co., Liverpool, under the trade name of "Pitchmac." The pavement contains about 13 per cent. of binder. A similar pavement was under construction upon an old cobble-stone pavement as a foundation. A 3-in. loose layer of new 2½-in. stone on top of the old foundation was well rolled and then covered from hand dippers with 1¼ gals. of tar mixture per square yard. This was then covered with a 2½-in. loose layer of 1½-in. stone well rolled and covered with about 1½ gals. of tar mixture. This was rolled hot with a 10-ton roller and covered with a layer of clean, dry, warm stone chips and rolled to a finish. Gasoline torches were used to dry the stone as laid in the roadway just prior to the tarring. The tar mixture consists of equal parts of refined coal tar and fine sand containing about 3 per cent. of powdered chalk. The hot materials were brought onto the street in two separate wagons by a traction engine from the central plant. The tar tank was covered with asbestos and black canvas, and held about 1,000 gals. The tar and sand were mixed together by a special mixing machine from which the mixture was wheeled along the street and dipped out and spread on the prepared broken stone. Mr. Brodie thinks he gets cheaper and better results with the mixture than with tar alone. The sand reduces the expense and stiffens the binder and the chalk or limestone dust seems to toughen it. Good results have also been obtained with this mixture as a joint filler and as a maintenance coating on new and old stone and wood block pavements. This idea seems worthy of a trial here.

Qwing to the great increase of traffic, the tendency abroad as well as here is to strengthen and increase a well drained stone or concrete foundation to a depth of from 6 to 12 ins. and maintain a wearing surface of stone or wood block, or bituminous material, suitable to the traffic and local conditions.

Stone Block Pavement.—Table I. shows the percentages of pavement in ten German cities which were visited. The largest percentage here and elsewhere abroad is stone block pavement. The blocks vary in size from the small 3-in. blocks in Liverpool to the large blocks used in southern Europe. I was much interested in the old Roman type of road with large irregular stone blocks, laid close together, and the later type still in use in Italy of large rectangle stone slabs from 1 to 2 ft. wide, from 1 to 3 ft. long and about 6 ins. or more thick, mostly with a sand bed and joint, some with mortar.

In France alone there are about 120 types of stone block pavements differing either in dimensions, permissible variations or taper. An effort is being made abroad, as has been done in this country, to standardize the sizes of stone paving blocks. The tendency abroad as here is to reduce the depth of block to about 5 or 6 ins. The length varies from 5 to 14 ins. and the width from 3 to 8 ins. Sand, gravel, cinders, broken stone, concrete, etc., are used for foundations. Sand, cement mortar, cinders, fine gravel, stone chips, and tarred chips are used for bed and the same materials are also used in the joints, also tar and other bituminous materials, but sand and tar are

used most. The majority of stone pavements seen abroad had fairly wide joints considerably worn.

In Germany there is quite an amount of 3 or 4-in. cubical stone block pavement called Kleinpflaster, the German word for small paving. Some of these pavements have been laid for many years and are smoother and more satisfactory than one might expect. When carefully constructed they make a fairly good economically maintained pavement for light and medium heavy traffic. A hard tough stone is necessary. The blocks are usually laid in sections with concentric semi-circular courses. This arrangement is more suitable to the irregular shaped blocks, as one side is usually shorter than the other. Blocks are also laid in random courses with edges at 45° to the line of traffic; where the joints are on an angle to the traffic, there should be less noise and less wear and the blocks may lay smoother. Small stone blocks have also been laid for many years in Liverpool, Birmingham and other places and their use is now being promoted by the Durax Dustless Roads Co., of London, under the name of "Durax Pavement." Their stone is cut into cubes cheaply and rapidly by drop hammer machines. The blocks are laid as described above and rolled with a road roller and they also use tarred chips as a bed and in the joints, which may be of an advantage. Stone chips seem to remain in the joints flush with the surface and may be better than gravel tar joints common here. Worcester, Mass., uses the stone chips in grouted joints and their stone block pavements are among the best in the country. Stone chips are not used in narrow joints or only to hold blocks in place while the joints are being filled. A Durax pavement has been recently laid in the Brooklyn Navy Yard. About a 3½-in. cubical Medina sand stone pavement similar to the Durax was laid last year in the experimental pavements on Second Avenue, near Third Street, New York City. The joints were laid at 90° to the curb. With the smaller stones it is easier to obtain a smoother dressed face, smaller joints and better foothold for horses, but there are more joints and more blocks per square yard, the expense is increased and the strength and bearing power is reduced. Narrower blocks are used on steeper grades, with stone liable to wear slippery. Larger blocks are sometimes grooved to improve the foothold. Large blocks are sometimes redressed and used over again. The larger blocks are more liable to rock unless well bedded. Softer blocks are less slippery on steep grades.

Track-ways of hard stone slabs in stone or wood block pavements are used in some cases in England, Italy and other places. In England, a similar stone slab gutter or channel is used along the curb for traffic and to carry the drainage. Curb stones are usually about 10 to 12 ins. wide and about the same depth, laid on concrete or otherwise. Curbs 5 to 7 ins. wide and 15 to 20 ins. deep are also used. Granite curb is preferred.

Liverpool and other cities have a number of very good stone and other pavements, as well as a number of poor pavements. I saw some special dressed stone brick pavements in Liverpool with such smooth surface and close joints that I thought was asphalt block pavement until I examined it closely. The small or medium sized stone block pavements with smooth, well dressed faces, laid on concrete, with close uniform joints filled with cement or bituminous grout, are of course very satisfactory, but they are very expensive and few places can afford to lay this type of pavement. Some stone pavements in Great Britain cost over $6 per square yard, at the cheaper foreign prices for labor and materials.

The Liverpool stone block pavements have been held up as a model by some tourists, and there are a number of first-class stone pavements there, but in my opinion the general average excellence does not compare with the stone block pavements of Hamburg. In Hamburg are many miles of smooth, close jointed Swedish granite pavements with blocks made about 7 to 9 ins. long, 5½ ins. wide and about 6 ins. deep, in very straight courses, at right angles to the curb except at intersections. The stone seems to wear quite uniformly smooth and the tar remains in the joints flush with the surface. This shows first-class materials and workmanship.

Wood Block Pavements.—Creosoted wood block pavements are favored in London and Paris for heavy traffic streets, where noiselessness is desired. The average life of creosoted wood block pavements in Paris has been about nine years and in London it has been about twelve years. Paris has about 3,000,000 sq. yds. of wood block pavements, or about one-quarter of its street paving.

The wood block plant in Paris, which is owned and operated by the city and lays or furnishes all the wood blocks used in Paris, is located on the Seine at Javel Quai, and is well equipped for handling the work. It has a machine which saws 16 blocks at one time and automatically discards the waste ends and sawdust, and conveys the blocks to the treating tanks. The practice there has been to only dip the blocks into hot creosote for a short time to obtain 2 or 3 lbs. absorption per cubic foot. The trend now is towards a 10-lb. treatment under pressure at high temperature, but it is not certain that the improved results justify the additional expense. The wood is carefully selected, the top and bottom of logs and tapped and untapped timber are treated separately.

The Paris plant has a capacity of about 200,000 blocks a day and furnishes over 400,000 sq. yds. of wood blocks per year. It has machines for cleaning old blocks, trimming off burrs, and sawing them smaller for relaying. These machines are portable and can be electrically operated on the street by connection with the underground electric wires.

Sheffield, England, also has a municipal wood block plant. The most satisfactory results in England have been obtained with creosoted soft wood blocks of "Pinus Sylvestris," known by the various names of Swedish Yellow Deal, Baltic Red Deal, Baltic Fir, Scotch Pine, Scotch Fir, etc., a close grained uniform wearing timber is selected. In Paris, the Landes Pine of France has been more satisfactory. These soft woods are somewhat like our short leaf yellow pine, but finer grained. The soft wood is more satisfactory because the top fibres crush down and mat together at the joints; this keeps the dirt and water out and makes the best kind of an expansion joint around each block. Soft wood wears more uniformly and the surface is covered with stone chips or grit which becomes more easily embedded in the soft wood and this makes the surface more durable and less slippery. Soft wood pavement is laid on steeper grades abroad than rock asphalt, because the latter is harder and more slippery.

The long leaf yellow pine paving block, which is usually used in this country, is intermediate between the soft and hard wood abroad. The size of the European block is about 3 ins. wide, 8 or 9 ins. long and 4 to 5 ins. deep. The usual depth of about 5 ins. permits a longer wear or allows the partly worn blocks to be cleaned, trimmed, sorted into sizes and turned over for relaying on a sand or mortar bed, or to be sawed to a uniform

depth and relaid upon smooth concrete. The 5-in. Baltic wood block does not split up as much as our 3½-in. yellow pine blocks.

Various foundations and beds are used, but the prevailing practice, especially in England, is to bring the concrete to a perfectly smooth, true finish by tamping and floating over with a layer of mortar on the fresh concrete. The concrete is allowed to set up and the wood blocks are laid directly on the smooth concrete. Sometimes untreated hardwood blocks are dipped into bituminous cement just before laying, or are laid on the tar mopped concrete. Treated blocks are sometimes laid this way.

The English practice of smooth concrete foundation probably is the best method for their deeper soft wood blocks, but it is a question whether with our 3½-in. harder yellow pine blocks there would not be more noise and pounding of the blocks and foundation and a greater expense. I would suggest that provision be made in one of our repaving contracts for laying adjoining sections of long leaf and short leaf yellow pine blocks by the English method and by our own and that complete records of the work be kept. Our method of laying wood blocks on a mortar bed and rolling with a tandem roller has some advantages and our wood block pavements are equal to those abroad.

In Vienna the wood and stone blocks are laid in courses at an angle of 45° each way from the centre longitudinal axis of the street. This has the advantage that the wheels and horse calks strike the joints obliquely and there should be less wear and noise. It also affords better opportunity for expansion of wood block pavement, but it is an open question whether the results warrant the increased cost of laying. In most European cities the wood and stone blocks are laid at 90° to the curb as is the custom here, but many of our American cities have laid wood block at an angle with the curb. One or more courses are usually laid alongside of and parallel to the curb and the railroad tracks. Abroad, wood blocks have been laid in panels with blocks alternating in different directions, etc., but sufficient advantage over the ordinary method has not yet been demonstrated.

Formerly thin wooden strips were frequently used between the courses but they are now only used in the bottom of the joints filled with mortar on light traffic streets to protect and seal the joints until the traffic mats down the top of the blocks. Grout is usually used in the joints but sand and bituminous cement is also employed. The bituminous joint is a better practice but it is a question whether the result is worth the additional expense in some cases. Clay, sand, sawdust, felt, tar, tarred oakum and other bituminous mixtures, removable wedge-shaped blocks, springs, plates, etc., have been used for expansion joints along the curbs to prevent buckling and pushing out of the curbs, but no entirely satisfactory remedy has yet been found. I was most impressed by the two kinds of compressible plates being used in Paris. This expansion joint is a bellows-like box of tar paper or thin metal, about 1 in. thick and ½ in. less in depth than the block. The box keeps dirt, etc., out of the joints until the blocks expand under traffic and weather conditions and the top of the blocks crush down and seal the joints. This compressible plate is made by G. Vallee, 5 Rue Saint Ambroisie, Paris. This looked to me to be worthy of a trial here, especially on light traffic streets. Transverse expansion joints are not so commonly used abroad. The expansion joints along the curbs are inspected and taken care of. One reason why the wood pavements in Paris do not buckle more is because the pavements are flushed with water several times a day and the blocks are kept in a more uniformly moist condition. The blocks do not dry out before they are laid or they are soaked before laying.

I would recommend that a trial be made here of the foreign practice of occasionally employing a bituminous maintenance coating on old wood blocks to waterproof the surface and prevent the blocks drying out and the joints filling up and buckling in wet weather. In Paris a large hot asphalt smoother was run over the surface of bituminous treated joints to smooth and seal the surface. Sand, grit, or stone chips are spread on the surface, which makes it more durable and less slippery.

Pavement Testing Machine.*—The National Physical Laboratory, where the English Road Board tests are made, has a new apparatus for accelerated tests of pavements. This apparatus consists of a circular roadway about 104 ft. long and about 2½ ft. wide, upon which any selected type of test pavement may be laid. On this roadway roll eight wheels which cover all parts of the roadway. The wheels are about 3 ft. in diameter and their load and speed can be varied as desired. The road can be sprinkled and the temperature varied to imitate weather conditions. This machine has not been in operation long enough to reach definite results. Engineers in Great Britain as well as on the Continent are far behind us in the matter of physical and chemical test of paving materials. It is only in the last two or three years that the foreign engineers have gone into this matter to any great extent. Most of their paving testing apparatus is of the American type, but they may develop some new ideas of value.

*See *The Canadian Engineer*, Oct. 30, 1913, p. 651.

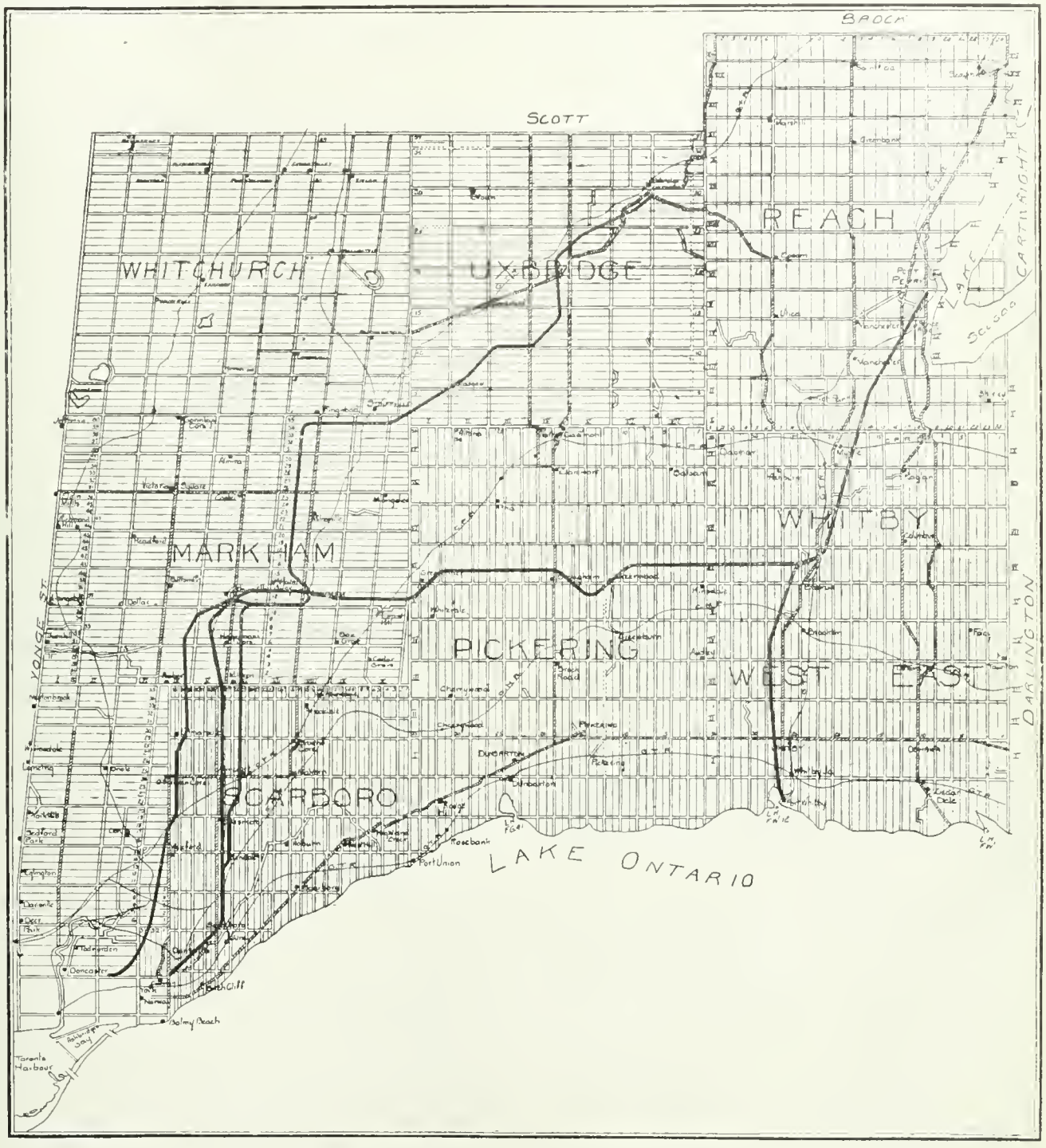
Table I.—Pavements in German Cities.

No.	City.	Population.	Total sq. meters, roadway pavements.	Percentage of each pavement					
				Wood.	Asphalt.	Large stone.	Small stone.	Macadam.	Other kinds.
1	Berlin	2,070,695	6,806,309	1.94	43.96	53.96	0.01	0.11	0.02
2	Hamburg	932,078	4,644,402	0.6	8.4	85.7	1.2	1.8	2.3
3	Dresden	546,882	4,450,700	0.5	6.4	41.7	0.7	49.9	0.8
4	Cologne	516,167	4,018,577	1.0	5.0	64.0	1.0	21.0	8.0
5	Frankfort-M.	414,598	3,778,152	1.9	11.8	46.9	7.8	30.5	1.1
6	Charlottenburg ...	305,181	1,670,724	5.0	64.0	25.0	0.5	5.5	...
7	Berlin-Wilmersdorf..	109,729	795,962	0.8	53.5	4.7	23.1	0.4	17.5
8	Berlin-Lichtenburg..	133,166	670,732	...	8.0	84.6	0.2	...	7.2
9	Pottsdam	62,224	590,300	0.03	11.6	35.0	3.0	27.27	23.1
10	Cohlence	56,487	436,850	0.8	6.0	57.1	...	36.1	...
Total of 98 German cities of over 50,000 popul'n.		17,336,320	107,409,023	0.62	5.57	48.02	3.26	36.41	6.12

A PROPOSED MUNICIPAL HYDRO-ELECTRIC RAILWAY FOR TORONTO AND NORTH-EASTERN DISTRICT.

LAST May the municipal councils of a number of townships in the vicinity of Toronto forwarded resolutions to the Hydro-Electric Power Commission of Ontario requesting a report and estimates on a proposed municipally owned electric railway connecting the various municipalities in the district to the city. In response to these resolutions the Commission has recently submitted a report containing all necessary information with respect to the district, and estimates of traffic, cost, operating revenue, and expenses, of the proposed line. The following information is derived from this report:—

Selection of Trial Lines for Estimates.—A survey party was organized to run preliminary lines through the district to obtain data for preparing estimates on the cost of roadbed construction. A reconnaissance was first made to select routes for these lines, and it was decided that a study of three different sections should be made between the northeastern boundary of the city of Toronto as far as Unionville. From this village, both easterly and northerly, the route was more or less fixed by the centres of population, and the general contours of the country.



Surveys Made for Estimating Purposes.

The lines surveyed for estimating and study purposes are shown on the accompanying map. In the event of construction being decided upon, the actual location line may or may not follow these exact routes.

The most easterly route of the three between Toronto and Unionville was run so as to pass through the centre of Scarboro township, but it was found to be very unfavorable for construction. The middle route would give almost as good service to the residents of this township and would be much cheaper to construct. A large section of the district traversed by the third route will probably be annexed to the city before many years, and, being controlled by three large estate companies at this time, it should be an easy matter to arrange for financing their proportion of the cost. The construction of this route, with the exception of a viaduct, across the Don Valley, would be considerably cheaper than the others, and, although the line would be one-half mile longer, the terminus would be some one and one-half miles nearer the centre of the city.

The estimates on traffic, capital cost, operating revenue and expenses that are included in the report are applicable to either the middle or westerly routes. The latter line might have slightly more suburban traffic, but, this class of revenue being at low fares, the effect on the total receipts of the line is not important. The easterly route does not appear to offer any inducements, other than being the most central through Scarboro township, and, as it would be much more expensive to construct, it has not been considered in the report.

Construction and Equipment—Roadbed.—An examination of a topographical map of the district shows that there is a difference in elevation of almost 700 feet between the city and the height of land at Goodwood. This will give an average grade of .5% that cannot be avoided. The effect of such a grade on the operation of heavy freight trains would result in slow service, but, since cars and short trains only are to be used on comparatively short runs with substantial layovers at terminals, no appreciable effect should be noticed on the schedules. The unavoidable short grades encountered have been kept below 2 per cent. and curves below 5 degrees.

The character of the soil throughout the entire district, with the exception of Uxbridge township, consists of a comparatively light loam, while that in the township mentioned, is very sandy. Gravel is present in sufficient quantities adjacent to the trial lines to ensure an ample and cheap supply for track ballast. These conditions should allow for grading being done at a very economical figure.

The estimates on track construction have been prepared on a 14-foot roadbed, 80-lb. rails, 6 in. by 8 in.—8-ft. cedar ties spaced 3,000 to the mile, gravel ballast, 8-bar woven wire fence with proper gates, cattle guards, etc. These requirements should provide a good type of construction for an interurban line.

Bridging and Railway Crossings.—All culverts and bridges have been designed to carry 100-ton locomotives, in order to provide proper structures to handle any traffic that may be obtained from interconnection with the steam lines. Plate girder bridges on concrete abutments would be used in the majority of cases, but some steel viaducts will be required.

Following the practice of the present roads in the district, all overhead railway crossings were estimated upon as crossing two tracks. Half interlocking plants have been figured upon for protection of all railway grade crossings, the operation of which would be taken care of by station men or other employees whose regular duties would require their attention in that vicinity. These plants would consist of a small central tower with outside stairs. A mechanical interlocking machine would be provided, controlling home and distant signals on the steam roads, and derails and home signals on the electric line. The signals on the electric line would be located close to the crossing, so that car conductors could operate the plant themselves, when station attendants are not on duty, with a minimum loss of time.

Buildings.—Provision has been made in the estimates to cover the cost of brick passenger and freight stations at important towns, and shelters with small loading platforms at the most important road crossings.

A suitable car barn and shops, of brick construction, would be located near Markham at the junction of the Uxbridge and Port Perry lines, and galvanized iron shelters, on steel frames and concrete footings, at termini for housing cars over night.

Fireproof sub-stations would be constructed as extensions to the station buildings at Markham and Brooklyn.

Overhead Construction.—The 2,400-volt direct current system has been used in figuring the cost of the electrical equipment, but the layout and traffic should give very similar results with the single-phase alternating current or 1,200-volt direct current systems. These systems, while being more expensive in first cost and operating expenses for a short line than the older low-voltage direct current system, are necessary for a line of this type, in order that holiday traffic may be properly handled without the capital cost being raised to an amount that would cause unusually heavy expenses for normal operation. These systems have also been chosen, so that the line may be able to take care of freight traffic and be extended short distances without installing additional sub-station equipment and trolley feeders.

If it is decided to construct only a short portion of the complete line, as discussed later in this report, it would be possible to use the low voltage direct current system until such time as the extensions would warrant the system that has been figured upon.

The single catenary bracket arm type of construction has been used in estimating the cost of overhead equipment. Thirty five-foot wooden poles, spaced 150 feet apart, would be used with a 7/16 in. Siemens-Martin mild steel messenger and a 4-0 grooved copper trolley. If desired, steel poles could be used, which would increase the capital cost slightly.

Rolling Stock.—Car equipments would be equipped with quadruple 100 or 125 h.p. motors, hot-water heaters, automatic air brakes, pantagraph trolleys, double end multiple unit control, and would be provided with smoking and small baggage compartments, in addition to the regular passenger section. Cars for suburban use would be, of course, lighter and less expensive.

Main line cars would be capable of operating up to 60 m.p.h. and maintaining schedule speeds of 25 to 35 m.p.h. with stops varying from 4 per mile, to one every two miles. Comfortable trailer cars would be carried on reduced schedules, on holidays and rush hours.

Express cars for milk and light express traffic would be provided with large motors so that freight cars could be shifted or hauled short distances. Doors and other facilities would be supplied so as to provide for rapid and easy loading of milk, etc.

The locomotives estimated upon would weigh about 60 tons, and would be capable of hauling from 6 to 20 cars of freight, or three or four passenger trailer cars for excursion business. Quadruple 100 or 150 h.p. motors and multiple control would probably be used.

As snow fences have not been provided for under Roadbed Construction, provision has been made under this heading to cover rotary ploughs.

Standard steam road freight cars would be required for freight and express business. These cars could be used for large inward and outward bound shipments and by utilizing sidings between stations, the loading or unloading points could be located so as to reduce the haul by team.

Estimated Capital Costs.—The cost of right-of-way was obtained from information gathered in the field. This is a matter that rests entirely with the municipalities, and it may be possible to obtain a private right-of-way for the complete line at a much lower figure than that which has been used. The Commission has received advice from some two or three owners of land, situated between the city and Unionville, intimating that they are prepared to give a free right-of-way through their property.

The figures used in the estimates to cover the various items entering into the capital cost of the road were obtained from manufacturers, and also from the railways operating in the district.

Considerable time was given to this work and much useful information was obtained from personal visits of the manufacturers, which data will be available for further detail study in the event of construction being decided upon.

Plans and profiles were prepared of the various lines surveyed and the quantities of grading, draining, etc., figured for the different sections. Attention was also given to the probable cost of ballast and borrow pits, which information is given in the detailed estimates attached to this report.

Overhead charges of seven per cent. (7%) have been added to the total capital cost to cover engineering, interest during construction and bond discount. As the figures used in each portion of the estimate are conservative, the total cost should be ample to cover the type of line described.

Estimated Operating Revenue.—The total estimated revenue of the proposed line was divided between passenger, freight, mail, etc. Each of them has been checked by statistics of other electric lines operating through somewhat similar districts. The working conditions of these lines were carefully studied over a number of years, and readjustments had to be made as they did not all class their expenses under the same heading.

Basing figures upon a comparison of the proposed line with the electric and steam roads in the district, it was estimated that within two or three years after the commencement a revenue approximating $450,000 should be obtained.

Estimated Operating Expenses.—In preparing estimates on the cost of operation of the proposed line, liberal allowance was made to include all possible expenditures and the rates used for maintenance and operation were probably higher than necessary. The number of car crews required to give the service was determined by the inspection of train sheets, and the number of station and repair men, by a study of the requirements of other steam and electric roads. Statistics covering the cost of maintenance and repairs of track and rolling stock were available from the returns of electric lines operating under similar conditions, and the cost of this branch of operating expenses was determined by applying these statistics to the annual car and locomotive mileage from the train sheet. Expenses such as station and car supplies, general office expenses, etc., were also taken into consideration.

Estimates Prepared.—To enable the project to be examined as to the effect of the alteration of any section of the line, a series of estimates was included showing in detail the capital cost, operating revenue and expenses for a number of combinations. Five schemes were proposed, ranging in length from 71 miles to 16 miles, and in capital cost from $2,470,766 to $693,003.

Conclusions.—To build a road as set forth in the report would require some 64 miles of line, the Toronto terminal considered located in the northeast part of the city and the freight handled by a subsidiary company. The territory through which the line passes, with the exception of some 15 or 20 miles, is very fertile, and thickly populated, and examining the project broadly it has the appearance of affording a splendid opportunity for obtaining a good business from the commencement of operation. The distance from any point on the line from Toronto would be less than 45 miles, and as all these points receive a very unsatisfactory service from the present steam lines, the best of the existing traffic should be easily obtained.

PREPARATORY TREATMENT OF SEWAGE—OBSERVATIONS AND EXPERIMENTS.

CHARLES GILMAN HYDE, professor of sanitary engineering, University of California, presented very recently a paper to the League of Pacific North-West Municipalities, recounting his observations made in the fall of 1912, during an extended trip to the east, upon sewage disposal plants visited wherein particularly interesting features of preparatory and final treatment of sewage were represented. Professor Hyde also bases his remarks on many other experimental and practical installations demonstrating possibilities in the preparatory and final treatment of sewage. But in his introduction he mentions particularly the fine-screening devices of the rotary type observed at Brockton, Mass.; Reading, Pa., and Baltimore, Md., and the Imhoff tank experiments and installations visited at Worcester, Mass.; Philadelphia, Pa., and Chicago, Ill. At Worcester and Chicago, these devices were experimental in character, and were being operated in conjunction with comprehensive testing stations. At Worcester, Baltimore, and Chicago, sedimentation with subsequent sludge digestion in independent chambers was noted; though at Worcester and Chicago, these devices were again experimental. At Worcester, chemical precipitation with accompanying sludge pressing on a large and efficient scale was examined. At Worcester and Chicago, experimental sprinkling filters, and at Brockville, Reading, and Baltimore, large installations were inspected. At Brockton and at Worcester, Professor Hyde remarks that the intermittent sand filter plants are most interesting.

The following is a transcription of the paper printed as written with various divisions and headings:—

Composition of Sewage.—In considering problems of sewage treatment and disposal, attention cannot be too firmly fixed on the fact that sewage essentially consists of two more or less independent parts, each vitally important in its own particular way. Sewage consists primarily

of a very considerable portion of the water supply of a community together with such ground and surface waters as may, by accident or design, enter the sewers. In these waste waters have become dissolved a large amount of organic and some mineral matters from household, industrial, street and other wastes. In addition to the liquid wastes the sewage carries a load of suspended matters, both organic and mineral.

It is the organic matter, dissolved and suspended, which is dangerous from a sanitary point of view, is subject to putrefaction and decomposition and is capable of producing a nuisance. The suspended mineral matter requires removal in order to protect streams from unsightly deposits, and final treatment devices (like sprinkling filters and contact beds) from undue clogging. The dissolved mineral matter, while exercising an important influence upon certain phases of the problem of disposal, does not, as a rule, require removal by any special process.

The Sewage Treatment Problem.—Because sewage consists essentially of two parts—suspended solids and a liquid containing dissolved or partially dissolved organic and mineral matters—the sewage treatment problem is two-fold in its nature. It is true, of course, that crude sewage may be disposed of by a single process, as for instance, by dilution in relatively large bodies of water and by treatment in contact beds and intermittent sand filter beds, by broad irrigation, etc. The presence of suspended matters, however, greatly reduces the volume which can be effectively treated by these devices and experience indicates that, in many cases, it is extremely wise to employ some preparatory treatment in order to relieve the burden upon them. The removal of suspended matters by fine screening or subsidence will increase the volumetric capacity of such devices as sprinkling filters, contact beds and intermittent sand filters from 30 to 100 per cent., depending upon conditions. Furthermore, the removal of these matters tends to increase the efficiency of these devices even when they are operated at the higher rates which are thus made possible. At the same time their maintenance and operation are rendered simpler and less difficult. It is also undoubtedly true that water courses may, through the processes known under the general term "self-purification," receive sewage in increased volumes varying more or less directly with the percentage of organic matter of a thoroughly unstable character which is removed by special treatment.

It must be borne clearly in mind that preparatory treatment alone does not solve the sewage disposal problem unless the effluent may be disposed of in bodies of water of much size and under such conditions that sanitary laws are complied with. In California the laws governing the discharge of sewage into all waters are to be found in Chapter 374 of the Public Health Act of the State (Revised Status of 1913) and under these regulations it is necessary that all communities, industrial establishments, institutions, etc., desiring to dispose of crude or treated sewage in either salt or fresh water on the coast, tidal estuaries or in the inland streams must receive special permission so to do from the State Board of Health. Such permits will announce the particular conditions under which any party in question will be allowed to dispose of sewage or industrial wastes.

Necessity for Preparatory Treatment.—From the brief and untechnical discussion above it will be seen that the preparatory treatment of sewage is frequently an economic, as well as a sanitary, necessity. It is almost always required except where disposal of crude sewage by dilution can be accomplished without nuisance or contrary to state laws.

Even the Pacific Ocean is not in every case capable of receiving crude sewage in large volumes without producing a nuisance or even, in extreme cases, without becoming a menace to public health. A most interesting instance in point is the situation at Los Angeles where, due to complaints of beach pollution in the vicinity of the sewer outfall at Hyperion, between Playa del Rey and El Segundo, the city is advised and proposes to adopt some preparatory treatment of the sewage. The suggested minimum treatment is screening through revolving very fine mesh screens of the Weand or similar type.

A large number of disposal projects in this state has thus far involved only preparatory treatments. Just how these projects will meet with the requirements of the law and the approval of the State Board of Health remains to be seen. In almost every case, however, the preparatory treatment of the sewage will represent a correct and necessary first step although final treatment methods may require to be applied in many cases before the real solution of the disposal problems of these places is arrived at.

California Conditions as Affecting Sewage Treatment.—Speaking generally, the climatic conditions in California are strikingly favorable to all processes of sewage treatment which involve biological activities, that is, the activities of bacteria, worms and other organisms which operate to decompose, digest, hydrolyze, gasify or oxidize the organic and mineral matters in sewage. The activities of the organisms in question are greatly affected by temperature, high temperatures tending to induce rapid development and great activity and low temperatures tending to inhibit development and to lower the vitality and the activity of the organisms. Except at the higher altitudes in California freezing weather occurs but rarely and for short intervals while over large areas of the state heavy frosts are only occasionally known. In fact the conditions are such that sewage treatment works must be designed and operated with the expectation of extraordinary biological activities. In septic and Imhoff tanks it is necessary to prevent excessive scum formation and in the latter tanks, especially, large scum chambers must be provided readily accessible for frequent scum agitation and if necessary scum removal. It is to be noted in this connection that scum formation is more or less directly related to biological activity and the production of gas through the decomposition of organic matter.

Sedimentation and Sludge Digestion.

The Single-Story Septic Tank.—All single-story septic tanks, however much they may vary in shape and size and in design with respect to baffles, etc., may be classed as of the Cameron type although not necessarily infringing upon the well-known Cameron patents which are generally held by sanitary engineers in America to be non-valid. This particular matter has been discussed from time to time in detail in Pacific Municipalities. When the ordinary or so-called Cameron septic tanks were first exploited they were thought to be a panacea in the solution of sewage treatment problems and were introduced throughout the state in promiscuous fashion. In many cases they were built without careful consideration of local conditions in determining, first, whether this type of treatment would meet those conditions and, secondly, the proper proportioning and design of details.

There are certain important fundamental principles involved in the design and operation of this type of tank.

Where these have been observed and where the conditions have been favorable both as respects design and environment the results have oftentimes been quite satisfactory. It must be admitted that the single-story septic tank has represented a distinct advance, under certain conditions, over former methods of sewage pre-treatment where sludge removal by sedimentation was necessary. There are situations where, in view of its simplicity in design, construction and operation, the single-story septic tank is a logical and advisable sewage pre-treatment method. The question of odor production, to be discussed shortly, is possibly the most important consideration in determining the satisfaction of use of this device. It is also to be observed that septic sewage is more difficult to treat in final treatment devices, such as sprinkling filters, intermittent sand filters, etc., than is fresh sewage containing an equivalent load of organic matter.

The Two-Story Sedimentation and Sludge Digestion Tank.—For many years various experiments have been conducted with the hope of discovering some method of treating sewage in such fashion that the solids could be removed and digested through biological action while the liquid portion of the sewage, relieved of its suspended solids, might pass on to final disposal in a fresh (not septic) condition. Plain subsidence and chemical precipitation have solved the problem from the standpoint only of the removal of suspended matters but these processes have presented the sludge disposal problem in an acute form. What has evidently been needed is a combination whereby subsidence might be accomplished as effectively as possible and at the same time the sludge might be digested independently of the liquid portion of the sewage through processes of digestion, liquefaction and gasification which are known to operate in the so-called single-story septic tank. Various two-story tanks have been proposed for the purpose, together with certain combinations of plain sedimentation and independent sludge digestion chambers. Some of the two-story tanks suggested have been very complicated and have been aimed at the removal of colloidal substances (namely, those solids which seem to be on the border line between suspension and solution) as well as the suspended solids in the sewage. Unquestionably the best known and the simplest device and the one which has met with the most general approval of engineers because of its ready adaptability to sewage treatment problems is the two-story tank generally known as the Imhoff tank, named for its inventor, Dr. Karl Imhoff, of Essen, Germany, and used by him for the pre-treatment of the Sewage of numerous communities in the Emscher Valley. The tank has thus become known also as the Essen and Emscher tank. Its purpose is avowedly the removal of the coarser suspended solids from the sewage and the subsequent more or less complete digestion of these independently of the flowing sewage.

The Imhoff tank consists essentially of two parts or stories: (a) an upper flowing-through or sedimentation chamber through which the sewage passes with a slow forward motion such that the heavier matters, held in suspension by the velocities in the sewers, are now deposited in the chamber which has a sloping slotted bottom so steep that the sludge must slip down and pass through properly designed slots into the lower chamber; (b) a lower or sludge digestion chamber designed to receive the sludge and to retain the accumulated deposits of several months of operation while these are being worked over, decomposed and digested through the action of bacteria and other organisms. Well designed Imhoff tanks should remove from 90 to 95 per cent. of the "capable-of-settling" suspended matters and from 50 to 70 per cent. of the total weight of suspended matter in the sewage. One of the essential facts of this device is that the sewage passes from it in a fresh condition, free from the disagreeable odors so commonly associated with the ordinary septic tank above described.

Independent Sedimentation and Sludge Digestion.—As above suggested, the great difficulty with plain or coagulated subsidence has been the subsequent disposal of the enormous amount of highly putrescible sludge resulting from these processes. Recently it has been proposed to design sedimentation tanks in such a fashion that the sludge may be drawn off at frequent intervals into separate chambers where it could be digested independently of the main bulk of the sewage under very much the same sort of conditions as obtain in the digestion chamber of the Imhoff tank or in the septic tank. Experiments involving this general scheme have been conducted by the Massachusetts State Board of Health at Lawrence, Mass., by the Sanitary District of Chicago and by the cities of Philadelphia and Worcester, and works on a large and comprehensive scale for the pre-treatment of sewage in this manner have been constructed and are now in operation in Baltimore. The results of operation at Baltimore are not yet available to the writer and at the time of his visit to the plant, nine months ago, the works were scarcely in operation. The experiments at Chicago, Philadelphia and Worcester indicate that the sludge can be partially digested by this method with a consequent reduction in the bulk of solids treated. This reduction is due to the change in the character of the solids through decomposition and loss of water content. Decomposition is accomplished mainly by the bacteria and is accompanied by the liquefaction and gasification of some of the organic matter. The experimental evidence has not yet been very satisfactory from the standpoint of complete digestion of the sludge and the question of odor production is important, as will be shown later.

The Odor Problem.

General Conditions in California.—It is to be remembered that, whereas the early California was a land held in great estates, the California of to-day is a state of relatively small subdivisions while the California of to-morrow will be a state comprising very many small and medium sized communities, some extremely large and populous cities and a vast number of intensively cultivated areas which will be suburban in character. This will mean a large population per square mile and an extraordinarily compact rural development. The people of California do demand and have a right to require a complete absence of offensive odors in the vicinity of their homes. Oftentimes, without doubt, prejudice enters into the problem and odors are alleged to occur which really do not exist, at least in the degree which complainants state that they observe. On this account sewage disposal problems of certain municipalities in California are to-day by no means easy to solve and it would appear that the conditions will become increasingly difficult as time advances.

In considering any sewage treatment project the direction of prevailing winds should receive most careful attention and temperature and other climatological features should be deemed important and should be studied in their relation to each problem in hand.

Some Fundamental Considerations.—It has already been pointed out that the flow of sewage is mainly com-

prised of the water supply of a community. In places where sanitary sewers only are provided and where these sewers are laid above the ground water table the volume of sewage is entirely made up of the water supply. Fresh sewage has a distinctly mouldy or musty odor which is not generally considered to be disagreeable. It is not pungent and is too slight to be carried to any considerable distances by winds or otherwise, even from large volumes of sewage. Stale or septic sewage, on the other hand, has a strong pungent odor probably due in large part to hydrogen sulphide which is formed through the action of the bacteria from the mineral sulphates and from the sulphur in the organic compounds in the sewage. To the presence of sulphur compounds in the sewage must be mainly attributed the odors which are produced therein under the general action known as decomposition, especially decomposition taking place in the absence or limited presence of air. Foecal wastes contain small quantities of sulphur but the really great source of sulphur in sewages is ordinarily found in the dissolved mineral sulphates in the water supply of which the sewage, as stated above, is mainly comprised.

Almost all of the ground waters of California are hard and contain a considerable weight of dissolved sulphates. Certain surface waters in this state, especially those derived from coast watersheds receiving small rainfall, are also extremely hard and contain very large amounts of sulphates. The weight of dissolved sulphur in the public water supplies of the state is frequently as great as 500 lbs. in a million gallons; occasionally the figure may rise to 1,000 lbs. per million gallons and in very extraordinary cases the sulphur content may be as great as 3,500 or 4,000 lbs. per million gallons.

When sewages are exposed to the action of anaerobic bacteria decomposition sets in and various species or groups of bacteria develop and act upon it to produce hydrogen sulphide—the gas which is mainly responsible for the disagreeable odors arising from decomposing sewage, especially in septic tanks—both from the organic matter and from the sulphates present. There is some evidence that aggravated cases of production of hydrogen sulphide are caused by the desulphurization of the dissolved mineral sulphates by one or more species of bacteria. Since these sulphates are mainly in solution and are not contained in the organic matter it is apparent that if odors are to be avoided in sewage treatment works the sewage should be kept as fresh as possible and should not be exposed to the action of bacteria of decomposition prior to its final disposal by some suitable process. When the decomposition of the sludge is effected in a chamber apart from the liquid sewage the latter may be maintained in a fresh condition and may not be exposed to the activities of the bacteria in question. On the other hand, since the sludge from ordinary city sewage contains but limited amounts of sulphur either hydrogen sulphide is not formed or, if formed, is quickly absorbed or combined with iron and other salts so that it does not become apparent to the senses.

Odors With Single-Story Septic Tanks.—In the single-story septic tank, where sewage, sludge and scum are all in contact, it is apparent that the dissolved sulphates in the sewage are subject to the action of so-called "sulphur" and other bacteria and consequently may be decomposed with the ultimate production of very large quantities of hydrogen sulphide which is thrown off into the air above such tanks or is liberated from the sewage after passing from the tank. This gas-laden effluent, when aerated, spread upon land, etc., may and frequently does produce local nuisances. In one case recently investigated by the writer it would appear that the odors from septic sewage while being spread out upon land in irrigation could be detected and cause comment, if not an actual nuisance, at a distance of from 2,500 to 3,000 feet or, say, fully one-half mile.

The disposal of septic tank effluents by sub-surface irrigation or by final treatment in contact beds dosed from the bottom by automatic devices would appear to be favorable methods under certain ruling conditions. Sub-surface irrigation is adaptable, generally speaking, to very small plants only but contact beds may be used in large installations. The use of sprinkling filters with septic tank effluents is undesirable in settled communities because of the fact that the spraying of the gas-laden sewage through the air may liberate the hydrogen sulphide in such volumes as would be almost certain to produce local nuisances. Indeed, in very closely built-up communities the use of the septic tank with surface treatment of sewage, as in irrigation, is becoming almost prohibitive.

Odors With Two-Story Imhoff Tanks.—Tanks of the Imhoff type do not ordinarily produce disagreeable odors because the liquid portion of the sewage passes through them in a fresh condition while the sludge is independently decomposed in a separate chamber out of contact with the liquid in question. From the preceding statements it will be seen that the great proportion of the sulphur will ordinarily have passed through the tank with the liquid sewage without change. Doubtless some hydrogen sulphide is formed from the sulphur present in the sludge, but this is combined with iron and other salts and does not cause offence. If the flowing-through chambers of Imhoff tanks are not kept clean, if scum is allowed to form upon their surfaces and sludge to clog the slots, septic action will very shortly be established and the effluents therefrom will contain more or less hydrogen sulphide and will become correspondingly offensive. A very considerable experience with Imhoff tanks in Germany and a more limited experience with these tanks in America indicate that where they have been properly designed, and especially where they have been properly maintained, they have been satisfactory from the standpoint of the production of odors.

Odors From Sedimentation Works With Independent Sludge Digestion Chambers.—The experiments which have been conducted at Chicago, Philadelphia and Worcester indicate that independent sludge digestion is apt to be unsatisfactory from two standpoints; first, because it is difficult to secure effective digestion of the sludge under conditions which almost necessarily must obtain in plants of the type in question and, secondly, because offensive odors are created during the process of digestion. The full explanation of the manner of production of these odors is not immediately forthcoming, but it would appear that only a fraction of the disagreeable odor is caused by hydrogen sulphide and by other organic compounds containing sulphur. Much is due to other organic substances. The action of gasification in this process is apt to give rise to large amounts of dry scum which do not digest satisfactorily and which cause physical difficulties with plants of the type in question.

Some California Experiences in Preparatory Treatment.

Experiences With Septic Tanks.—A very large number of septic tanks has been built in California both by communities and by individuals. Some of these tanks are operating with fair satisfaction as far as odors are

concerned, but others are not satisfactory and are causing local nuisances on account of the strong odors which are produced therein. No chemical or physical studies showing the operating efficiency of the tanks in California, with one exception, have been made and therefore no information is available with respect to the percentage of removal of suspended matter by these devices. Data are lacking as to normal, maximum and minimum efficiencies. In certain cases, due to too active gasification, which in turn is partly attributable to extremely favorable climatic and other conditions, there has been a very excessive scum formation, so much so that this has required frequent removal and has been not only a source of trouble and difficulty in operation but undoubtedly also a cause of low efficiencies or at least of lower efficiencies than would otherwise obtain. In general it is to be noted that too active gasification is responsible for the appearance of large quantities of digested or partially digested suspended matter in the effluent. In Ohio, in 1906 and 1907, the State Board of Health made 16 separate examinations of eight plants with the result that on eleven occasions the removal of suspended matter, by weight, was nothing or actually negative and on only five occasions was there a positive removal of suspended matter. In no case was the percentage of removal as great as 50. These tanks were probably as well designed on the average as would be the case anywhere.

Experience With Imhoff Tanks.—To-day there are in operation in California only six Imhoff tanks, but a number of others are now under construction and still others are projected. It is apparent that operating experience, under California conditions, must be very limited, especially as most of the tanks in question have been operating but a very short time. Unfortunately most of the tanks thus far built have been provided with tight covers and have not been suitably arranged for carrying out the most essential features of operation. On this account septic action has in some cases taken place to a limited extent in the flowing-through chambers. In at least two cases very excessive amounts of scum have been allowed to accumulate in the scum chambers connected with the digesting chambers. In one instance at least nine feet of scum accumulated in these chambers and very little sludge had settled to the bottom of the tank. This had not digested in several months' time. In at least one tank in California sludge digestion has been accomplished satisfactorily and the sludge which has been dried out upon the bed provided for the purpose has been representative of the best that Imhoff tanks have been able to accomplish.

Experiences With Sewage Screens.—Practically no data have been gathered as yet in California with respect to the efficiency of sewage screens under practical working conditions. Recently interesting data with respect to the amount of suspended matter which may be removed from sewage by such devices have been experimentally gathered at Sacramento and at Stockton. Fine rotary screens of the Weand type are advised to treat the sewage of Los Angeles at the Hyperion sewer outfall and one unit of this general type is being installed at the Anaheim Sugar Factory for the pre-treatment of its wastes. While in general it may be remarked that the field for fine screening of sewage is comparatively limited in California, it may also be said that there are undoubtedly numbers of conditions and circumstances under which the process might be used with success. Greater attention should be paid in this state to the rough screening of sewage, especially in conjunction with pumping devices.

SPEEDY REINFORCED CONCRETE CONSTRUCTION AT FORT WILLIAM, ONT.

A SAMPLE of reinforced concrete construction that is probably a record for Canada, or, at all events, an unusual example of speedy erection, taking into consideration the handicap which severe frosts present and likewise the lack of facilities for quick transportation, is a building here referred to and illustrated in several of its stages of construction by the accompanying photographs. It is built of reinforced concrete with an exterior of brick. Its dimensions are 100 feet by 125 feet, and consists of five stories and a basement. Its foundation is 8 feet below sewer level, a total depth of 20 feet below the ground surface. The building is set upon 1,300 piles, varying from 40 feet to 55 feet in length, according to the variation in the depth of rock over the area.

Fig. 1.

The contract for the erection of the Grain Exchange was awarded to A. C. Stewart & Company, general contractors, Fort William, and was signed on the 14th of February, work commencing the following day. There was a depth of 4 feet of frost to remove in the excavation. This was undermined and shattered with a 2-ton pile hammer falling 50 feet. Excavation began on February 17th, and the first piles were driven on March 5th. Fig. 1 shows the progress that had been made up to March 15th, the excavation work and the pile driving proceeding simultaneously. Concreting the basement began on April 2nd. Piling was finished on the 11th of the month,

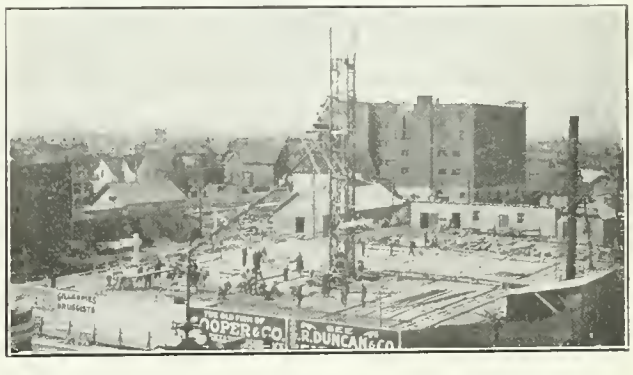


Fig. 2.

and excavation work completed on April 28th. A 4-inch Emmerson pump was installed to prevent undue flooding of the foundation work from the spring melting of snow and ice.

Fig. 2 illustrates the progress which had been made up to May 5th, at which date the concrete was entirely laid in the basement and ground floor, and the building was, so to speak, at ground level. The first floor was

poured by May 15th, the second floor by May 23rd, and so on to the 6th, or roof, the pouring of which was completed on June 21st. Fig. 3 shows the progress up to May 20th, and Fig. 4 shows its appearance on June 21st, when the concreting of the roof was completed. At this date, also, the brickwork was up two stories, and the majority of the pyro-bar partitions were in position.

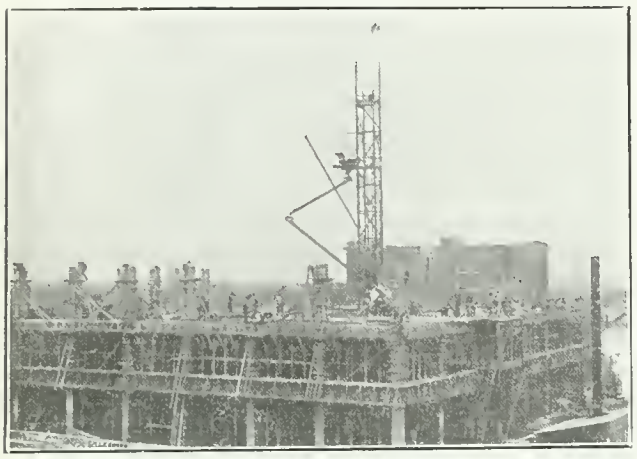


Fig. 3.

The Dominion Grain Commission leased the entire third floor of the building, and for their inspection room, designed to carry 300 lbs. per sq. ft., a test of one slab was taken when the concrete was forty days old. This particular slab was 16.0 feet by 17.4 feet in dimensions, and experienced a deflection of 0.10 under a test load of 500 lbs. per sq. ft., a total of 70 tons.

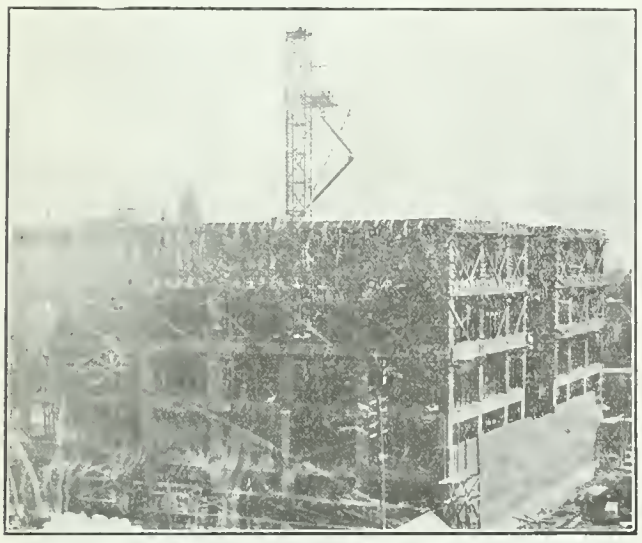


Fig. 4.

The entire building was bricked, and the roof finished, on August 16th; while the wood trimming, painting, and terazzo floors were finished by the end of September. The only items that prevented the contractors from handing over the building to the owners on October 1st were owing to unavoidable delays in the delivery of the elevator machinery, and of the marble for the main entrance. Notwithstanding this, the Grain Commission occupied the entire floor the first week in October, a number of offices were occupied the following week, and the building was accepted by the owners a few weeks ago, the total cost being $320,000.

While any statement of this construction surpassing previous records might be termed erroneous by various companies in the United States, it must be remembered that building construction in the south has not to contend with heavy winter frosts and snow; with an excessive run-off in the spring due to melting snow and ice, and the long and difficult means of transportation which contractors have frequently to overcome in Canada.

While it is not possible to make speed comparisons of buildings that are materially different in construction, the following data of some recent contracts in the United States may be of interest:—

A building in Jersey City, N.J., is 100 feet by 100 feet, with five stories and basement. It comprises soil bearing foundations and flat slab floor construction. The contract was signed February 20th, 1912, and the building substantially completed September 1st, 1912.

Long Island, N.Y., has a building 60 feet by 355 feet, three stories. The contract was signed September 11th, 1912, and the building was completed on January 1st, 1913. Concrete piles were furnished by the owners, and the contractor, for this portion of the work, began operations about August 15th.

There is a warehouse at Jacksonville, Fla., that is 110 feet wide, 60 feet deep, with five stories and basement, one-half of the foundation resting on wood piles. The contract was signed November 23rd, 1912, and completed July 15th, 1913.

A 175-foot by 258-foot three-story factory building at Baltimore, Md., rests on concrete piles. Its foundation work began February 1st, 1913, and the building was accepted as completed on May 7th.

An eight-story building, 60 feet by 200 feet, with soil bearing foundations at Brooklyn, N.Y., was completed just seven months after commencement, in 1911.

RESOURCES OF THE PEACE RIVER DISTRICT.

Possibilities of the Peace River district and the far northwestern territory through which winds the Mackenzie River were the subject of an interesting address given recently by Mr. Charles Camsell, of the Dominion geological survey, under the auspices of the Vancouver Chamber of Mines, at Vancouver. Mr. Camsell characterized that district as unparalleled in the fur trade at present, and a future country where mineral will be largely produced, from all present indications. The mineral indications found there by Mr. Camsell gave indications of probably large deposits of copper, zinc, silver and lead, as well as gold.

In addition to its other vast resources there would be oil. Oil and tar exudes from the earth in areas which were spread over from 150,000 to 300,000 acres. These, he said, were the best possibilities in the world. Oil, and where to find it, and find it in big quantities, is Britain's most intensely interesting problem just now, owing to the fact that the use of oil fuel is growing to such a degree that it is but a question of time when all the big ships will of necessity have to use it as the cheapest and best-known fuel for economical operation.

Mr. Camsell also spoke of the geological study he had made of the Similkameen district of British Columbia, where he spent considerable time. The general formations were for depth and permanence of the mineral lodes, he said. The district was fast being opened up by large mining interests, and was receiving a careful prospecting, as the result of which in time the Similkameen district would become one of the most important from what knowledge his studies had gained for him while in that district.

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CONTENTS OF THIS ISSUE.

Editorial:	PAGE
Water in Oil Wells	775
The Engineer as an Expert Witness	775
Fire-Resisting Concrete	776
Leading Articles:	
Laying of Toronto's Second Intake Pipe	760
Some European Pavements—Report	764
A Proposed Municipal Hydro-Electric Railway for Toronto and North-Eastern District	767
Preparatory Treatment of Sewage—Observations and Experiments	769
Speedy Reinforced Concrete Construction at Fort William, Ont.	773
Letters to the Editor	776
Some Notes on High Railway Abutments	779
Fixed Carbon Tests	780
Toronto Filter Specifications	782
Engineers' Library	785
Coast to Coast	788
Personals	789
Coming Meetings	790
Railway Orders	72
Construction News	76
Technical and Municipal Societies	94

WATER IN OIL WELLS.

This subject has been receiving a good deal of discussion in the technical press. It is an important one, as the importance of incursion of water into oil wells cannot be emphasized too thoroughly or too soon. It would appear, from recent reports from one or two important oilfields in other countries, that this problem has not yet been solved in a manner efficient enough to obviate the abandonment of what might ultimately have been producing wells. It seems extraordinary at this date that, although every drilling man of experience recognizes the danger of the inflow of water, no device or method has yet been introduced which can be relied upon to exclude water from oil wells—to such an extent, at least, as would not involve their abandonment. Great attention has been given to this matter by some of the most experienced both in European and American oil-boring practice, and yet no satisfactory solution of the difficulty has been discovered. The existence of such problems as this affords ample justification even of the necessity of the formation of a technical institution where experienced drillers and others could meet together and endeavor to discover some more efficient method of dealing with the question than is at present available. Now that the Canadian oil industry has received a decided impetus by the discovery of important oil indications in Alberta, and by the proposed adoption of oil as a fuel in numerous branches of industry in the west, an investigation of the water problem would not be out of place.

THE ENGINEER AS AN EXPERT WITNESS.

An interesting reference was made in the article by Walter J. Francis, C.E., entitled "Engineering as a Profession," (*The Canadian Engineer*, Nov. 6th, 1913, page 685), where it is stated that the engineer's remuneration for professional services in the law courts is something like $1.25 per day. This question regarding the inadequacy of fees to professional witnesses has been under consideration a great deal in England during the past season. It was aroused by a complaint made by an association of shipbuilders that the allowance for expert witnesses was too meagre in the case of Board of Trade inquiries, and the result has been the formation of a special committee of representatives of the Institution of Naval Architects, the North-East Coast Institution of Engineers and Shipbuilders, and the Institution of Engineers and Shipbuilders in Scotland, to consult as to whether representation should not be made to the Board of Trade regarding this inadequacy of fees. It appears that an act, passed in 1894, provides for the payment of expenses in respect of the attendance of witnesses at Board of Trade inquiries on the same scale as in the ordinary courts. The Board, however, allows only $15.75 and first-class railway fare. Under the County Court rules and the High Court Orders, which apply to Board of Trade inquiries as well as to the ordinary courts, an extra fee of from $5.25 to $26.25 may be obtained for "qualifying to give evidence." The consultative committee of the North-East Coast Institution of Engineers and Shipbuilders think that while the Board of Trade has no jurisdiction to raise the fees proper, it might in practice allow expert witnesses and leading officials of shipbuilding firms attending inquiries and giving evidence an additional qualifying fee, in terms of the Rules of Court, of from $5.25 to $26.25, making a total of $21 to $42.

But in Canada, although members of other professions are, generally speaking, given some recognition for their qualifications for giving evidence, the engineer is reimbursed for his services by a dollar and a quarter per day, there being no consideration given his ability and training more than if he possessed only that acquired by the handling of pick and shovel.

FIRE-RESISTING CONCRETE.

Of recent years complete confidence has been established in the fire-resisting qualities of properly constructed concrete. These, combined with its durability and strength, render it particularly suitable for the construction of buildings in which more or less hazardous occupations are to be carried on, or which are to be erected in areas wherein it would be difficult to cope with a conflagration.

For fire-resisting concrete quartz sand should be used, and broken trap rock is, perhaps, more suitable than any other substance. Limestone is probably next in order of suitability, although it will eventually run into a crude form of glass or be calcined; but that will not take place until the cement itself has been disintegrated. Contrary to the commonly received opinion, cinder concrete is not unsuitable from a fire-resisting point of view. The chief objection to its use is that it is far from strong. Heat does not affect it to a great extent; indeed, it has been found that small pieces of coal embedded in concrete have remained entirely unaffected by heat. That was due to the low heat conductivity of concrete; indeed, it might almost be said that it is an insulator of heat—so much so, at any rate, that the hand can be borne on the top of a slab of concrete five inches in thickness under which a fierce fire has been raging for five hours or more.

This non-conductivity is well shown by the following account of a steam conduit built of concrete. The conduit was about 500 ft. long, and was built between a mill and a boiler-house, and was made just wide enough to take two steam pipes 6 in. in diameter and two smaller pipes. After the pipes had been laid in position a concrete cover was constructed over them, so as to render the conduit proof against any moisture in the soil or surface water. The conduit was carried some 2 ft. 6 in. below the surface—not sufficiently deep to be beyond the influence of the specially heavy frosts which were periodically experienced in the neighborhood in which the conduit was laid. The concrete troughing was left open at both ends, to make it easy to ascertain whether there was or was not any leakage. It was assumed that if any vapor was found to escape from either end of the conduit there must be some leakage which would permit the water to vaporize. The conduit was allowed to dry thoroughly, which took about two weeks; but no vapor has at any time been visible, and the loss of heat, which has been measured, through the concrete is so small as to be negligible.

The province of Quebec has constructed about 225 miles of macadamized roads and about 60 miles of gravelled roads this year. In all about 900 miles of roads have been constructed or have undergone extensive improvement, according to Hon. Mr. Taschereau, Minister of Public Works. The King Edward Highway is practically completed and about 40 miles of roads between Quebec and Montreal are at present under construction.

LETTERS TO THE EDITOR.

Further Discussion of "Bending Moments in Flat Slabs."*

Sir,—The paper by Mr. V. J. Elmont on "Bending Moments in Flat Slabs," published in your issue of September 25th, 1913, and the discussions which have followed it, disclose but one real criticism of the flat slab, namely, its lack of reinforcement, in a number of systems at least, at right angles to the edges of the slap in what might roughly be called the middle third of the space lying between the column centres.

That negative bending moments exist across strips having these edge lines as axes must be admitted by all who give any consideration to the matter. Their magnitude is unfortunately a source of much difference of opinion. Mr. Elmont estimates the maximum negative moment at the centre of an edge line and at right angles to it as $gl^2 \div 28.8$. The researches by Mr. Frank J. Trelease conducted on rubber models for the Corrugated Bar Company indicate a moment which, when expressed in Mr. Elmont's notation and in terms of the span centre to centre of columns, becomes $gl^2 \div 87.5$. It would be interesting to have Dr. Eddy's estimate of the magnitude of these moments, but notwithstanding Mr. Elmont's assertion that he (Dr. Eddy) had found far greater values for them than his critic had indicated in the original paper, Dr. Eddy nowhere in his treatise on flat slabs, so far as the present writer has been able to ascertain, attempts to assign a value to the particular moments under discussion. His brief consideration of them is concluded by the following general statement:—

"The curvature of these sections (normal to the edge lines) is controlled by the stiffness of the mushroom heads, which is so great as to make the curvature very small. No considerable tensile cross stresses are consequently to be apprehended; but in case the stiffness of the head were to be decreased, stresses might arise such as to develop longitudinal cracks over the middle rod of the side belts." Indeed, it could scarcely be expected that the advocate of a system without reinforcement for the resistance of a particular stress, would establish mathematically the existence of such a stress unless it were so small as to not exceed the safe resistance of the material at the section under consideration. The comparative silence of Dr. Eddy on this matter can scarcely be interpreted otherwise than as an admission of a stress condition somewhat difficult to meet with the rod arrangement of the mushroom and certain other systems.

The writer does not, however, support the view that the tensile stresses across the edges of flat slab panels are of necessity seriously objectionable. Undoubtedly the size of the column heads and the width of the diagonal belts of rods have an important bearing on the magnitude of these stresses. It is a fundamental principle of structural engineering that a load will divide itself among a number of resistance-paths in proportion to the rigidity of those paths. If, therefore, strong resistances are supplied by stiff column heads and plentiful diagonal reinforcement, the floor load will travel to the columns largely along these lines. But in a reinforced concrete slab, necessarily continuous in construction, one cannot force the loads to exclusively follow paths marked out by reinforcement steel. The presence of the concrete as a unify-

*This article appeared in *The Canadian Engineer* for Sept. 25th, 1913, and was discussed by Dr. H. T. Eddy and Mr. V. J. Elmont in Nov. 6th issue.

ing mass involves the transfer of a certain part of the loading to the side belts of rods along lines at right angles to them, and tension along these lines cannot be overcome, no matter how much diagonal reinforcement may be used. But if the tension is small, as it probably is in well-designed slabs, it should be no more objectionable than the tension which often exists over the tops of beams and girders in floors of ordinary reinforced concrete construction due to under-reinforcement for negative moment or the placing of the steel so low as to be quite ineffective for the purpose for which it was intended. In any event, it is not a question of the ability of flat slabs to support the applied loads with entire safety, but simply one of the probable effect of the existence of certain small edge cracks on the embedded steel or on the finished flooring. Corrosion tests conducted in Germany by Professor E. Probst have shown that cracks on the under side of concrete beams produced by stressing the embedded steel up to nearly the breaking point have no deleterious effect on the metal, so that it would appear safe to dismiss the former effect as of no great consequence. Cracks in the finished flooring would be objectionable only if visible, and as far as the present writer knows, these have not been observed in buildings with flat slab floors.

C. R. YOUNG,

University of Toronto, November 20th, 1913.

* * * *

Discussion of "Bending Moments in Flat Slabs."

Sir,—In an engineering discussion, fairness is presupposed on the part of those taking part therein, unless they have been misinformed. Mr. Elmont's discussion, noted in your issue of November 6th, hardly comes up to this standard.

He credits Mr. Mensch with being the first, to his knowledge, to have applied flat slab to actual building. The writer has noted Mr. Mensch's statement that he had used flat slab construction in the Armourdale Plant of the Procter and Gamble Company, and was sufficiently interested to write to the company for information, and the reply from their superintendent, Mr. Robert Anderson, states that 'the only concrete used in these buildings was the reinforced concrete foundations and footings. The buildings themselves were mill construction." Concerning the flat slab, Mr. Anderson states in another letter: "We beg to advise that this floor slab is in one portion of our Kansas City plant, and covers a room 100 feet square. This floor slab is directly on the earth and is designed to support tanks which have conical bottoms, distributing the weight of the entire tank on six columns around the periphery and one point in the centre. These tanks will hold 396,000 pounds of water each, this being divided on the seven points mentioned." Thus Mr. Elmont's knowledge of what Mr. Mensch accomplished seems to be somewhat misleading; that is, supposing the superintendent of the Procter and Gamble Company is familiar with the character of the construction of the buildings.

Mr. Elmont's remarks about Matrai are equally interesting. A mere resemblance in plan of the arrangement of reinforcing hardly proves the construction to be flat slab. Matrai's idea, as he has expressed it freely, was to put up a building which would not depend on the strength of the concrete. He would provide wires for tension members and girders to resist the pull of the wires, the concrete being merely spread upon the wire to distribute the load over these suspension members. A cheap concrete was to be used, cinder concrete, or even a natural cement mortar. The office of the concrete being merely secondary—a means of distributing the load over a steel system, and yet Mr. Elmont would have the readers infer that Matrai arranged the reinforcement for flat slab, a form of construction in which the motive was entirely different.

Equally interesting is Mr. Elmont's representation of the unreinforced or helpless character of the concrete in his so-called unreinforced areas. Placing the steel in the concrete does not prevent tensile deformations in the tensile zone. It merely limits or controls the magnitude of these deformations. If Mr. Elmont will consider the curves of flexure on which Grashof theory is based he will see that the tensions in the areas which he refers to are normal to the lines joining the columns, and hence can be resisted and controlled by steel in the same direction in the top of the slab in the area about the column, rather than in the areas midway between columns, and that steel in this area has greater load carrying power, hence designers of the Turner slab prefer to limit and control these stresses by steel placed in accordance with their standard design.

The writer will frankly agree with Mr. Elmont that the Deere and Webber test was not a sufficiently severe test to warrant very serious consideration. It was not the test load that was required by the city of Minneapolis, which demands ordinarily that the test shall be double the working load. On the other hand, when we bear in mind the fact that it requires a drop of only 23 degrees Fahr. to exceed the normal tensile strength of concrete, providing the ends of the slab are fixed, positive conclusions cannot be drawn from the discovery of a check in the slab. The safe plan is to see that the steel is there to take the tensions, and to count on the concrete for compression. A microscopic check which cannot be found except by the use of a magnifying glass should cause no one having an engineering education to consider the defect as sufficiently serious to merit extended discussion. The writer makes this statement, not with a view to advertising someone else, but merely as a question of fair dealing which should be recognized on its face as such.

Interesting misinformation is contained in his article as to what floors of ordinary buildings are designed to carry. The Turner slabs are designed for a working stress on the steel of 13,000. Sixteen thousand pounds working stress is used by the average structural steel engineer, and doubling the working load on a structural steel building, thus increasing this stress to 32,000 pounds, makes the stress in the steel only a shade under the yield point value of the metal, and eliminates the factor of safety. In the concrete structure, with 13,000 pounds working stress, we have an opportunity to put on 216 times the working load, live plus dead, without straining the steel more than would be the case in doubling the load on the structural steel building, and we have not anywhere nearly reached the ultimate strength of the construction. A mushroom slab which would ordinarily be rated at a 350-pound working load has been loaded to 3,300 pounds per square foot in the centre of the slab and deflected and bent out of shape 9 inches and still carried the load without further deformation. These are facts which rather upset Mr. Elmont's contention.

The average critic of flat slab construction, it would seem to the writer, has never heard of the fundamental theory of work enunciated by Clapeyron, almost seventy years ago, which principle has been developed so that the

theory of work is used to-day in the computation of stresses in statically indeterminate structures in determining the deflections in all bridge structures, and forms the ground work in a large part of the science of structural engineering.

The consideration of the principle that the external work of the load must equal the internal work of deformation and that the active energy of the load passing through the height of deflection is stored up as potential energy within the slab, and a consideration of the manner in which this potential energy is stored up, should be sufficient to cause Mr. Elmont to admit frankly his error in the premises. If the radial deformation about the head at a given section at a distance R from the centre of the column and within the line of inflection be called ΔR, then the circumferential deformation must be $2\pi\Delta R$, and we can readily show that the amount of energy stored up in the circumferential direction is fully three times that which is stored up in the radial direction, and to assume with that in view that the same formula can be applied to the flat plate that is suitable for the beam strips becomes as absurd on its face as Mr. Elmont's endeavor to attribute to the man who put in a concrete foundation resting on the earth throughout, the origination of flat plate construction in commercial form in the floors of the warehouse buildings, a form so popular that it is almost universally imitated by all who are successful in concrete construction. Certainly it would seem that a reasonable degree to fairness ought to exist among engineers, and that they should not, without personal knowledge, undertake to assign the credit for a radical departure in modern construction to those who did nothing whatever toward materializing such construction. Hearsay evidence seems to be accepted without question by men with no legal training and frequently the mere assumption that certain conclusions without proof are a mechanical fact and are based on natural laws is also unfortunately a failing of the laymen, and it would seem to be the office of a reputable engineering paper to do all in its power to eliminate such error.

It should be noted that Mr. Elmont's final quotation from Professor Talbot, in the last paragraph of his reply, is with reference to the very cracks in the Deere and Webber test which were discussed in quotation from Professor Talbot made by Dr. Eddy, in which it was explicitly stated that "so far as any one knows, they are not detrimental to the structure." Mr. Elmont evidently disagrees with Professor Talbot on this point, but he will have to adduce far more convincing reasons in support of his position than he has yet given before the profession will be willing to agree with him rather than Professor Talbot.

C. A. P. TURNER.

Minneapolis, Minn., Nov. 11, 1913.

* * * *

[Mr. Elmont was furnished with a copy of the above communication, and in reply, he has transmitted the following.—Ed.]

Sir,—In November 6th issue of this journal the writer answered a discussion on his paper "Bending Moments in Flat Slabs," sent in by Dr. Eddy. Now Mr. C. A. P. Turner takes the word from his mathematical assistant, continuing his discussion.

In answering, the writer considers it necessary to remind Mr. Turner that the point of the writer's paper was, to show theoretically what he considers has been shown practically by Prof. Talbot's careful testloading of the Deere and Webber building, i.e., that there are heavy negative bending moments perpendicular to the sides of a flat slab panel; these should be provided for by placing reinforcing steel where the moments act and in quantities depending on the value of the moments. Most flat slab designers, including Messrs. Eddy-Turner, do not adopt this arrangement.

Messrs. Eddy-Turner's practical reason for not wishing to adopt the writer's recommendation seems to be that numerous testloadings of flat slabs have shown that their design is safe, these slabs having been designed in their usual way with an allowable steel stress of 13,000 lbs. per sq. in. This argument, however, carries no conviction to the writer's mind; firstly, because a safe structure according to the Eddy-Turner definition is one which can "carry twice the live load without failure and can do this for months at a time without signs of distress"; as explained in the writer's answer to Dr. Eddy this definition is unsuitable to efficient structural engineering. Secondly, the writer thinks that no conclusions about the point of his paper can be drawn from Messrs. Eddy-Turner's testloadings because they have not been conducted carefully enough—as it also was said in a recent discussion in the American Society of Civil Engineers—"they are largely confined to the loading of single bays and deformations or strains not measured."

The second and third last paragraphs of Mr. Turner's discussion are, the writer assumes, intended as a theoretical explanation of his standpoint; the main words contained in them seem to be statically indeterminate structures, Clapeyron's theory and potential energy. Though the writer has had the opportunity to calculate and build a number of statically indeterminate reinforced concrete structures, and is familiar with Clapeyron's theory and the definition of potential energy, he is at a loss to get any sense out of these two paragraphs, and therefore is unable to pass any opinion about the wisdom contained of them.

The writer had no reason to doubt the source from which he received the information that Mr. Mensch was the first engineer who used reinforced concrete flat slabs in an actual building, hence his statement that credit was due to him. If this is not the case, credit is due to somebody else for it, *palmam, qui meruit, ferat.* No matter who it is, it is not of any consequence in connection with the point of the discussion, the distribution of bending moments in flat slabs.

V. J. ELMONT,

Montreal, November 17th, 1913.

A general survey of the mineral production of Canada for 1912 has been issued by the Department of Mines in the Dominion Government. The total value of last year's output, the greatest yet on record, was $135,048,296. This is an increase on 1911 of $31,827,302. Since 1886 mineral production has risen from $2.23 to about $19 per capita. Ontario leads the list with a production of $51,985,000, British Columbia comes second with $30,000,000, and Nova Scotia third with $18,922,000. A substantial increase in the price of most metals was a feature of the year, as was the extended development of ore reserves, pointing to much greater annual outputs in the future. Coal has been the most important product in point of value with a total production of $36,019,044; silver coming next in importance and nickel, copper and gold following. With the exception of petroleum every important mineral mined in Canada showed an increased production in 1912.

SOME NOTES ON HIGH RAILWAY ABUTMENTS.

By Alan Fraser, B.A.Sc.,
Assistant Engineer, Frank Barber, Toronto.

THE bridge seat of railway bridges is often high above water level or above the elevation of some similar obstacle to be crossed, such as another railway track or a highway. Therefore, occasions may frequently arise wherein the back fill or embankment supporting the track may be allowed to fall in front of the abutment shown by the *RD* in Fig. 1. This does not necessarily mean that the fill may come into contact with the surface of the bridge seat, such a condition being, to say the least, bad practice, and is in most cases not permissible. Attention is called to this fact in order to more fully appreciate the following, it being sufficient to state that the back fill should not, under any conditions, encroach upon the bridge seat.

With this in view the following points should be kept in mind when designing:—

(1) With a ballast wall on top.

(2) Angle between back of ballast wall and vertical axis, designated by θ.

(3) Angle of repose of the back fill.

(4) Distance from top of ballast wall to the bridge seat, designated by *S*.

A little thought will convince the reader that, other things being equal, the solution of the problem of keeping the back fill away from the bridge seat becomes easier as the angle of repose of the back fill increases. The ballast wall is, generally speaking, that part of the abutment immediately above the bottom of the bridge seat.

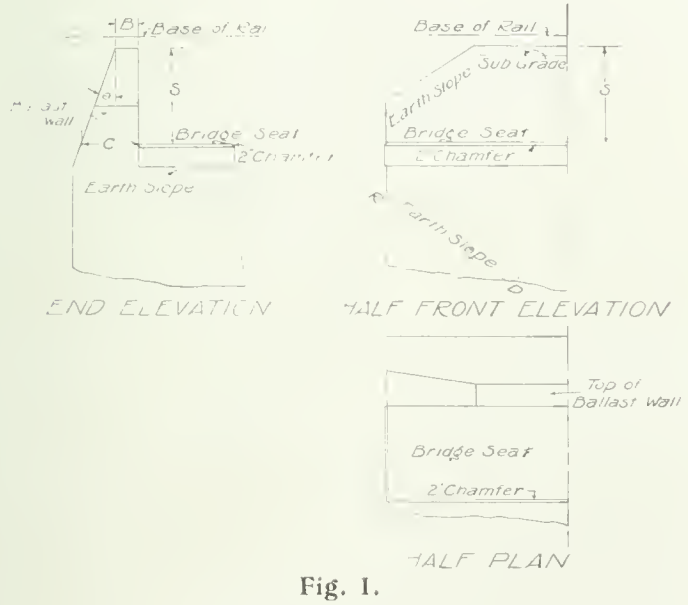

Fig. 1.

The frost batter is merely the slope on the back of the ballast wall.

Where, in Fig. 1,

B = width at top of ballast wall,

S = distance from top of ballast wall to the bridge seat,

θ = angle between back of ballast wall and the vertical axis,

C = width of the ballast wall in the same horizontal plane as the bridge seat.

Then, $C = B + S \tan \theta$ thus giving an empirical method for obtaining the thickness of the ballast wall in the plane of the bridge seat.

As the distance, *S*, becomes greater the problem of keeping the back fill away from the bridge seat increases in difficulty where wing walls are dispensed with. Where *S* becomes as high as eight feet, walls known as "lug walls" are used. These project left and right from the ballast wall. They are simply a continuation of the ballast wall and are shown in Fig. 2. It may be well to mention here that *S* increases in direct proportion to the increase of the span of which the bridge seat is an end support. The lug walls are developed to withstand as much of the

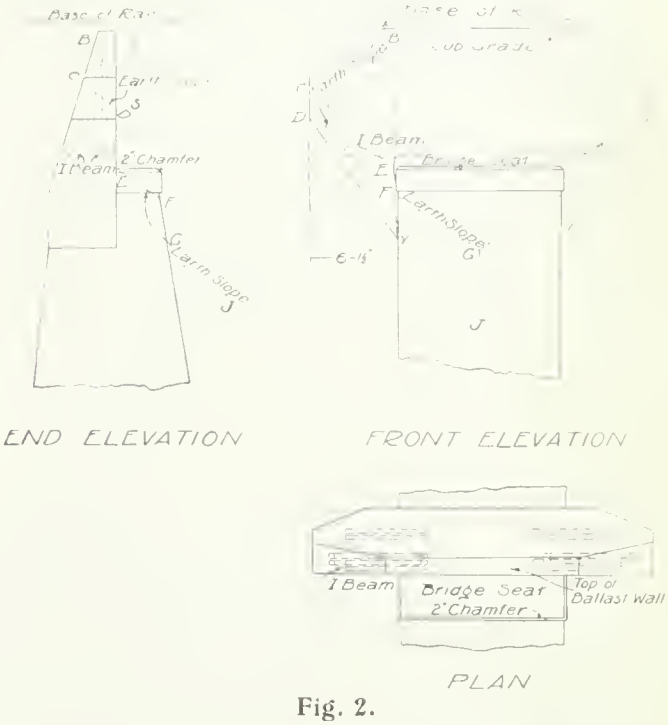

Fig. 2.

tendency to break off along the line *x y* as possible. It is not uncommon to use old rails or small I-beams as a reinforcement for these lug walls. The trained engineer need not be informed that the webs of I-beams should be in the vertical plane, so that the webs take up as much of the shear through *x y* as possible. The reinforcement of the projecting lugs is placed as economically as good practice will permit. The webs of I-beams, when used, may be assumed to take up all the shear that the concrete cannot resist, and this excess of shear is assumed to be distributed evenly over the webs. The reinforcement should be placed as near the back fill as possible, so that any tendency the back fill may have to snap off the projecting parts is, to a certain extent, overcome.

There is, of course, a limit to the safe projection of the lug walls. If beyond 5 or 6 feet, it may be expected that great difficulty will be experienced in their construction. The cost of the lug walls and the tendency (in spite of reinforcement) for them to break off becomes excessive. The attention of the reader is called to an article in October 23rd, 1913, issue of the "Engineering News," which treats with this type of abutment.

Where the depth *S* becomes over 12 feet (approximately one-tenth of the span) a patented design (No. 150003) obtained in August, 1913, by the writer, overcomes the problem of designing an economical, safe and easily constructed abutment without wing walls. This is shown in Fig. 3. The lines designated KL, LM, MN,

NO, OP, PQ correspond with the surface of the back fill during its fall from K to Q. The back fill will be observed to leave the bridge seat entirely free from encroachment.

Comparing this design with that shown in Fig. 2, where BC, CD, DE, EF, FG shows the surface of the back fill during its slope from B to G it will be observed that a considerable amount of concrete is saved. For a 120′ 0″ span the use of the abutment shown in Fig. 3 means a saving of approximately eight to ten yards both for single and double track lines. The fact that the projecting lugs in Fig. 2 are reduced from 6′ 1½″ to 2′ 6″ in Fig. 3, is sufficient to prove that the chances of their breaking off are much less than were they as long as would be the case were the design shown in Fig. 2 used in the place of the design shown in Fig. 3. Lastly, the construction is obviously easier.

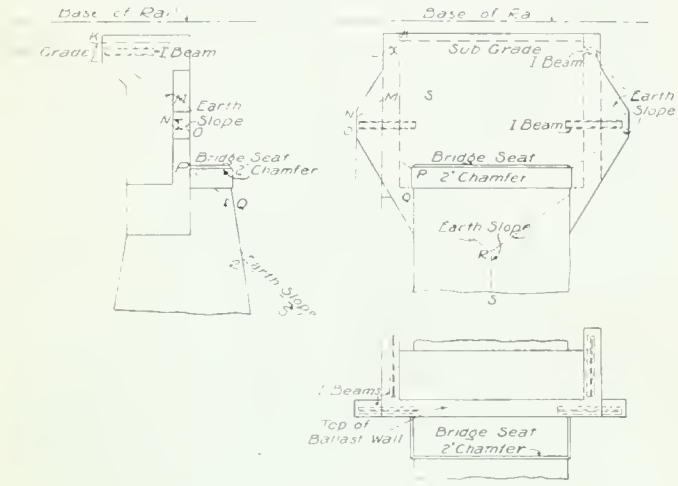

Fig. 3.

In order to keep the earth away from the bridge seat, it would, of course, be theoretically possible to reduce the length of the lug walls by constructing small curtain walls at both ends of the bridge seat. If this were done, however, the curtain walls would form a trap, as it were, between themselves and the steel deck girders. In this receptacle, however, the ice and snow collected during the winter would melt in the spring and tend to rust out the bed plates. Furthermore, there is a possibility of these curtain walls being destroyed during the erection of the steel work. In one case that the writer has observed, huge vertical columns of solid concrete were used to support the greatly extending and unsupported lug walls. The saving in concrete due to the absence of wing walls became almost a negative quantity.

Transcona Board of Trade is advocating a "good roads day," in which citizens of Transcona and those of Winnipeg (whose interests are more or less directly concerned in the building of an improved road to connect the two places) will be expected to turn out to make a good highway from Winnipeg to Transcona.

Railroads covering nearly a billion locomotive miles are in the competition for the first award of the E. H. Harriman Memorial Medals, which will be made at the First International Exposition of Safety and Sanitation, to be held in New York City, December 11th to 20th, under the auspices of the American Museum of Safety.

FIXED CARBON TEST.

"THE Fixed Carbon Test, designed for coal, has practically nothing to do with the finished quality of a refined asphalt, asphalt cement or road binder. It is a brand-identifying test."

The above extract from an article which he recently wrote, clearly indicates the opinions on the fixed carbon test that are held by J. W. Howard, C.E., E.M., of New York, whose work as a consulting engineering-chemist has been chiefly notable in the bituminous field. Col. Howard discusses the value of the fixed carbon test in more detail in the following letter:—

"The question has often been asked by city and state engineers, as well as many producers of excellent asphalt and bituminous cements and road binders, what, if anything, has the 'fixed carbon test' to do with the quality of these products for pavement and road construction? The answer is that it has nothing to do with the qualities of these materials. Fixed carbon is not a definite substance nor quality in any given coal or other material. It constitutes the results of an arbitrary test of the approximate portion of coal, which will remain and continue to burn and give heat after relatively light, volatile hydrocarbons have been partially burned away by flame. This test was devised solely for coal, by the committee on coal analysis of the American Chemical Society, and published in the Journal of the American Chemical Society, 1899, No. 21, p. 1116.

"The test is made briefly as follows: One gram of coal is put in a 'platinum crucible weighing 20 or 30 grams and having a tightly fitting cover. Heat over the full flame of a Bunsen burner for seven minutes. The crucible should be supported on a platinum triangle with the bottom 6 to 8 cm. above the top of the burner. The flame should be fully 20 cm. high when burning free, and the determination should be made in a place free from drafts. The upper surface of the cover should burn clear, but the under surface should remain covered with carbon.'

"It is therefore evident that the fixed carbon test has nothing to do with the quality or uses of asphalt, bitumens, asphalt cements and road binders. Burning and consequent destruction of the asphalt or bitumen proves nothing concerning the original condition and qualities before being burned. The qualities of the asphalt or other bitumens as used (not the burned products) are what are needed for cementing together and waterproofing the other materials in a pavement or road.

"No two persons, in the same or different places, with the various allowed sizes of crucibles, different sized Bunsen heaters, different kinds and pressures of gas, different lengths and sizes of flames, different distances the crucibles stand above the burner, even aside from the personal factor or difference in the way different persons work, can get the same quantity of fixed carbon (ashed free) or otherwise from the same sample of coal or other substance. When this variable process is applied to an asphalt or bituminous substance, even more widely varying and discordant results are obtained. It cannot be used as a basis of comparison of asphalt and bituminous materials, nor as a proof of their good or bad qualities.

"The attempted introduction of the fixed carbon test for coal into the asphalt industry has nothing to do with the determination of quality; nor can any minimum or maximum amount be set for this alleged test, between which all good asphalts and bitumens will come. Some good ones will be outside such limits, and some poor, worthless asphalts and bitumens will be inside any limits

attempted to be established by fixed carbon requirements. This test is sometimes used by chemists simply as a small but imperfect indication, taken with other special chemical tests, to identify, if desired, an unknown or unnamed brand of asphalt, but has nothing to do with quality. This test should not be placed among the tests for quality of asphalt, nor any road building materials.

"The fixed carbon (coal test) should be ignored if still found in asphalt or bituminous specifications, and not enforced, not only on engineering, but also on legal grounds, that 'the test does not apply to or establish any quality of the material necessary for the construction made or to be made,' i.e., in this case it does not apply to refined asphalt, asphalt or bituminous cement or road binder for constructing and waterproofing roads or pavements."

Col. Howard admits that a great deal of chemical and physical research work is necessary and useful to those who obtain crude materials and manufacture refined asphalts, road binders, etc., but he claims that research tests should not appear in specifications for pavements and road construction. He includes the fixed carbon test among the purely laboratory tests which do not apply directly to the quality of finished asphalt products and which, he says, are now best omitted from specifications.

"The determination of the amount of hydrogen, carbon and other ultimate elements of asphalt is interesting as a scientific study," says Col. Howard, "and bear somewhat upon the commercial and engineering problems connected with the sources of supply and manufacture, but have no place in contracts and specifications. Standard methods of making the tests to establish the requisite qualities (of asphalt, etc.) are found in various publications of the American Society for Municipal Improvements, the American Society for Testing Materials, the reports of the Association for Standardizing Paving Specifications, and in various other publications.

"A set of 'Standard Tests for Asphalt Cements for Sheet Asphalt Pavement' with numerical requirements or standards, prepared by the writer, will be found in the proceedings of the American Society for Municipal Improvements for 1911. A few of them are no longer needed for specifications but were inserted to check or confirm some of the other tests. The requisite qualities which good asphalt cements and road binders should possess are found in many products made from crude materials coming from California and other parts of the United States, from Mexico, Cuba, Trinidad, Venezuela and elsewhere, all of which asphalt cements and road binders are in successful use everywhere."

In the introduction to an article that appeared in Engineering Record recently, Col. Howard said: "The city, county, state and independent users are not concerned in the geographical source or crude materials from which asphalt products are manufactured. Specifications should have no requirements regarding the source of supply or the crude materials, nor the manner by which they are made into asphalt products. That is solely a matter for the manufacturers. Contracts should specify the qualities and tests needed for good asphalt cements or binders for use in pavement surface layers, just as they specify the qualities and tests needed for good Portland cements for use in foundations.

"Objectionable specifications which 'let in' or 'exclude' one or another asphalt, with few real quality tests, have lately been used for some highways. This is done by inserting irrelevant or useless tests for gravity, fixed carbon, paraffine, sulphur, etc., with special requirements or limits which fit the peculiarities of certain limited asphalt products, to the exclusion of others equally as good or better. Standard, essential, and useful tests are partly included and partly omitted, according to whether or not the asphalt product, thus secretly described (except to an expert), meets good requirements or not. Such wrong, unwise, and unjust specifications are being steadily eliminated by good men."

Readers who noted Mr. Pullar's suggestions of methods for making the fixed carbon test of increased value, which appeared in the Nov. 13th issue of *The Canadian Engineer*, and those also of Mr. Law, appearing in last week's issue, will notice the marked difference of opinion between Col. Howard and Mr. Law on one side and Mr. Pullar with an opposite view as to the value of the fixed carbon test; although all three evidently think that it is useless to write a specification naming the same maximum limit for fixed carbon for all asphalts.

The difference of opinion on this subject between these writers is indicative of the doubt that exists at the present time among municipal and highway engineers as to whether the fixed carbon test has properly a place in their specifications for asphalt supply. *The Canadian Engineer* invites letters from any engineers who may have well-defined views on this subject.

HIGHWAY ENGINEERING AT COLUMBIA.

The non-resident lecturers in the Graduate Course in Highway Engineering at Columbia University appointed for the 1913-1914 session are as follows: John A Bensel, New York State Engineer; William H. Connell, Chief, Bureau of Highways and Street Cleaning, Philadelphia; C. A. Crane, Secretary, the General Contractors' Association; W. W. Crosby, Chief Engineer, Maryland Geological and Economic Survey, and Consulting Engineer; Charles Henry Davis, President, National Highways Association; John H. Delaney, Commissioner, New York State Department of Efficiency and Economy; A. W. Dow, Chemical and Consulting Paving Engineer; H. W. Durham, Chief Engineer of Highways, Borough of Manhattan, New York City; C. N. Forrest, Chief Chemist, New York Testing Laboratory; Walter H. Fulweiler, Chief Chemist, United Gas Improvement Company; Frank B. Gilbreth, Consulting Engineer; George P. Hemstreet, Superintendent, the Hastings Pavement Company; Samuel Hill, President, American Road Builders' Association; D. L. Hough, President, the United Engineering and Contracting Company; J. W. Howard, Consulting Engineer; Arthur N. Johnson, State Highway Engineer of Illinois; William H. Kershaw, Manager, Paving and Roads Division, the Texas Company; Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment; New York City; Harold Parker, First Vice-President, Hassam Paving Company; Paul D. Sargent, Chief Engineer, Maine State Highway Commission; Philip P. Sharples, Chief Chemist, Barrett Manufacturing Company; Francis P. Smith, Chemical and Consulting Paving Engineer; Albert Sommer, Consulting Chemist; George W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn, New York City.

Electric blasting is being employed in certain mines in South Africa. The whole of the one level at a leading mine was fired recently by the new system. There were 300 shots in the blast, which was effected from a station, only one man being required below for the firing. Cables are now placed to enable blasting to be effected from the surface. The system so far has proven satisfactory.

TORONTO FILTER SPECIFICATIONS

BOARD OF CONTROL AUTHORIZES CALL FOR TENDERS FOR MECHANICAL PLANT OF SEVENTY-TWO MILLION IMPERIAL GALLONS DAILY CAPACITY —RESUMÉ OF ESSENTIAL PARTS OF CITY ENGINEER'S SPECIFICATIONS

TORONTO'S Board of Control yesterday gave formal permission to Commissioner of Works R. C. Harris to advertise for tenders for a complete mechanical filtration plant at Toronto Island, the plant to include pumping station, chemical storage room, coal storage building, filter house, mixing tanks, coagulating basins, clear water basins, filter units with complete equipment, crane, pumps, valves, boilers, chimney, turbo-generator set and all appurtenances.

The estimated cost is approximately one million dollars. The specifications require that work shall be commenced within ten days after the execution of the contract, and shall be carried on without delay, so that one-half of the filter plant and all its accessories shall be in satisfactory service not later than December 31st, 1914. A bonus of one hundred dollars a day is offered for completion of the first half of the plant earlier than that date, and a penalty of two hundred dollars a day is imposed for non-completion of the first half of the plant by that date. Should the plant not be completed within sixty days after December 31st, 1914, the penalty then increases to three hundred dollars a day.

It is also required that the whole filter plant shall be completed and operating satisfactorily not later than September 30th, 1915, and a penalty of fifty dollars a day is imposed for delay beyond that date, allowances in every case, of course, being made for delays caused by strikes, or by any act of the City Council, or on account of additional work ordered, or for any other delay for which, in the opinion of the Commissioner of Works, the contractor cannot be held responsible.

"It is the purport of these specifications and also of the instructions to tenderers to obtain bids for a plant which will be first-class in every respect and equal to the best on this continent, and complete in every detail, and ready to operate." This sentence in the specifications expresses the spirit in which the Works Department is regarding this plant. The Commissioner of Works and Engineers Powell, Milne and Barr, who have all done notable research work in gathering data for the preparation of the specifications for this plant, are determined that Toronto shall have a filtration plant that will not be outranked by any on this continent, and in the specifications they have guarded the plant, seemingly, in every possible way.

Specifications Ensure Good Plant.

It is the intent of the specification to permit bids to be submitted by the proprietors and licensees of any mechanical filter, provided they comply with the guarantees and duties required by the specifications. Yet, the provisions made regarding guarantees, bond and surety regulations are such as to ensure the city's receiving bids only from firms who are financially responsible and who have absolute faith in their ability to live up to the guarantees required.

A marked cheque or cash deposit is required for the sum of two and one-half per cent. of the value of the tender. A satisfactory bond must be furnished to the full extent of the contract price for the proper performance of the work, and in addition to this a bond will be required for five years from date of acceptance of the completed plant by the city, for the cost of the foundations, substructures, superstructures and chimney, in order to guarantee their not failing. This is on account of the sand on which they must be built. Similarly, all machinery, equipment and appurtenances must be guaranteed free from all visible or inherent defects for one year from date of acceptance. Eighty per cent. of the value of the work done and materials incorporated in the work will be paid monthly by the city. One year from the date on which all tests as to efficiency and capacity have been made, and the plant and all its accessories accepted as satisfactory to the Commissioner of Works, the remaining twenty per cent. will be paid. Payments may be withheld at any time if the work is not proceeding in accordance with the contract.

Besides being protected by the heavy guarantees required and the general rigid and high character of the entire specification in all details, the plant's success is further guarded by the requirements imposed regarding responsibility and reliability of the contractors. The specification says:—

"Bidders must furnish satisfactory evidence of their experience and ability to construct this class of work, and that they have construction and financial resources to enable them to prosecute the same successfully and promptly, and to complete the work within the time named in the contract. Evidence must be submitted showing positively that the tenderer has designed or constructed similar work."

Strainer System Must Be Perfect.

All modern appliances are specified under the heading of "filter equipment," and special attention is given to the strainer system. The specification says that while it is not the intention to limit the tenderers to any particular type of strainer system, it must be distinctly understood that anything in the nature of an experiment will be prohibited. Should tenders cover any design that has not been in successful operation for at least three years, the city will require a bond for the sum of seventy-five thousand dollars for the proper maintenance of such a type of strainer system for a period of five years after the completion of the plant.

Tenders must be mailed by registered post and will be received up to noon, January 20th, 1914. The Works Department will examine and compare the various tenders and expect to award the contract about three weeks after receipt of tenders. Each tenderer will be required to submit a full set of plans drawn to scale, showing the general arrangement of the plant in relation to the existing slow-sand plant and connection thereto, also showing the position of the pump room, coagulating basin, filters, etc. There drawings must show in detail the entire plant. In other words, they must be descriptive of the system by which the tenderer expects to live up to the guarantees required in the specification. Two months after the award of the contract, the successful tenderer must furnish in

duplicate accurate drawings showing all parts of the plant in such detail that the whole may be erected from those plans.

While the city specifies that the plant must be "mechanical," that is slow-sand designs are barred, the competition is open to all types of mechanical plants, whether pressure or gravity, patented or unpatented, provided, of course, that all guarantees required are furnished and all other conditions of the specifications complied with.

The specification is very complete, comprising eighty pages of printed matter, with an appendix giving a very useful index to contents. The language used is clear and concise, and the general arrangement of the specification lends itself to the easy finding of any particular portion.

As previously stated in *The Canadian Engineer*, the plant is to be capable of satisfactorily filtering continuously sixty million Imperial gallons every twenty-four hours, with a maximum capacity of not less than thirty million Imperial gallons during any ten hours. The effluent at all times is to be of the standard of purity required by the specifications. This, of course, practically means that the plant must have a daily capacity of seventy-two million Imperial gallons.

Pure Water Assured.

The contractor will be required to guarantee that the mechanical filtration plant which he proposes to furnish, will remove 90 per cent. of all organisms where there are 50 to 500 bacteria per cubic centimeter in the unfiltered water; will remove 95 per cent. of all organisms where there are 500 to 2,000 bacteria per cubic centimeter in the unfiltered water; and 98 per cent. of all organisms where there are 2,000 or more bacteria per cubic centimeter in the unfiltered water.

The contractor must also guarantee removal of 98 per cent. of the B. Coli as determined by the standard methods for the examination of water of the American Public Health Association. All turbidity must be removed, leaving a bright, colorless water, free from taste. Such results must be guaranteed by the use of not more than one grain of alum per Imperial gallon of water, under average conditions. Where such is required, a sedimentation period of not less than three hours must be provided for after the addition of alum.

Each tender must be accompanied by a report of some similar plant, municipal or otherwise, of at least one-half million gallons daily capacity, such report having been made by a reputable disinterested bacteriologist, and showing the daily bacteriological analyses of the water before and after filtration for a continuous period of at least thirty days, including the percentage of B. Coli organisms removed, as well as the percentage of the total number of bacteria; also showing the removal of suspended matter, and the nature of the effluent.

A schedule of quantities must be furnished, showing in detail the prices of the various classes of work and articles to be supplied, which make up the total tender price. These unit prices are for comparison only, and if the contractor finds he has underestimated quantities he can make no claim for extra remuneration, but must supply the additional quantities necessary to the work. The idea of obtaining unit prices is good, as it allows of much fairer comparison of tenders. A firm whose bulk tender is higher than another firm's may really be figuring on lower unit prices, but the higher firm's plans would then call for more material in the work. It would then remain for the Department of Works to determine whether the greater amount of material would add anything to the stability or efficiency of the plant; also whether the lower firm had made up their low bid by skimping quantities.

The Work Involves Difficulties.

The building of the plant involves engineering and contracting difficulties, and for that reason the specification requires all tenderers to visit the site of the plant, and to familiarize themselves with existing or future obstacles to speedy and safe construction. None of the material excavated from the foundations or otherwise, nor any of the material adjoining the filter plant, or on the Island, or under the waters in the vicinity of the Island, can be used in the construction of the work, without the express consent of the Works Commissioner. It is thought that this is to avoid a repetition of troubles encountered during the construction of the existing slow sand plant.

Tenderers must describe thoroughly the method that they propose to adopt in all the foundations required. The concrete work is well guarded by the specifications, which give instructions regarding materials to be used, the placing, setting and waterproofing of the concrete work. The mixtures to be used are to be satisfactory to the Works Commissioner. The contractor must provide reliable means for handling the water, which may prove troublesome in excavations at the Island, and he must not allow the water to rise above the lowest point to which he excavates. Duplicate machinery, if required, must be provided by the contractor, so that positive drainage is assured.

While it is the intention of the city to have wash-water pumps, air-blowers and other apparatus requiring small power units, operated by electrical motors, contractors are requested to put in an alternative bid for other drives for the three low-lift pumps required. Alternative No. 1 permits these low-lift pumps to be driven by vertical, compound or triple expansion condensing engines. Alternative No. 2 permits these low-lift pumps to be driven by gas engines or in any way desired by the tenderer. In deciding whether to substitute either of these alternatives for the electric drive, the Works Department will take into consideration the cost of transporting coal, etc., to the Island.

The contractor must state in his tender when one-half of the filter plant will be completed, and ready to operate, and when the filter plant as a whole will be completed and ready to operate. Should these dates of guaranteed completion be earlier than December 31st, 1914, and September 30th, 1915, respectively, that fact would undoubtedly be a point in favor of that tenderer. The reason that the Works Department is placing a bonus, as mentioned above, on the early completion of the first half of the plant is that they really need the thirty million gallons of filtered water that one-half of the new plant would give them daily. The existing slow sand plant is not filtering the full requirements of the city.

Must Live up to Guarantees.

The Medical Officer of Health is to test the plant for clarity of effluent and bacteriological efficiency within three months after the plant, or portion thereof, is placed in operation, and in the event of failure to fulfill the guarantees the entire plant may be rejected and all payments to the contractor recovered.

The whole of the work must be carried on and completed without interference with, or interruption of, the operation of the present slow sand plant. The contractor cannot assign, or sublet, any portion of the work without the consent of the Works Commissioner.

The specification includes, of course, all the usual clauses regarding tests, workmen's rights, progress certificates, inspectors' powers, etc., but the following points covered by the specification may be interesting to engineers and contractors interested in water supply problems:—

It is the intention to utilize the present clear water reservoir, which has an area of 2.2 acres with a depth of 12 ft., but it is probable that some bidders may require a clear water basin. If so, cost of same must be included in tender. The work also includes:—

The necessary number of mechanical filter units of four million Imperial gallons each, or approved equivalent. These units to be complete with all appurtenances. Filters will be grouped on both sides of the piping gallery, which will be utilized as an operating platform. Filter tanks to be of steel or reinforced concrete. Filters to discharge into clear water reservoir at Elevation 45, Toronto datum.

The low lift pumping machinery shall comprise three centrifugal pumping units, each of not less than 36,000,000 Imperial gallons capacity per 24 hours. Units to be capable of pumping from an elevation of 30 (Toronto datum) to whatever height is necessary for delivering the water to the filters.

The necessary wash water pumps connected to the tank. Each pump shall be of ample capacity to supply all the wash water required for the entire plant.

The necessary air-blowers, each of which shall be of ample capacity to supply all the air required at the desired pressure for washing.

Interesting Specification Details.

All piping and connections from shore end of existing intakes to pumps, including hydraulically operated valves, together with well and surge overflow, all furnished and erected in place.

The amount specified by tenderer for coal storage shall provide for a building capable of storing not less than 1,500 tons of coal, and shall include coal-handling apparatus from scow to storage building, and from thence to boiler-room.

The low lift pumping station shall be of ample size and proper construction to accommodate all the apparatus requisite for pumping the water, together with the wash water pumps, air-blowers, travelling crane and other machinery, and also to accommodate certain enumerated machinery that will be moved from the old to the new pumping station, as the old station is crowded.

The window frames and sash of all buildings shall be of approved pressed steel, fitted with first quality wired glass.

All plans and specifications submitted by the tenderers shall become the property of the city, and must be specially prepared for this work, and be in sufficient detail so that the quantities of the work and materials can be computed with accuracy.

The contractor shall furnish and install all the necessary filter equipment, including strainer system, filter piping, the necessary hydraulically operated valves, all the operating tables, loss of head gauges, air and wash-water gauges, recording gauges for wash-water tank, measuring apparatus for automatically recording the amount of wash water used, filter sand, filter gravel, rate controllers, wash-water pump and gutters, air-blower with requisite motive power, sampling devices, water meters.

Tenderers may also tender on a combined air and water wash, consisting in the application of both compressed air and filtered water through the strainer system.

Tenderers may bid on a separate air and water wash, comprising the application of compressed air through a separate air-distributing system of perforated brass tubes and of the filtered water through the strainer system.

The general design of the strainer system shall be such, that in combination with other parts of the filters and filter piping a uniform distribution of wash water and of air, if used, shall be ensured over the entire bottom of the filters; it shall be designed so as to completely drain the bottom of the filters; the system shall be substantial, and provision made that the parts may be readily renewed. Further, the individual openings in the system shall be large enough so as not to be easily clogged, and yet small enough and so formed as to secure uniform distribution of the wash water.

Operating Equipment Complete.

The contractor shall furnish and install on each operating table a loss-of-head gauge of approved type, complete with all the necessary floats, float tube, counterweight, wire, pulleys and other appurtenances. The gauge shall be arranged to accurately record the loss of head through the corresponding filter by means of an approved pen upon a chart mounted on a disk or drum revolving once in twenty-four hours, graduated in an approved manner, so as to report distinctly losses ranging from zero to the maximum, while the travel of the pen is about 6 inches. The float tubes shall be 8-inch galvanized wrought iron pipe of ample length, capped at the lower end, and securely fastened in a truly vertical position. Floats shall be seamless and spherical, about 6-inch diameter, and made of copper. The connections from the filters and effluent pipe shall be of not less than ¾-inch brass pipe, with brass nipple, through the wall of the filter.

Provision must be made to prevent the entrance of wash water or sand into the float tubes. The mechanism of the gauge shall be of brass enclosed in a strong, neatly finished, heavily nickel-plated brass case, same to be accessible for adjustment and repair. Connection shall be made to the tubes to permit of adjustment and drainage, and valves shall be placed on the connections between the tubes and the filter wall or effluent line respectively.

Special care shall be taken in transporting and placing filter sand to prevent contamination of any sort, and sand which may have become dirty, either before or after placing in the filters, shall be washed or removed or replaced by clean sand in a satisfactory manner. All contaminated sand shall be rejected. After sand is in place in the filters it shall be washed at least ten times with the washing devices connected with the filter, and the fine sand appearing at the surface shall be removed by scraping or otherwise. Sufficient sand shall be placed in each filter bed to secure a layer of the proper depth required for giving the most efficient results after the sand has been washed and scraped. The contractor must state the depth of filtering medium in inches required in the filters, and he must also state the effective filtering surface, and the rate of filtration in Imperial gallons per sq. ft. per hour.

The contractor shall furnish and erect in suitable location, approved by the Commissioner, one chimney not less than 120 feet in height above the grate bar level, with an inside diameter not less than 84 in. This chimney may be built of buff brick or other approved material, and provided with stranded copper lighting conductor, with all necessary ground and other connections, and of design approved by the Works Commissioner.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

CONTENTS.

Book Reviews:

Graphics and Structural Design 785
Overhead Electric Power Transmission 785
Switchgear and the Control of Electric Light and Power Circuits 786
General Metallurgy 786

Publications Received 786

Catalogues Received 787

BOOK REVIEWS.

GRAPHICS AND STRUCTURAL DESIGN.—By H. D. Hess, M.E., Professor of Machine Design, Sibley College, Cornell University. New York: Publishers, John Wiley & Sons, Inc., London; Canadian selling agents, Renouf Publishing Company, Montreal; pp. viii. + 426; 361 text figures; cloth; 6 x 9 inches. Price, $3.00 net.

Reviewed by C. R. Young, M. Can. Soc. C E.,
Assistant Professor of Structural Engineering, University of Toronto.

In spite of the frequent condemnation of general treatises on structural engineering, there exists a considerable demand for such works. Many engineers, whose activities lie mainly outside the structural field, as well as those just entering it, feel the need of a simple, elementary, immediately-usable book on the design of a variety of ordinary, everyday structures. Numerous attempts to meet this demand have been made, and it must be admitted that they have not always been attended with success. Inadequate and erroneous treatment of the subjects discussed, with the complete neglect of others equally important, has so frequently characterized such efforts that the chances of the reader deriving any real assistance from a book of this kind purchased at random are small, indeed.

The present volume is an unusually successful venture in this difficult field. The author's special object is the discussion of useful problems "on the border line between Civil and Mechanical Engineering," and, while the book is intended for student use, it cannot fail to be of very real value to any one whose work is not too highly specialized.

Of necessity, many subjects must be treated in the borderland which Professor Hess indicates as the field of his book. The subject is introduced by the presentation in the first chapter of general data on materials, common formulas and properties of sections. Chapters 2 to 5 are devoted to graphical and analytical methods of analysis of structures, including the method of influences diagrams. Chapter 6 concerns riveted connections. Columns are given an effective short treatment in Chapter 7. A variety of steel structures are then given consideration, covering conveyer girders, trussed and suspended pipes, transmission line towers, mill buildings, a railway girder span, crane frames and bridges of travelling cranes. Unfortunately, no attempt is made at stress analysis in the case of transmission line towers, although a few pages on this subject would have supplied a very real present need in engineering literature. The author's reason for designing a railway plate girder was that it made a more comprehensive and better problem than a runway girder, and one who could design the former was well prepared for the simpler structure. A particularly useful portion of the book is the 28 pages devoted to the detailed design of the structural parts of jib and travelling cranes. In reinforced concrete, slabs, beams and columns are covered in a concise manner. Foundations, including those for machines, form the subject of Chapter 15. A very valuable chapter is that on chimneys, comprising the design of these structures in brick, steel and reinforced concrete. Chapter 17 contains a discussion of retaining walls, with a detailed design of a typical wall, while Chapter 18 is given to the consideration of the allied subject of bins. Floors, walls and roofs occupy Chapters 20 and 21. One of the most valuable features of the book is the inclusion of authoritative specifications covering materials, design and workmanship in both steel and reinforced concrete structures, and such clauses as are necessary to cover the timber and masonry work entering into ordinary structures. The volume is concluded with 195 useful problems.

One does not find it difficult to commend the book. Indeed, every mechanical engineer who has to do with structural problems at all, and every civil engineer who must at times concern himself with the structural features of the mechanical engineer's work should possess a copy.

Overhead Electric Power Transmission.—By Alfred Still. Published by McGraw-Hill Book Company, New York. 306 pages; illustrated; cloth; 6 x 9 inches. Price, $3.00 net.

Reviewed by Prof. H. W. Price,
Department of Electrical Engineering, University of Toronto.

Books have been published which deal copiously with problems of engineers in charge of construction of lines for high and low voltage and of moderate and large capacity. Other books treat the complicated problems of high-voltage, long-distance transmission. This book by Mr. Alfred Still is aimed directly at a composite field, of special value and convenience to engineers having under consideration the design of a transmission system for estimated service.

Three outstanding features of this book are these: (1) It is evidently written by a man who has been "through the mill," and has known the inconvenience of searching here and there for specific information on methods of arriving at the best choice of details of a transmission system for given service under specified operating and financial limitations. The book resembles the notes of such a man, who took time to systematically arrange and elaborate the problems he considered, and examples of his methods of solution.

(2) The information contained is thoroughly cross-indexed for convenience of the reader. An unusual supplementary index of formulas, data, charts, sample calculations,

etc., is provided for convenience of those actually engaged on transmission line calculations.

(3) This book does not assume to be the only competent source of information on the subject treated. As any proper engineering book should, it contains numerous footnotes and references advising the reader of authorities and further information on points in question.

Transmission lines are considered from many points of view: Economic choice of system, of spans, conductors, flexible and solid towers, insulators, protective devices, etc., etc. Considerable space is given to a method of applying Kelvin's Law to collected data to determine the features of system to yield maximum economy. A brief is given of the latest information on high-voltage, high-frequency disturbances and their effect on line and connected apparatus. High-voltage, direct-current transmission receives some attention. A sample set of specifications for a transmission line is included, which the author hopes will be of service, in that it may suggest points to be covered which might otherwise be overlooked.

Switchgear and the Control of Electric Light and Power Circuits.—By A. G. Collis, A.M.I.E.E. Constable & Company, Limited, London, W.C. 82 pages; 46 illustrations; cloth; 4 x 7 inches. Price, 30 cents net.

Reviewed by A. S. L. Barnes,
Hydro-Electric Power Commission, Toronto.

This is a book of 82 pages, forming one of a series, called "Electrical Installation Manuals," which is being put forward by the publishers.

The best feature of the book is its insistence on simplicity in the design and arrangement of switchgear.

Many diagrams of connections for all kinds of service are given. Some of these are good, but several of them are very difficult to read, and in one or two cases it is hardly possible to do so at all, this being partly due to the author's having attempted to include rather too much detail, partly because, to indicate various types of apparatus, he has employed symbols that are not very generally used. Again, in some cases the diagrams are surrounded by marginal lines which are badly confused with the lines of the diagrams. In one figure a dynamo appears to be short-circuited, and in another a shunted ammeter is mysteriously connected across the main bus bars—unless, perchance, these two extra lines are intended to supply current to a lamp at the back of the instrument, which appears to be of the illuminated dial pattern!

The book is not one which, in its present form, is likely to make much of a mark for itself, although its usefulness might be much improved by a careful revision of the diagrams in order to make them more intelligible.

General Metallurgy.—By H. O. Hofman, E.M., Metallurgical Engineer, Ph.D. Professor of Metallurgy, Massachusetts Institute of Technology. Published by McGraw-Hill Book Company, New York City. 909 pages; 836 illustrations; 252 tables; numerous inserts of plates; cloth; size, 6 x 9 inches. Price, $6.00 net.

Reviewed by T. R. Loudon, B.A.Sc.

As stated in the Preface, it is the object of this book "to cover the field of General Metallurgy." There are, of course, certain principles common to the various fields of metallurgical endeavor, and it is to the expounding of these principles that this book is given over. The book is very well written and the illustrations are good. As to the value of such a work portions are appropriate as a reference for the advanced metallurgist and other sections will be of value to the beginner. In most books covering a wide field of scientific work, there must necessarily be many sections of reading matter that are not truly explanatory, but are mere statements of fact. For this reason the value of such books is often doubtful, as the beginner requires above all things, clear explanations; and, on the other hand, the advanced reader already knows the facts. It must be said, though, that the amount of explanatory matter given in this book is in a very good proportion to the amount of mere statement of fact. One very noticeable feature about the book that is good is the enormous number of references given. The author has certainly spent a great deal of time on the work of gathering together a list of references that in themselves constitute a very valuable addition to metallurgical literature.

There are thirteen chapters to the book, the titles to which are as follows: Introduction; Properties of Metals; Alloys; Metallic Compounds; Ores; Fuel; Refractory Materials; Pyrometallurgical Processes and Apparatus; Hydrometallurgical Processes and Apparatus; Electrometallurgical Processes and Apparatus; Mechanical Metallurgical Operations, a chapter which is subdivided into sections dealing with Ores, Metal Alloys, Liquids, Gases, Preheating and Drying of Air, Purification of Gases; Metallurgical Products; and Economic Considerations.

The chapter on Mechanical Metallurgical Operations is very well put together, and, on account of its large amount of illustrated explanatory matter, is a valuable general reference. On the other hand, such a chapter as that on Electrometallurgical Processes and Apparatus, while it does contain certain laws that apply in Electrometallurgy, is so fragmentary that it is difficult to see just where its value lies. The chapter on Refractory Materials is very good.

As stated before, the book is a valuable addition to Metallurgical literature if for no other reason than the references given in connection with the written matter.

PUBLICATIONS RECEIVED.

The Approximate Melting Points of Some Commercial Copper Alloys.—10-page leaflet, issued under authority of the United States Bureau of Mines, by H. W. Gillett and A. B. Norton.

Mine-Accident Prevention at Lake Superior Iron Mines.—A 38-page bulletin, compiled by Dwight E. Woodbridge and issued by the United States Bureau of Mines, dealing with mine-safety problems.

Coal Mining Disputes on Vancouver Island.—40-page report of the Royal Commissioner on coal mining disputes on Vancouver Island. Issued with the authority of the Minister of Labor, by Samuel Price.

Problems in Physics.—23-page leaflet, based upon the Text-Book of Physics, by A. Wilmer Duff (editor), etc. Issued by Morton Masins, Ph.D., of the Department of Physics, Worcester Polytechnic Institute, Worcester, Mass.

Uses of Commercial Woods of the United States.—56-page bulletin, No. 12, published by the United States Department of Agriculture. Written by Hu Maxwell, expert, and dealing principally with beech, birches, and maples, as commercial woods of the United States.

Vitrified Brick as a Paving Material for Country Roads.—34-page illustrated bulletin, No. 23, authorized by the United States Department of Agriculture, and edited by Vernon M. Peirce, Chief Engineer, and Charles H. Moorefield, Senior Highway Engineer, office of Public Roads.

First Aid Instructions for Miners.—A 66-page bulletin, compiled by M. W. Glasgow, W. A. Raudenbush and C. O. Roberts. It is well illustrated, and serves as a guide to

miners in rendering aid to injured fellow-workmen. Issued by the Bureau of Mines, Department of the Interior, Canada.

Tide Tables for the Pacific Coast.—By W. Bell Dawson, Superintendent, Tidal and Current Survey, Department of Naval Service, Canada. The Bulletin gives complete tide tables for the year 1914, and includes Fuca Strait, the Strait of Georgia and the Northern Coast. It also contains data for Slack Water in the navigable passes and narrows, with information on currents.

Tide Tables for the Eastern Coasts of Canada.—By W. Bell Dawson, Superintendent of the Tide and Current Survey in the Department of the Naval Service of the Dominion of Canada. The bulletin gives complete tide tables for the year 1914, and includes the River and Gulf of St. Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits. It also contains information on currents.

Forest Products of Canada, 1912.—Bulletin No. 40, Forestry Branch, Department of the Interior, Canada, compiled by R. G. Lewis, B.Sc.F. The bulletin contains an account of the quantity of wood manufactured into lumber in the Dominion and the various provinces for the year 1912. Tables are also given showing the quantities and value of the different kinds of wood manufactured into lumber during the year specified.

Arguments for and Against Train Crew Legislation.—A 38-page bulletin, published by the Bureau of Railway Economics, Washington, D.C., dealing with the much-talked-of subject of the regulation of train crews, giving the history and present status of train operation, the provisions of the measures enacted and proposed for "full crew" legislation, and a discussion of the effect that such legislation would have upon the efficiency and safety of transportation.

Working of Steam Boilers.—147-page book, fifth edition, well illustrated, and indexed. Published for those in charge of, and responsible for, the working of steam boilers insured with "The National Boiler and Insurance Company," giving directions essential to safety, and also precautions necessary for satisfactory working and for the prevention of undue deterioration of the steam-raising plant. Issued by Edward G. Hiller, B.Sc., M.I.C.E., M.I. Mech. E., Chief Engineer, the National Boiler and General Insurance Company, Limited, Manchester, Eng.

Mines Statement, New Zealand, 1913.—7½ x 13 inches, well supplied with maps and illustrations, being the mines statement for the year ended the 31st December, 1912, and including statistics, reports relating to metalliferous mines and stone-quarries, state aid to mining, roads on goldfields, prospecting-drills, water-races, school of mines, inspection of mines, examinations for certificates, geological survey, state coal mines, diagrams, maps, and plans. The publication has been compiled by the Hon. W. Fraser, Minister of Mines for New Zealand, and covers approximately 160 closely-set pages.

Forest Protection in Canada, 1912.—164-page book, 7½ x 10 inches, well illustrated, and with map inserted. The publication is subdivided under six main topics, e.g., protection from railway fires; forest fires and the brush disposal problem; the top-lopping law in the Adirondacks; the use of oil as locomotive fuel from a fire-protective point of view; forest planting in Canada; report of committee on forests, Commission on Conservation, 1912. There are, moreover, three appendices—the first, concerning Dominion forest reserve extension in Manitoba, Saskatchewan, Alberta, and British Columbia, and a table of forest reserve areas; the second, memorandum regarding the country between Sudbury and Port Arthur, by J. H. White; the third, opinions on fuel oil.

The report is edited by Clyde Leavitt, Chief Forester of the Commission of Conservation, and Chief Fire Inspector of the Board of Railway Commissioners, and is issued by authority of the Dominion Government Commission of Conservation.

CATALOGUES RECEIVED.

National Metal Moulding.—A 28-page catalogue of mouldings, couplings, outlets, receptacles, bushings, flush-plates, etc., for sale by the Canadian General Electric Company of Toronto.

A Thousand Uses for Gas.—An 8-page well-illustrated catalogue dealing with gas and the various uses to which it may be put. Issued by the United Gas Improvement Company, Philadelphia, Pa.

Standard Class "NF-2" Compressor.—A leaflet descriptive of the important features governing air-compressor selection, and of the vital points of automatic operation. Published by the Canadian Ingersoll-Rand Company, Montreal.

Transformer Drying, and the drying, filtering and testing of transformer oil.—A 16-page bulletin, No. A4134, descriptive of the General Electric transformer dryer and filter. The Canadian General Electric Company, selling agents.

The Morrison Water-Tube Boiler.—A 10-page catalogue dealing with the water-tube boiler as a preventative of costly accidents and delays, the reduction of maintenance and repair expenses, etc. Issued by the Morrison Boiler Company, Sharon, Pa.

Electricity in Iron Foundries.—A Bulletin issued in October by the General Electric Company, descriptive of the electrical operation of cranes, air-compressors, elevating and conveying machinery, etc. The Canadian General Electric Company are the selling agents.

Chicago Pneumatic Corliss Compressors.—Bulletin No. 24D, issued by the Chicago Pneumatic Tool Company, descriptive of their horizontal, cross-compound Corliss compressor. It is well illustrated and furnished with tables of dimensions, and occupies 32 pages.

Improved Forced-Draught Furnace.—A 12-page, illustrated catalog descriptive of the "Meldrum" furnace; another describing their "Koker" and "Sprinkler" mechanical stokers, and a third dealing with refuse destructors. Issued by Meldrums, Limited, Manchester, Eng.

Rotating Hammer Drills.—A 12-page catalogue descriptive of the McKiernon-Terry rotating hammer drills for sinking, stoping and drifting; illustrated and including specifications, weights, etc. The Canadian Allis-Chalmers, Limited, Toronto, are the Canadian selling agents.

Cars, Tracks, Turntables, Switches, etc.—Catalogue No. 900 of the Orenstein-Arthur Koppel Company, Koppel, Pa., descriptive of their many products, comprising rails, portable track, switches, cars, turntables, steam and electric locomotives; well illustrated and tabled, comprising 84 pages. The Canadian Fairbanks-Morse Company are the Canadian sales agents.

Book Catalog.—A new illustrated catalog of scientific, industrial and technical books has been issued and will be mailed post-free by Crosby, Lockwood & Son, 7 Stationers Hall Court, London, England. Among the new books listed are an English and German Pocket Glossary of Technical Terms, and "Screw-Cutting for Engineers," a very practical book for mechanics.

Floating Docks.—A well-illustrated 50-page book descriptive of floating docks, published by Swan, Hunter & Wigham Richardson, Limited, Wallsend-on-Tyne, ship engine and floating dock builders and repairers. The booklet contains 50 illustrations of various docks and an article dealing with the subject in an interesting, descriptive constructional manner. It also contains a lengthy list of docks built by this company.

Willans Rotary Air-Pump System.—This is pamphlet No. 50, issued by Willans & Robinson, Limited, Victoria Works, Rugby, Eng., descriptive and illustrating the Muller-Josse patent rotary air-pump system, showing the two most common applications, viz., the shunt and series system. In either case the air is extracted from the condenser by means of an air-ejector, and the condensed steam extracted by means of a separate centrifugal pump drawing the water from the bottom of the condenser.

Robb's Scotch Boilers.—A Bulletin issued by the International Engineering Works, Limited, descriptive of the Robb Scotch marine boiler, showing changes from the standard design in the interests of better circulation, etc. The boiler is fully described in the bulletin, and details of a special economy test, in which the 200 h.p. boiler, operated a widely fluctuating load, showing an average of 73 per cent. efficiency when working under variable conditions up to 50 per cent. overload. The International Engineering Works, Limited, have sales offices, in Toronto, Montreal Edmonton, Winnipeg and Calgary.

Deutsche Maschinenfabrik, A. G., of Duisburg, Germany, have issued one of the most completely illustrated catalogs that has reached *The Canadian Engineer* office for some time. Its title, "Who We Are and What We Do," indicates the contents. Photographs are shown of the founders and present managers, together with a great many views of the works and offices. In addition, there are over seventy large pages replete with excellent illustrations of installations of the many different kinds of machinery manufactured by this firm. Among their lines are mining machinery, blast furnace plants, steel works and rolling mills, cranes and transporting appliances, ship berths, harbor and wharf-cranes, and structural steel work. The catalog is in English, and is very attractively arranged. It is being distributed by Gerald Lomer, Limited, Fraser Building, Montreal, who are the Canadian agents.

COAST TO COAST.

Dawson, Y.T.—Dawson has still in consideration plans to secure a water service.

Toronto, Ont.—The net profits of the Toronto Hydro-Electric Commission are approximately $150,000 for the past year. Last year's statement showed a profit of $13,000.

Toronto, Ont.—Freight service has been promised by January 1st over the C.P.R.'s short line between Toronto and Montreal—e.g., the Campbellford, Lake Ontario and Western Railway.

Toronto, Ont.—Chairman P. W. Ellis of the civic Hydro-Electric Power Commission, has reported for the first nine months of 1913, an increase over the corresponding period of 1912, in sales, 100 per cent.; and in purchase, only 40 per cent.

South Vancouver, B.C.—The proposal that the municipality should construct and control an electric plant is coming more and more into favor among the citizens, though there is still much divergence of opinion upon the question as to whether such a plant can be run economically or not.

Ottawa Ont.—It is understood that President Wilson of the United States has communicated with the Canadian Government suggesting a conference of representatives from the two governments to consider the question of mutual action and possible means of improving boundary waters either for navigation or for power business.

Vancouver, B.C.—A suburban train service will be inaugurated on the line of the Pacific Great Eastern from North Vancouver to Dundarave by December 31 of this year, according to Mr. D'Arcy Tate, vice-president of the road. Already grading is practically finished between North Vancouver and Dundarave, and steel is now being laid.

Calgary, Alta.—The greatest reform in the railway dispatch system of the world has been practically completed. All the C.P.R. trains in Alberta will now be dispatched by telephone instead of telegraph, with the exception of that district from Crow's Nest to Kootenay Landing. Men from Montreal are putting in the apparatus at each of the stations.

Ottawa, Ont.—The public works department at Ottawa has prepared estimates totalling $50,000,000, an amount exceeding that of last year by about $2,000,000. This outlay is not necessitated by a large program of new works, but rather those already in progress, by extensive constructions proceeding principally in harbor improvements, dredging, and the construction of drydocks.

Victoria, B.C.—The results of the analysis of water in Elk Lake, made by City Analyst Birch, in view of the possibility of its use as a future water supply, are not encouraging. Mr. Birch states that, roughly speaking, there is four times as much organic matter in Elk Lake as in samples taken from the Goldstream supply. Further experiments are to be made by the analyst.

Vancouver, B.C.—Motors for the automatic gates which have been placed by the C.P.R. to protect its level crossings at the North Vancouver Ferry slip and other docks near the foot of Columbia Avenue, are being installed and the barriers will be ready for service in a few days. The gates will slide up and down on the lift principle. They can be governed individually or collectively.

Vancouver, B.C.—The temporary dam across False Creek near the Main Street bridge built in connection with the reclamation operations, has been completed. The barrier is built of rip-rap filled with loose rock and is intended to keep the material deposited by dredging for the channel west of the bridge from drifting back with the tide. It will be replaced later with a permanent retaining wall.

Vancouver, B.C.—Word has been received in Vancouver of a rock slide which occurred at Sea Bend Bluff, near Ruby Creek, completely covering the double tracks of the C.P.R. with rock debris. Rocks, some of which weigh as much as 100 tons, have buried the track 60 feet deep for a distance of 300 feet. Dynamite is being used to remove the blockade, and a temporary track has been built around the slide.

St. Catharines, Ont.—Track laying on the extensions of the Niagara, St. Catharines and Toronto railway from this city to Niagara-on-the-Lake has been completed, and a temporary passenger service will be opened in two weeks. A spur freight line to Port Weller, the lower entrance to the new Welland Ship Canal, is now open, and material and machinery are being hauled for work on the land excavation on No. 1 section.

Winnipeg, Man.—City officials have inspected the new reservoir on Logan Avenue and McPhillips Street, and report the construction in satisfactory condition, and ready for the pumping in of water. The total cost of the new reservoir, which will hold about 18,000,000 gallons of water, will be about $300,000, and with the other city reservoirs it will provide a storage of about 24,000,000 gallons of water, or enough to supply the whole city with water for three days in case of need.

Thorold, Ont.—The Confederation Construction Company, contractors for the Government, in the undertaking of

the diversion of the G.T.R. main line, so that it may erect a bridge at a suitable point, are making rapid progress with the work involved. Steam shovels, locomotives and dump cars are busy at the deep cut being made on the eastern side of the town, where houses have had to be removed or demolished. And on the cut south of the town, good progress is also reported.

Rossport, Ont.—The engineers in charge of the now famous sink-hole at Rossport which has been tying up transcontinental traffic from time to time since September, claim that it will be impossible for the ballast to sink further. Many thousand tons of ballast have been necessary to fill up the sink-hole sufficiently to allow of the passage of trains. In the opinion of many, a steel trestle arch will ultimately have to be erected at Rossport to eliminate permanently the possibility of further difficulty or disaster.

Guelph, Ont.—The annual report of the Guelph Street Railway is one of the best in its history, recording increase of traffic throughout the system, and especially since the opening to service of St. Patrick's Ward extension. The total receipts were $40,816.09; total expenditures, $33,771.33; and resulting profits $16,045.66. After an estimate for appreciation was deducted from this amount, the net profit was fixed at $6,391.55. The report recommends that ratepayers be asked for $17,000 to improve the service.

Nelson, B.C.—Constructed entirely by Doukhobor labor, under supervision of a Vancouver firm of consulting engineers, the new steel and concrete suspension bridge over Kootenay River at Brilliant, near Nelson, has been completed at a cost of $45,000. The Government contributed $20,000 of this amount, as the bridge, which saves the Doukhobor community, is on the highway route between Nelson and Trail. The main span is 331 feet in length. Four concrete pillars 48 feet in height support the span and cables.

Toronto, Ont.—The dispute between the Etobicoke Township Council and the Toronto Suburban Railway Company in reference to the protection of crossings, has been practically settled by the Railway Board; and, as a result, work has recommenced on the Toronto to Guelph radial extension, and has advanced to the district west of Islington. The original plans have been greatly improved through the efforts of the railway commissioners, though the council was not entirely successful in its appeal for subways at certain points.

Moose Jaw, Sask.—It is reported that the high pressure mains being laid in Moose Jaw, have been completed, with the exception of a connection at one street intersection; but the system can be operated without this. The levelling of the tops of the trenches is now proceeding, and a final test of the system will be made very soon, when the pressure in the pipes will be raised to the 300-lb. mark. The fire brigade is to be supplied with hose for high pressure purposes when new motor apparatus has been ordered; so that the new system may be available in case of fires.

Niagara Falls, Ont.—The simultaneous peak load of the Hydro-Electric system recently exceeded the 50,000 h.p. mark of consumption, purchased by the commission from the Ontario Power Development Company at Niagara Falls. The breakers automatically cut the circuit and an interruption of five minutes affected the entire hydro-electric zone. As a consequence of the expansion of business, the peaks of the various municipalities overlapped at their maximum. Another interruption has been forestalled, however, by a higher adjustment of the breakers.

London, Ont.—It has been stated by the Hon. Adam Beck that before the end of 1913, hydro-electric distribution lines will be serving the farmers from end to end of the county. The line from London to Dorchester, and thence to Thamesford, is well nigh completed; and three lines—one, from London to Lucan, and thence to Ailsa Craig; another, from London to Port Stanley, using the London and Port Stanley Railway as a distribution main line; and the third, from London to Lambeth, Delaware, Mount Brydes, Strathroy, and Glencoe—are projected.

Estevan, Sask.—Engineer Miller, who is in charge of the C.N.R. grade construction out of Estevan, will have the road bed ready for the laying of track by December 1st. Culverts and grading from Bienfait to Estevan have been completed, and steel has arrived at Bienfait, further consignments being on the way. It is not expected that the work of laying track will exceed two weeks. In connection with the question of the construction of a transfer line by the C.N.R. at Estevan to link its two roads, which is being opposed by the C.P.R., Mr. Spencer, traffic expert of the board of railway commissioners, who was authorized by the board to examine local conditions, has visited Estevan, and has made a thorough investigation. It is quite expected that his report to the commission will result in the immediate order for the construction of the transfer track.

PERSONAL.

H. C. ANDREWS, of Chambers, Limited, Toronto, sailed for England last week on a six weeks' trip.

J. W. PORTER, who succeeded J. B. Armstrong as chief engineer of the Hudson Bay Railway, has assumed his new duties in Winnipeg.

R. O. WYNNE-ROBERTS, consulting engineer, Regina, Sask., has been on a trip through eastern Canada, visiting Ottawa, Montreal, Toronto and London.

A. H. HARKNESS, B.A.Sc., consulting engineer, Toronto, addressed a large meeting of the members of the University of Toronto Engineering Society on Wednesday, Nov. 26th, on the Construction of Modern Skeleton Frame Buildings. The lecture was well illustrated by lantern slides.

F. A. CREIGHTON, M. Can. Soc, C.E., who has been with the city of Prince Albert as manager of the Hydro-Electric Development at La Colle Falls, has opened an office in Winnipeg, where he will engage in the practice of civil engineering as consulting and supervising engineer. Mr. Creighton has had some twenty-two years' experience in engineering work, and has been with the city of Prince Albert since he was appointed city engineer in 1907.

OBITUARY.

The death is announced in Winnipeg of Mr. Geo. McPhillips, a well-known pioneer surveyor and engineer. Mr. McPhillips was a native of Richmond Hill, Ont., and was for many years chief surveyor for the Canadian Pacific Railway, western division. Death, on November 20th, terminated a long illness.

The death occurred at Montreal recently of Mr. A. C. Brady, assistant superintendent of C.P.R. terminals. Mr. Brady, who had been associated with the C.P.R. for 24 years, was a son of Mr. Frank Brady, general manager of the Intercolonial Railway.

On November 17th, Mr. Russell D. Willson, assistant city engineer of Winnipeg, met instant death from contact with an electric current of 13,200 volts. While on a tour of inspection of the well houses of the city waterworks system, Mr. Willson, in company with one of the engineers

of the city waterworks department, was making a careful examination of the machinery in one of the units about ten miles north of the city. While testing a lightning arrestor switch, Mr. Willson came simultaneously in contact with an iron railing, thereby causing instant death.

Mr. Willson is a graduate in engineering of the University of Toronto. His first engineering work, carried on during his university course, was in connection with the original surveys of the Toronto-to-Sudbury line of the Canadian Pacific Railway, with Mr. Hugh D. Lumsden in charge. In 1899, he joined the engineering staff of the C.P.R. in Toronto, and became associated later with the Sturgeon Falls Pulp and Paper Company. In December, 1900, he returned to Toronto, resuming his academic course in civil engineering and graduating in the following spring. In May, 1901, he accepted an offer to go to Winnipeg with the Canadian Northern Railway, and spent four years on its engineering staff, leaving to enter the employ of the city, where he was given charge of outside work for the city waterworks department. In February, 1908, Mr. Willson became assistant city engineer, which position he held up to the time of his death, with practically complete charge of the construction and operation of the waterworks department.

Russell D. Willson.

The late Mr. Willson was 34 years of age, and was born at Sharon, Ont. He was a member of the Canadian Society of Civil Engineers and was regarded by the profession generally and all others in touch with his work as one of the foremost civil engineers especially in municipal work in Western Canada.

The death is announced at Montreal of Mr. P. A. Peterson, for many years and until 10 years ago, chief engineer for the Canadian Pacific Railway, and retained by the same road as consulting engineer, after his retirement from active duties.

Mr. Peterson was born at Niagara Falls, 74 years ago. He is a graduate of the University of Toronto. He was associated with the construction of both the Intercolonial Railway, and the Canadian Pacific Railway. He was a member of the American Society of Civil Engineers and of the Institution of Civil Engineers of Great Britain; and was president of the Canadian Society of Civil Engineers in 1894.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Annual Meeting, December 2-5, 1913.

Attention is called to the diversified program of the annual meeting of the American Society of Mechanical Engineers, to be held in the Engineering Societies Building, 29 West Thirty-Ninth Street, New York.

Papers will be presented on the following subjects:—

Boilers and their operation. Cement. Enameling. Fire protection, with special reference to turbo-generators, oils, and the novel use of sprinkler systems. Gas measurement. Gas power engineering. Lineshaft bearings. Machine tools. Management. Properties of steam. Rope drive. Steel railway cars. Textiles, covering mill engineering. Vacuum cleaning.

The professional sessions will be held in the mornings, while the afternoons will be devoted to simultaneous sessions in which special subjects, according to the above list, will be taken up. Excursions will be held at various times during the meeting. Dr. W. F. M. Goss, the president of the society, will deliver his presidential address on Tuesday evening, December 2nd.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

A meeting of the Electrical Section of the Canadian Society of Civil Engineers was held in Montreal on November 20th. Mr. H. B. Dwight, A.M.Can. Soc., C.E., read a paper entitled "The Use of Synchronous Condensers with Transmission Lines." The Mechanical Section of the society will meet on December 4th.

The Vancouver Branch held a meeting on November 25th, at which Mr. R. F. Hayward, M.Am. Soc., C.E., described the Hydro-Electric development at Stave Falls.

The annual convention and dinner of the B.C. members of the society will be held in Vancouver on December 12-13th.

COMING MEETINGS.

AMERICAN INSTITUTE OF ARCHITECTS.—Forty-seventh Annual Convention, to be held in New Orleans, La., December 2nd, 3rd and 4th. Secretary, Glenn Brown.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.—Annual Meeting will be held in New York, December 2nd to 5th. Secretary, W. H. Reed, 154 Nassau Street, New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The Annual Meeting will be held in New York, December 2nd to 5th, 1913.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—Annual Meeting to be held in New York, December 10th to 13th. Secretary, C. D. Odsen, Polytechnic Institute, Brooklyn, N.Y.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—Seventh Annual Convention will be held at Great Northern Hotel, Chicago, December 29th to 31st. Secretary, I. W. Dickerson, Urbana, Ill.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

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Special Note We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding. If any abbreviated form is desired however the following is suggested: ROOFING—Shall be a Barrett Specification Roof laid as directed in printed specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirement.

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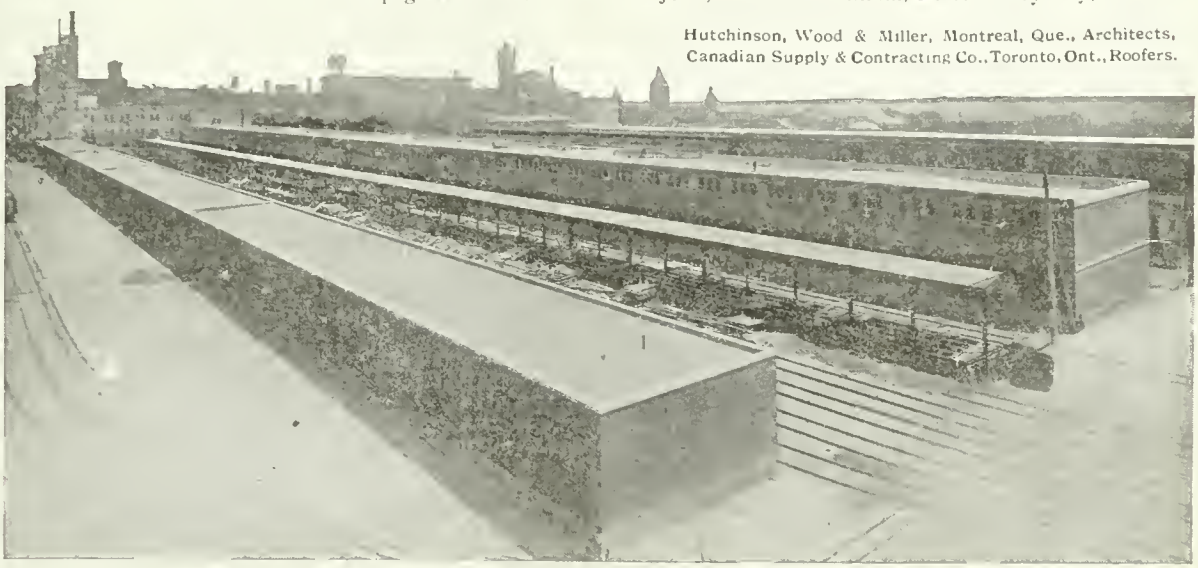

Canadian Pacific Railway Co.'s Freight Sheds, Toronto, Ont.

ORDERS OF THE RAILWAY COMMISSIONERS
OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20814—November 13—Approving plan and specifications of drain known as "Ellice Maitland Relief Drain," to be constructed under C.P.R. on Lots 29 and 30, Con. 18, Tp. Elma, Ont.

20815—November 12—Authorizing C.N.R. to operate trains over Thirteenth Street, Brandon, Man., without first being brought to a stop; cars of Brandon Mun. St. Ry. Co. be brought to a stop before proceeding over crossing and conductors of such cars operate levers of the interlocker.

20816—November 12—Directing that C.P.R. and G.N.W. Tel. Cos. remove their wires from poles on Queen St. North, between King and Weber Sts., Berlin, Ont. Applicant (City of Berlin) make provision by which said Cos. have right to string wires on Frederick and King Sts. to enable them to reach their offices, on King St.; poles be removed from Queen St. N.

20817—November 11—Directing C.L.O. and W. Ry. (C.P.R.) to construct an undercrossing on farm of A. R. Farewell, Town of Oshawa, Ont., at a point on old farm road where fill is 15 ft., near east end of lot, and about 300 ft. east of level crossing. Work be completed within three months from date of this order.

20818—November 14—Authorizing C.P.R. to construct, subject to conditions contained in By-law No. 1747, excepting clause 8 of such By-law, spur for Peter Hamilton Co., Limited, across Sherbrooke St. and along Water St., Peterboro, Ont.

20919—November 14—Authorizing G.T. Ry. to construct siding to premises of Grand Gypsum, Limited, Tp. North Cayuga, at Nelles Corners.

20820—November 14—Authorizing G.T.R. to construct, subject to conditions of consent, siding into premises of Dominion Tar and Ammonia Co., Limited, part Lot 16, Con. 2, Tp. Barton, now City of Hamilton, Ont.

20821—November 13—Authorizing C.N.R. to construct across Winnipeg Electric St. Ry. Co. on Jubilee Ave., Winnipeg, Man., subject to and upon certain conditions.

20822—November 15—Authorizing C.P.R. to operate Bridge No. 45.6 on Orford Sub. Div., Eastern Division, Province of Quebec.

20823—November 17—Authorizing G.T.P. Ry., subject o conditions contained in Order-in-Council, to construct bridge across Nechaco River, at mileage 371.4, Prince Rupert Easterly, B.C.

20824—November 15—Authorizing G.T.R. to operate three (3) bridges, No. 217, mileage 13.07 over Jacques River, Que.; 2, No. 232, mileage 36.85, over English River, Que., and 3, No. 236, mileage 43.82, over Chateauguay River, Que.

20825—November 17—Approving location Montreal and Southern Cos. Ry. from Central Vermont Ry. Station, at St. Cesaire, through Parish of St. Cesaire, Co. Rouville, Que., to boundary line between Parish of St. Cesaire and St. Paul de Abbotsford.

20826—November 14—Amending Order No. 20514, dated Oct. 6th, 1913, by substituting words "known as Con. 9, between Counties of Haldimand and Norfolk, on which Townsend Station is located," for words, "at Townsend Station between Cons. 8 and 9, in Co. of Haldimand," in recital of said Order.

20827—November 14—Authorizing C.P.R. to construct bridge No. 92.7 on Toronto Subdivision, Ont. Div. Don Viaduct, near Donlands, Co. York, Ont., subject to certain conditions.

20828 November 14—Authorizing C.P.R. to take, for purpose of a double track, certain parcel of land in Tp. York, Co York, Ont.

20829—November 17—Amending Order No. 18837, dated March 12th, 1913, by substituting "plan 'B,' dated Feb. 15th, 1913, and revised Oct, 30th, 1913," for "plan 'A,' dated Feb. 15th, 1913," approved under said Order; and that plan of permanent structure, dated Oct. 15th, 1913, as revised Nov. 5th, 1913, be approved.

20830—November 18—Approving revised location C.N.R. Calgary-Southerly Line through Tp. 22, R. 29, W. 4 M. mileage 10.59 to 13.21; through Tps. 22 and 21, R. 29, W. 4 M. mileage 13.74 to 16.16; through Tp. 18, R. 29, W. 4 M. mileage 35.49 to 38.05; and through Tps. 10 and 9, Rgs. 25 and 26, W. 4 M. mileage 93.21 to 100.79.

20831—November 18—Amending Order No. 20609, dated Oct. 15th, 1913, by striking out clause (b) of paragraph 1, in operative part of said Order.

General Order No. 114—November 12—Approving general form of contract to be entered into between Bell Telephone Co. of Canada and any other company, municipality, or corporation having authority to construct and operate a telephone system or line, for interchange of telephone messages or service passing to or from their respective telephone systems and lines, the division or apportionment of telephone tolls, and management, working, or operation of their respective telephone systems or lines.

20832—November 15—Granting leave to City of Edmonton, Alta., to cross, at level, with its municipally-owned electric street railway, with necessary poles and wires to transmit power, the line of C.N.R. where same intersects Athabasca Ave., said city, subject to certain conditions.

20833—November 18—Authorizing G.T.R. to construct additional track across John St., Village of Weston, Co. York, Ontario.

20834—November 18—Authorizing Mun. Corporation of Town of Sudbury, Ont., at its own expense, to construct highway crossing over Stobie Branch of C.P.R., to connect Bond St. with Notre Dame St., Sudbury, Ont.

20835—November 18—Authorizing Montreal and Southern Cos. Ry. to construct bridge to carry its line across Yamaska River, near St. Cesaire, Quebec, subject to terms of consent of Parish of St. Cesaire.

20836—November 18—Approving location C.P.R. station at Gravel, mileage 32.50, Lake Superior Div. Nepigon Sub. Div., Ontario.

20837—November 18—Authorizing St. Lawrence and Adirondack Ry. Co. to construct highway across its railway, just south of Bellevue Station, Que.; cost of construction be borne by Parish of Chateauguay, Que.; cost of maintenance be borne by Railway Company.

20838—November 19—Approving plans showing location and details of C.N.R. special station proposed to be constructed at Gravelbourg, Saskatchewan.

20839—November 19—Amending Order No. 8627, dated Oct. 21st, 1909, by adding after word "follows," in second line of paragraph 7 of Order and before words "the sum," words following, namely, "twenty per cent. of the cost of the said works, not to exceed."

20840—November 18—Authorizing C.P.R. to construct spur for Joseph Elie, Montreal, Que.

20841—November 18—Authorizing G.T.P. Branch Lines Co. and C.P.R. Co. to operate their trains over crossing at Frobisher, Sask., without their first being brought to a stop.

20842—November 19—Authorizing C.P.R. to operate trains over drawbridge over Kaministiquia River, at Fort William, Ont., without their first being brought to a stop.

20843—November 19—Authorizing C.P.R. to construct spur for Quaker Oats Co., Saskatoon, Sask.

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BOOKLETS ON REQUEST

20844—November 11—Directing that C.N.R. and G.T.P. Ry. Cos. construct transfer track near Dana, Sask., subject to certain conditions.

20845—November 17—Directing that C.L.O. and W. Ry. (C.P.R.) install an improved type of automatic electric bell at crossing of highway between Cons. 3 and 4, Tp. Tyendinaga, Co. Hastings, Ont., at mileage 61.87, bell to be installed by time line is opened for traffic.

20846—November 19—Establishing collection and delivery limits of Express Companies in City of Hamilton, Ontario.

20847—November 19—Authorizing C.P.R. to open for traffic following portions of double track on Lake Superior Div. Ont., Azilda, mileage 86.0 to 95.5, mileage 113.2 to Cartier, mileage 114.6, Cartier Subdivision. Nemegos, mileage 120.9 to 125.0, Poulin, mileage 127.0 to 130.0. Chapleau Subdivision, Esher, mileage 7.1 to 9.0, mileage 18.9 to Goldie, mileage 34, on White River Subdivision. Redlite, mileage 11.2 to 21.0, Schreiber Subdivision, and Selim, mileage 9.3 to Rossport, mileage 14.3, mileage 29.0 to Gurney, mileage 39.1, Nipigon Subdivision.

20848—November 18—Authorizing G.T.P. Ry. to reconstruct bridge across Kitssumkaylum River, at mileage 91, Prince Rupert East, British Columbia.

20849—November 12—Directing that C.N.R. provide suitable crossing over its tracks where same cross Fort Garry Boulevard, Rural Mun. of Fort Garry, Man.; cost of constructing and maintaining said crossing be borne by Municipality.

20850—November 19—Authorizing Canada Southern Ry. Co. to construct branch line from a point on its railway east of Welland Station, Tp. Crowland, Co. Welland, Ont., to a point in Lot No. 22, Con. 5, Tp. Humberstone, Co. Welland, crossing Ontario Road, Commercial St., Dover St., Dain St., and Town Line Road between Tps. Crowland and Humberstone.

20851—November 19—Relieving C.P.R. from providing further protection at crossing of highway, being first crossing east of station building at Tyndall, Man.

20852—November 17—Authorizing N. St. C. & T. Ry. to open for traffic its line between city of St. Catharines and town line between Tps. Grantham and Niagara, Ont., distance of 7.1 miles, for a period of three months from date of this Order. 2. Authorizing Ry. Co. to operate cars over crossing of G.T.R. at Welland Ave., St. Catharines; and pending installation of interlocking plant, all trains and cars be flagged over crossing by a day and a night watchman.

20853—November 20—Directing that, within 3 weeks from date of this Order, C.N.R. extend siding at Sleeman, Ont., so as to accommodate thirty-eight (38) cars.

20854—November 13—Authorizing City of Edmonton, Alta., to operate its cars over G.T.P. Ry. on Twenty-first St., Edmonton, pending installation of half-interlocker; cars to come to a stop and be flagged over crossing by conductors of Applicant's Street Railway.

20855—November 20—Authorizing C.P.R. to construct siding for Cowan Co., Limited, Toronto, Ont., at Parkdale, Ont.

20856—November 20—Directing Edmonton, Dunvegan and B.C. Ry. to construct farm crossing, to road allowance, on farm of Wm. Dives, Independence, Alta., on N.E. ¼ Sec. 36-57-27, W. 4 M., Alta.; work to be completed within 20 days after approval of plan.

20857—November 19—Directing G.T.P. Ry. forthwith to construct No. 1 B.R.C. station and platform at Telkwa, B.C.; to be located on south side of track at point just west of cut, near east end of curve; construct also, at same time, siding to hold at least 12 freight cars, at west side of bridge, at or near point shown in red on plan; and provide wayfreight and local passenger service at Telkwa.

20858—November 20—Authorizing Town of Stony Plain, Alta., at its own expense, to construct Main St. across C.N.R., Town of Stony Plain, Alta.

20859—November 21—Directing Whyte St., Edmonton, Alta., be protected by gates installed by C.P.R., and operated by day and night watchmen. 20 per cent. of installing gates be paid out of Ry.-Grade Crossing Fund, 2/3 remainder by Ry. Co., and 1/3 by City; wages of watchmen—2/3 by Ry. Co., and 1/3 by City.

20860—November 21—Establishing collection and delivery limits of Express Cos. in Town of Cochrane, Ont.

20861—November 20—Dismissing complaint Otis-Fensom Elev. Co. against proposed 6th-class rating in Supplement No. 2 to Can. Freight Classification No. 16, submitted by Can. Freight Association for approval of the Board.

20862—November 21—Directing that C.N.R. trains be brought to a stop before proceeding over Fournier and Browning Avenues, and operated over such crossings at a speed not exceeding four miles an hour; posts showing word "Stop" to be erected at east side of Fournier Avenue and at west side of Browning Avenue, at points 75 feet from crossing. 2. Ry. Co. make an entrance for vehicular traffic from driveway or lane at back of station building, situated midway between Fournier and Browning Avenues: Applicant (council town of Carman, Man.) undertaking to trim trees at south-west corner of Browning Avenue, to a height of 22 feet above the rail.

20863—November 20—Authorizing C.P.R. to operate its trains over the bridge across McKellar River, Fort William, Ont.

20864—November 19—Authorizing C.P.R. to construct spur for J. L. Abbott, Toronto, Ont., from a point on northerly limit of right of way, in W. ½, Lot 16, Con. 7, Tp. Eldon, Co. Victoria, Ont., at mileage 35.07, Ont. Division, Port McNicoll, Subdivision at Balsam Lake.

20865—November 21—Establishing collection and delivery limits of Express Companies in town of Sudbury, Ont.

20866—November 21—Establishing collection and delivery limits of Express Companies in town of North Bay, Ont.

20867—November 20—Authorizing city of Winnipeg, Man., to extend Godfrey Avenue, across Oak Point Branch of C.N.R., Winnipeg.

20868—November 20—Directing that C.P.R. construct bridge with a roadway 30 feet wide over its tracks on Eighth Avenue West, in city of Moose Jaw, Sask., and an extension sidewalk 6 feet wide on one side of said bridge. Cost of construction be apportioned:—$5,000 out of Ry. Grade-Crossing Fund, 75 per cent. of remainder by Ry. Co. and 25 per cent. by city of Moose Jaw. Substructure be maintained by Ry. Co. roadway and sidewalk by city. Order No. 17206, dated July 25, 1912, be rescinded.

20869—November 21—Amending Order No. 16978, dated July 11th, 1912, to provide that C.L.O. and W. Ry. (C.P.R.) construct under Oshawa Electric Ry. Co., on Simcoe Street, town of Oshawa, Ont., as shown on plan "A," dated November 5th, 1913, instead of as shown on plan approved under said Order.

20870—November 13—Approving location G.T.P. Branch Lines Co.'s Mountain Park Coal Branch from S.E. ¼, Sec. 33-45-23, to N.E. ¼, Sec. 32-48-21, W. 5 M., mileage 0 to 30.24, District North Alta., Alta.

20871—November 21—Authorizing G.T.R. to construct siding for Arthur Sherk, Whitehall, Ont., into premises of Northern Veneer Co., Limited, on Lot 28, Con. 11, Tp. McMurrich.

20872—November 21—Authorizing G.T.R. to construct siding into premises Messrs. Whiteside and Arnold, on Lots 2 and 3, south of Tiffin Street, Allandale, town of Barrie, Ont.

20873—November 11—Authorizing Rural Mun. Keyes, No. 303, Sask., at its own expense, to construct highway crossing over C.N.R. between Secs. 25 and 36, Tp. 33, Rge. 1, W. 2 M., Saskatchewan.

20874—November 20—Directing that First Street and Namayo, Syndicate and Alberta Avenues, Edmonton, Alta., be protected by gates installed by Canadian Northern and G.T.P. Rys., and operated by day and night watchmen; 20 per cent. of cost of installing gates at said crossings of First Street and Namayo and Syndicate Avenues respectively, be paid out of Ry. Grade Crossing Fund: remainder be paid in equal proportions by Ry. Cos.; city to pay wages of watchmen at said crossings; cost of maintenance of gates be divided equally between Ry. Cos.; 20 per cent. cost of installing gates at Alberta Avenue be paid out Ry. Grade Crossing Fund, remaining 80 per cent.:—two-thirds by Ry. Cos. and one-third by city. Cost of maintenance of gates and wages of watchmen be paid two-thirds by Ry. Cos. and one-third by city.

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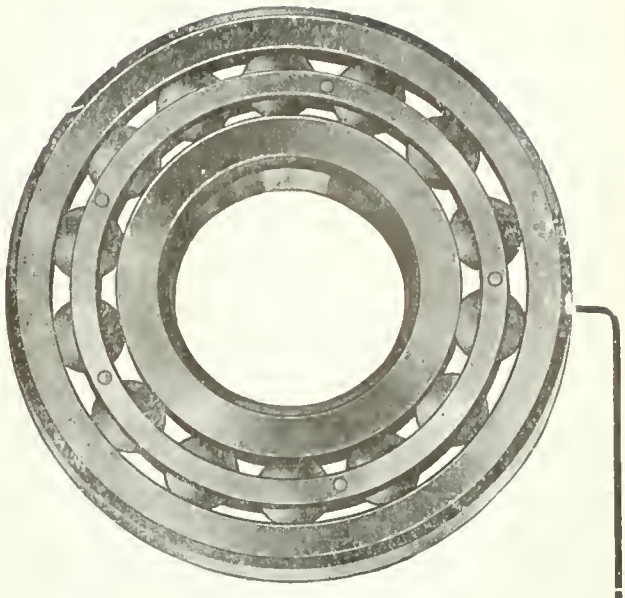

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Brockville, Ont., water tube boilers		Nov. 20.	78
Burlington Channel, Ont., pier	Dec. 15.	Nov. 20.	82
Calgary, Alta., machinery, etc.	Dec. 31	Nov. 13.	88
Edmonton, Alta., iron posts	Dec. 1.	Nov. 13.	88
Gull Harbor, Man., extension to wharf	Dec. 4.	Nov. 13.	82
Halifax, N.S., and Esquimalt, B.C., stores for dockyards	Dec. 1, 3, 15.	Nov. 20.	82
Little Sands, P.E.I., breakwater	Dec. 3.	Nov. 13	82
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., coaling plants, etc.	Jan. 7.	Nov. 13.	86
Ottawa, Ont., iron posts	Dec. 1.	Nov. 20.	88
Richard's Landing, Ont., wharf and warehouse	Dec. 2.	Nov. 13.	86
South End P.O., Ont., pumping plant		Nov. 20.	88
Toronto, Ont., crushed limestone, etc.	Dec. 2.	Nov. 20.	88
Victoria Harbor, B.C., wharfs	Dec. 9.	Oct. 30.	84
Winnipeg, Man., motor hose-wagons, etc.	Dec. 15.	Nov. 20.	82
Winnipeg, Man., water supply		Oct. 16.	86
Yorkton, Sask., electric machinery	Dec. 22.	Nov. 13.	86

RAILWAYS—STEAM AND ELECTRIC.

+—Calgary, Alta.—The contract has been awarded the CARTER-HALLS-ALDINGER COMPANY of Calgary, for the construction of a temporary station, freight shed, and office building for the C.N.R. company. The building will cost approximately $100,000, and will be completed by the end of December.

Fredericton, N.B.—C.P.R. engineers and bridge experts have made an examination of the Southampton railway line, and Mr. James K. Pinder, M.L.A., has announced that it will be taken over within a few days for operation as a part of the C.P.R. system.

Hamilton, Ont.—The Ontario Railway Board has decided that the incline railway company must put its line in safe condition and resume operations. No date was set for the completion of repairs, this being left open pending a report from the engineer of the board.

London, Ont.—The G.T.R. will not build the Port Burwell-London line, according to the statement made in London by Superintendent Wittenberger. The Pere Marquette will continue to haul coal for the company.

+—Moncton, N.B.—Orders have recently been given by the I.C.R. to the LOCOMOTIVE WORKS at Montreal, Kingston, and Toronto, respectively, for 15, 9, and 5 locomotives, of which 5 are switch engines, and the rest heavy freight—4 of the Pacific type, and 20 consolidated.

Montreal, Que.—The Canadian Autobus Company has submitted its offer to the city, in which it shows that it is ready to build 7 or 8 miles of subway to serve the heaviest lines of traffic in Montreal, at an estimated cost of $20,000,000. Certain conditions are to be agreed upon; among others, the company requests a franchise for thirty years with the option of the city acquiring the plant and equipment at the end of that term at its actual value plus 10 per cent. The work is to be started in 1914 and finished in 1918.

Montreal, Que.—Two organizations are offering to supply the additional transportation facilities urgent in Montreal. The Montreal Tramways Company has applied for an extension of its charter, promising underground railways. The Canadian Autobus Company has intimated to the city that it is prepared to construct tubes serving both the down-town and uptown districts

Montreal, Que.—A committee has been appointed by the council of the board of trade to consider the revised contract between the city of Montreal and the Montreal Tramways Company, and to report to council.

Ottawa, Ont.—Application to Parliament will be made to incorporate the All Red Line Railway, which proposed to build from Cape St. Charles, Labrador, to Lake Mustassi, crossing the Wottaway River to the boundary between Quebec and Ontario, and so on in a north-westerly direction to a crossing of the Hudson Bay Railway at Cormorant Lake, and thence to the Peace River country, and on to a terminal in British Columbia at Dean's Inlet on the Pacific Ocean. Branch lines are proposed to connect the railway with the cities of Quebec and Winnipeg, and with the Yukon by way of the Peace River Valley. The application is made by J. K Dowsley, of Prescott, solicitor for the promoters.

Ottawa, Ont.—Application is being made to parliament for the incorporation of the Ungava Railway Company, which proposes to build a railway from Aylmer Sound, on the St. Lawrence, to the Hudson Bay post at Whale River.

Port Arthur, Ont.—Sir Donald Mann has purchased the 14 miles of North-Eastern Railway, built two years or more ago to serve several miles in the inland region from the head of the Portland Canal. It is a strategic piece of railway, commanding the Pacific terminus of the shortest transcontinental route in Canada.

St. Thomas, Ont.—Mr. Geo. B. Woods, of Toronto, and Mr. W. N. Warburton, of London, Vice-President and General Manager, respectively, of the London and Lake Erie Transportation Company, operating between London and Port Stanley, state that the company is considering extensions of its line; one for St. Thomas to Aylmer and Port Burwell at a cost of over $300,000, including a branch line to Sparta; and one from London to Ingersoll, Woodstock and Brantford. Another extension from Lambeth to Delamere is planned for the near future.

Toronto, Ont.—A by-law will be submitted to ratepayers, Jan. 1st, to authorize the purchase of the Sunnyside-to-the-Humber section of the Toronto and York Radial Railway Company's Mimico line for the sum of $81,615.13.

Toronto, Ont.—Auditor John MacKay has reported to Mayor Hocken that the purchase of the Toronto Street Railway and Toronto Electric Light properties will justify itself financially. The purchase of the railway company, its consolidation with the civic car lines and extension into an ideal system is compared by Mr. MacKay with the non-purchase of the company until the expiry of the franchise in 1921, and the extension of the civic car lines into the best possible system. His opinion is that the former alternative will result in a saving of three million dollars.

Toronto, Ont.—The T. & N.O. Railway has under construction steel equipment for two passenger trains, which will be ready for service early in the spring. It is the intention of this company to eliminate gradually from its service the wooden car; and to have its entire equipment of steel underframe and steel superstructure cars. It possesses already 100 steel under-frame flat cars and 100 steel underframe box cars, and claims credit as the first railroad in the Dominion to adopt the steel car.

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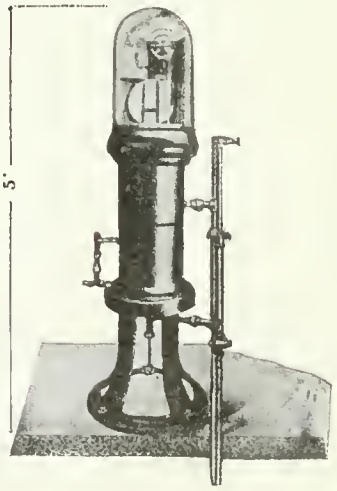

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Vancouver, B.C.—The Coquitlam council wrote recently to the civic bridges and railways committee of Vancouver City Council asking for assistance in obtaining an extension of an interurban line from New Westminster to Coquitlam. The committee did not favor the scheme, but supported the plan for reaching Coquitlam by an extension of the Hastings street line or a line on the Johnston road.

Winnipeg, Man.—Tenders will be received up till December 4th for one steam locomotive with separate fender and snow plow. Plans and specifications may be obtained from M. Peterson, Esq., Secretary, Board of Control, Winnipeg, Man.

GARBAGE, SEWAGE AND WATER.

Dawson, Y.T.—A civic league has been formed by a large number of Dawson citizens for the purpose of co-operating with the local government for the installation of city water, light and telephone plants.

Hamilton, Ont.—Considerable damage has been effected by a break in the 20-inch water main on King William Street, when thousands of gallons of water flooded the central district of the city.

Ingersoll, Ont.—Consulting Engineer Weston, of Boston, and Engineer Thorold, of Toronto, are investigating the plans prepared by the latter for a sewerage system for Ingersoll.

London, Ont.—An engineer, acting under Consulting Engineer Willis Chipman, is daily expected in London, and it is expected that the surveys for the east end disposal plant, and for parts of the storm water system will be completed before the hard winter weather sets in.

Mimico, Ont.—The recent epidemic of scarlet fever at Mimico has been attributed to the unsanitary arrangement for the disposal of the sewage in vogue in the village. In order to guard against a repetition of the epidemic the Council are seriously considering a proposition to install a complete water and sewage disposal system. It is estimated that a complete system, including the erection of a waterworks and sewage disposal plant, together with the laying of the necessary mains, would cost nearly $340,000. Of this amount $70,000 would be raised by the issuance of debentures, while the remainder would be assessed as a local improvement covering a period of years.

Montreal, Que.—Mr. R. S. Lea, consulting engineer, has reported to the city, recommending the construction of a garbage reduction plant, to be located at some distance from the city, and the garbage to be hauled to it by rail.

Ottawa, Ont.—The acting city solicitor announced at the recent board of control meeting that the bond offered by the City Garbage Company is now quite satisfactory, and it is expected that the contract for the collection of garbage will be executed in the immediate future.

Ottawa, Ont.—The board of control has approved of the engagement of E. J. Rainboth, land surveyor, for work in connection with the Gatineau water scheme right-of-way and the land proposed to be secured around the lakes. He will get $40 to $50 a mile and $2 for the description of each parcel of land.

Ottawa, Ont.—Mayor Ellis has announced that the first contract for Gatineau water supply pipe will be let in about six weeks' time and the first contract for construction next April. It was also stated that as far as possible Canadians will be engaged upon the work.

+—Toronto, Ont.—The contract has been awarded by the board of control for the supplying and installing of an 84-inch steel conduit to be run across the island from the pure water reservoir to the south tunnel shaft, to the firm, ROGER MILLER & SONS. The contract price is $540,000; and the tender of this firm was the only one submitted.

▲—Toronto, Ont.—Tenders will be received up till January 20th for the installation of a complete mechanical filtration plant, boilers etc., at Toronto Island. Plans and specifications may be obtained from Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto. Signed, H. C. Hocken (Mayor), Chairman, Board of Control.

▲—Vancouver, B.C.—Tenders will be received up till December 1st for the construction of trunk sewers, Contract No. I. Plans and specifications may be obtained from the Burrard Peninsula Joint Sewerage Board. G. W. Phipps, Secretary.

Vancouver, B.C.—Further delay in the awarding of contract for the laying of the Point Grey partnership water main is due to lack of definite information as to the depth the pipe will have to be carried across False Creek. A statement has been requested from the Department at Ottawa, and it is hoped that the matter will be settled finally within a few days.

Vancouver, B.C.—Tenders will be received up till December 1st for the construction of trunk sewers—Contract No. I.—at the offices of the Burrard Peninsula Joint Sewerage Board, 514-518 Birks Building, Vancouver, B.C. Plans and specifications may be obtained from Geo. W. Phipps, Secretary-Treasurer, Burrard Peninsula Joint Sewerage Board.

Victoria, B.C.—Both the Sewer Loan by-law and the Waterworks by-law have been passed by the property owners of Oak Bay, B.C. $150,000 will be expended on the completion of the installation of a sewer system; and $35,000 will provide a water supply.

LIGHT, HEAT AND POWER.

Brockville, Ont.—Tenders will be received for the supplying of two 300 h.p. water-tube boilers, and for an electric-driven turbine pump. Plans and specifications may be obtained from the Brockville Water and Light Department. E. J. Philip, manager.

Claresholm, Alta.—Natural gas has been struck about six miles east of Claresholm on the property of Mr. John Sutherland, who purposes securing capital for its development.

Edmonton, Alta.—Ratepayers in Edmonton will be requested to vote on a plebiscite at the civic elections, on December 8th, upon two proposals, both designed to supply natural gas to consumers at low rates, as follows: (1) to accept the offer of the Pelican Oil and Gas Company at 15 cents a thousand feet, delivery November 1st, 1915; or (2) to expend about $300,000 for exploration work under municipal direction in the Vegreville and other gas fields.

+—Guelph, Ont.—The contract has been awarded GRINYER & COMPANY for the electrical work for Hewittson's new factory in Brantford.

+—London, Ont.—An agreement has been made between the City Gas Company and the SOUTHERN GAS COMPANY, a natural gas syndicate for the supply of gas in London, commencing April 1st. The rates in summer months will be 50 cents per 1,000 cubic feet, with 5 cents discount; and in winter, 45 cents per 1,000 up to 4,000 feet, and 35 cents when consumption exceeds this amount.

Niagara Falls, Ont.—Mr. Frederick Walker, of New York, has devised a water and power project, which will be backed by British and Canadian money, and will cost about $2,500,000. His plan is to build a suspended raceway to tap one-half of the waterfall from the Canadian Falls and one-half from the American Falls at Niagara and carry the water through the Niagara River to a point where a great power plant will be erected for the creation and distribution of electricity.

Ottawa, Ont.—The Michigan Northern Power Company and the Algoma Steel Corporation have applied conjointly for approval of a scheme to divert certain waters of the St. Mary River at the Soo to develop power for the various industries on both sides of the international boundary. The plans have been sent to the public works department at Ottawa and to the secretary for war of the United States for approval before being passed upon by the international waterways commission.

Ottawa, Ont.—A delegation from Merrickville has interviewed the Hon. Dr. Reid, acting minister of railways, and has urged that the improvements to Rideau Canal at that centre be carried out so as to provide for the development of electric power in the town.

Puslinch, Ont.—The Puslinch council has passed the motion required by the Hydro-Electric Power Commission before taking proceedings in any municipality, under the Hydro-Electric Railway Act of 1913. This was done in connection with the proposed road from Hespeler, connecting with Puslinch Lake, through Guelph to Elora, Fergus and Arthur, and from Guelph through Aberfoyle and Morriston to Puslinch Station; and also from Arthur, connecting with Mount Forest, and through the Beaver Valley to Meaford or Thornbury. This scheme, in addition to furnishing railway service, would also distribute power and light.

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+—**Regina, Sask.**—The city council has awarded to WILLANS & ROBINSON the contract for the installation of a 3,000 k.w. steam turbine and condensing plant, and a Siemen's generator, in connection with the city power plant.

Saskatoon, Sask.—The C.N.R. are endeavoring to secure a lower rate for water from Saskatoon; and in case a satisfactory agreement cannot be made, it is understood that the company will construct a separate plant.

St. Catharines, Ont.—Government engineers are surveying for the proposed big water main from Sugar Loat (west of Port Colborne) to supply lake water to St. Catharines and all other towns along the canal in the event ot the river and canal being brought to the same level. No definite decision has been announced concerning the project. The towns now taking water from the canal are requesting the Government to bear the cost of the pipe line.

Toronto, Ont.—Mayor Hocken, in his address to members of the Municipal Improvement Association on the subject of the railway deal, made the statement to the effect that at present the Toronto Hydro system is unable to lay its wires where they will give the greatest benefit, owing to the limitations on its activities imposed by the terms of the Toronto Electric Light Company's franchise of the streets. The Mayor stated further that the city will insist, in the final agreement with the vendors, that the contract to be assumed with the Electrical Development Company for the supply of Niagara power must provide a similar price for current to that now paid by the city to the Ontario Power Commission.

Toronto, Ont.—As a result of a report made by Chief Engineer Gaby the hydro commission will make a general reduction in the hydro rates of the various municipal systems.

Toronto, Ont.—At the meeting held on November 19th, the Hydro-Electric Commission authorized the closing of the contract with Owen Sound, and the ordering of the commission's engineers to immediately see about the plans and tenders for the work in hand. An expenditure of $650,000 is involved in the development of power at Eugenia Falls, and the supply of many towns en route. This line will also tie with the Collingwood connection now serving Midland, Penetang, and Barrie.

Toronto, Ont.—A reduction of 10 and 15 per cent. on the rates now obtaining in Toronto, London, and Ottawa, has been authorized by the Hydro-Electric Commission. Toronto and Ottawa were given a reduction of 10 and 15 per cent., respectively on all light and power rates; while London will have a cut off of 15 per cent. on light, and 18 per cent. on power charges.

Victoria, B.C.—An estimate has been submitted to the South Saanich municipal council by the British Columbia Electric Company for the providing of a system of street lighting for four of the wards of the municipality at a cost ot about $37,500. The council has moved that the British Columbia Electric officials be asked to consider an agreement by which the two wards omitted in the plans submitted should be included in the proposed system.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—Plans are being prepared by Mr. T. H. Mawson, city planner for Calgary, and City Engineer Craig, for a bridge across the Bow River at Center Street. They will prepare plans for a bridge at right angles, and for an oblique bridge; also for an elevated as well as a low-level bridge. It will be left to the council to choose the most aesthetic and economic scheme.

Cornwall, Ont.—The Williamsburg township council has passed a resolution in connection with the action of the Ontario Government in appointing a commission to investigate the question of better roads. The resolution urges upon the commission the necessity of improving first the market roads in each municipality, the necessity of expending assistance granted to municipalities under the direction of a government engineer, and the advisability of abolishing the present system of statute labor and of instructing the clerk to send a certified copy of this resolution to the chairman of the commission.

+—**Digby, N.S.**—The C.P.R. has given over to the FOUNDATION COMPANY of New York, the work of completing the new steel bridge across Bear River. Trouble has been caused in the course of construction by one of the piers toppling over in the mud, and Messrs. Power and Brewer have withdrawn from the work.

Edmonton, Alta.—Civic officials are investigating and considering the construction of a good thoroughfare from Forty-second Street to the Country Club's grounds. The road to the club grounds is part of the proposed river drive to Big Island.

+—**Halifax, N.S.**—The contract has been awarded by the provincial government to the STANDARD CONSTRUCTION COMPANY, of Halifax, for the building of the substructure for the Lennox Passage bridge, Richmond Co., Cape Breton. The structure will consist of nine cement piers faced with granite and will have a draw for vessels in the centre. The company will begin in the early spring and hope to complete the job by the end of 1914.

Hartland, N.B.—It is being rumored with considerable authority that a new highway bridge will be constructed, probably this winter, across the river at Hartland, N.B. The new bridge will span the river a little farther up than does the present one.

Howick, Que.—Tenders will be received up till December 10th for the construction of about 5 miles of macadamized road in the Parish of Tres St. Sacrament, County of Chateauguay, Que. Plans and specifications may be obtained from D. R. Hay, Secretary-Treasurer, Municipal Council, Howick, Que.

Montreal, Que.—Delay in the matter of settling the underground railway question in Montreal is inevitable, due to engineering and financial problems which must first be solved. It must be ascertained whether a subway under St. Catherine Street can pass the C.N.R. tunnel, which passes under that street at McGill College Avenue. In the case of the Tramway Company's offer, no idea of the cost of the proposed subways can be made until it is known whether the company proposes to build two or four-track subways. There is also the question of the depth of the tunnels to be considered, the steep hills and grades to be encountered. Negotiations will doubtless extend over several months.

Ottawa, Ont.—At a special meeting of the Board of Control it has been settled that the new Billings' bridge will not be a temporary construction, but that traffic will be diverted by way of Hurdman's bridge until the completion of the permanent structure. A rapid start on the work has been urged, which, according to City Engineer Currie's plans, will be 350 feet long and 60 feet wide, with four concrete piers and steel superstructure, and will cost $60,000. Tenders will be called for as soon as possible.

Ottawa, Ont.—The selection of a site for a new bridge over the Rideau Canal has been left to the city engineer. The residents across the canal are endeavoring to have a temporary bridge erected for the winter.

+—**Ottawa, Ont.**—The contract has been awarded by the Dominion Government cabinet council to the CANADIAN DREDGING AND CONSTRUCTION COMPANY for four bridges in Districts C and D of the Transcontinental Railway, at a cost of $9,469.

St. Catharines, Ont.—The alternative bridge plan at St. Paul Street has been reported upon by the city engineer to the civic council and as a result has been abandoned as a means of improvement. The council has resolved to engage the services of a consulting engineer to prepare a report on other routes in an endeavor to arrive at the most feasible solution of the problem.

Toronto, Ont.—The Street Improvement Committee, a sub-committee of the Civic Works Committee, has decided to ask the city council to approve plans for the extension of several streets in Wards Six and Seven. With regard to the extension of Campbell Avenue south to Bloor Street in Ward Six, while recognizing that it was desirable, the committee decided the present time was inopportune.

+—**Vancouver, B.C.**—The contract for building the passenger subway to the North Vancouver ferry wharf has been practically awarded to the M. P. COTTON COMPANY by the civic bridges and railways committee, its tender of $30,105 being the lowest of fourteen submitted to the committee. Before being actually awarded, however, the city engineer will make a report to be read before the City Council. The committee will proceed with the subway, and will install pumps to countervent the wet weather.

+—**Vancouver, B.C.**—The city council has awarded the contract for the North Vancouver pedestrian subway to the M. P. COTTON COMPANY, its tender of $30,105 being the lowest received. The council adopted the city engineer's recommendation that excavation work be delayed until spring

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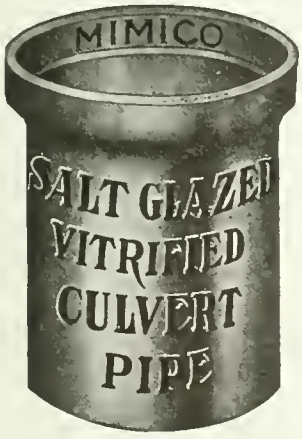

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This edition contains many important changes and additions. A new chapter on the application of bacteriology to the sanitary study of shellfish has been added, due to the growing importance of this subject.

to avoid the wet weather and to allow the C.P.R. to drive piles for certain tracks.

Victoria, B.C.—The report of the provincial engineer, Mr. Griffiths, following his investigation of the project and estimate of construction of the Second Narrows Bridge, is at present under consideration.

Victoria, B.C.—Further conference is being held on the question of the Johnson Street bridge with the hope of getting the project sufficiently settled and advanced to submit the necessary by-law to the city council early next month, and to ratepayers, at the annual January elections. It will be the largest money by-law on the list, if sufficiently advanced to be included.

Victoria, B.C.—With regard to the new Johnson Street bridge, the Inner Harbor Association favors the increase in the grade of the approach, and suggests provision to give a clear headway under the central span of 36 feet of high water. The attitude of the association is to be communicated to the city council, and attention is to be drawn further to the fact that it is about 400 feet from Store Street to the movable span of the bridge, and that in this distance a rise of about 18 feet would have to be obtained to securet a clear headway of 36 feet at high water. This would give a grade of four and a half per cent., which would be easier than that at Portland, A general conference is to be held of government, railway, and city officials; and it is expected that some progress will be made in advancing this important work.

Victoria, B.C.—The Hon. Thomas Taylor, provincial minister of public works, has announced the plans for the new government bridge to span the Pitt River at the Dewdney trunk road are sufficiently complete to admit of the call for tenders at an early date. Work is expected to be well under way next spring; though, due to the difficulty of the work, the erection can hardly be completed much before 1915. The bridge when completed will cost between $400,000 and $450,000, and is to provide for railway traffic as well as vehicular and pedestrian traffic.

Victoria, B.C.—In the recommendations of the finance committee of the city council, still to be considered by the council, is a suggestion for an appropriation to start the new railway bridge across the street at Hereward road. This is the last trestle on the Esquimalt and Nanaimo Railway in Victoria West before it reaches the boundary at Dominion road.

Winnipeg, Man.—Owing to the adjournment of the regular meeting of the city council, consequent on the sudden death of Assistant Engineer R. D. Willson, no definite action was taken at the city hall last night on the Talbot Avenue sub way matter.

Winnipeg, Man.—The city council has passed the following resolution concerning the construction of a subway at Talbot Avenue: "That an appropriation, equalling the amount which the Board of Railway Commissioners for Canada shall fix as the city's share of the cost of constructing a subway at Talbot Avenue, under the Canadian Pacific Railway tracks, be made, and authority is hereby given that such sum shall be placed to the credit of a fund for the construction of said subway, as shall be determined by the said commission. The Dominion Railway Commission has already been notified of the creation of such a fund by the city and an order compelling the construction of the subway and apportioning the cost is expected within a short space of time.

INDUSTRIAL WORKS.

Ainsworth, B.C.—As a result of representations made by R. F. Green, M.P., and Neil F. Mackay, M.P.P., repairs are to be made by the government to the wharf at Ainsworth in order that it may be in good condition for use until the new wharf, for which tenders have been called, has been built.

+—Ottawa, Ont.—The Dominion government has let the contract for a wharf at Vaill's Point, Grey County, Ont., to W. A. GRIER and A. J. CREIGHTON, of Owen Sound, for $6,983.

+—Ottawa, Ont.—The Dominion government has let the contract for the pier and wharf at Meaford, Ont., to ALEX. GREEN and JOHN WOOLICH, of Owen Sound, for $30,000.

Ottawa, Ont.—It is announced that an exceptionally large number of tenders for Section 5 of the Welland ship canal have been received, and deposit cheques average over $1,000,000. When the awards have been made in the course of a day or two, tenders will be called for the fourth section.

Ottawa, Ont.—Tenders will be received up till December 15th for the construction of a breakwater at Caldwell's Cove, Digby Co., N.S. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—Applications have been made to the government by companies interested in the construction of dry docks for legislation increasing the subsidy in respect to such undertakings. The present limit is 3½ per cent. annually, on a maximum of $5,500,000. It is desired that this be increased to 4, 4½ or 5 per cent., it being urged that under present monetary conditions it is very difficult to finance the propositions on the basis of the present subsidy.

+—Ottawa, Ont.—The contract for section 5 of the Welland Ship Canal has been awarded by the Cabinet Council to the CANADIAN DREDGING COMPANY. This section extends from Allenburg to Port Robinson, and will cost $1,945,788.

+—Ottawa, Ont.—The contract has been awarded by the cabinet of the Dominion Government to the MARITIME DREDGING AND CONSTRUCTION COMPANY for extension to wharf and dredging at Chocolate Cove, N.B. The contract price was $26,879.

+—Ottawa, Ont.—The contract has been awarded the MARITIME DREDGING AND CONSTRUCTION COMPANY by the Dominion Government for the construction of a breakwater at Little Dipper Harbor, N.B., at a cost of $10,593.

Ottawa, Ont.—Tenders will be received up till December 15th for the construction of a wharf at Pritchard, Yale District, B.C. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. Signed, R. C. Desrochers, Secretary, Department of Public Works.

+—Ottawa, Ont.—The cabinet has let the contract for the construction of a wharf at Gillies Bay, B.C. The contractors are Hodgson and King, of Vancouver.

+—Ottawa, Ont.—The contract has been awarded the MARITIME DREDGING AND CONSTRUCTION COMPANY for a breakwater at Welsh Cove, Mace's Bay, N.B., at a cost of $11,825.

Sarnia, Ont.—Engineers from the Public Works Department, Ottawa, have been working on an enterprise which affects the entire water front of the St. Clair River. The plan is to fix a limit to the harbor line, and to permanently prohibit the extension of any wharf or pier beyond this line. The work is being done at the request of the Canadian marine interests, and of the United States Lake Carriers' Association, and the survey for the port of Sarnia will be carried from Point Edward to below the town limits, and will include the frontage along the bay shore. It may be that the fixing of the limits will cause a modification of the plan for a Government pier in Sarnia Bay, but the modification would not be radical.

Vancouver, B.C.—After seven months' delay, the city has received the equivalent of a crown grant, e.g., the sanction of the Deputy-Minister of Justice at Ottawa, for the use of the bed of False Creek for 300 feet west from Main Street, which is to be enclosed by a sea wall to be built by the C.N.R. Company. A committee has been engaged to form plans for the sea wall, which will take the form of a wharf with piers probably extending at right angles. Chairman Carter-Cotton has asked on behalf of the Harbor Commission, that two slips be provided at the retaining wall.

MISCELLANEOUS.

Grand Forks, B.C.—T. M. Sutherland, who is in charge of the forestry department of the Kootenays and Boundary, has instructed his men to proceed with the construction of the telephone line up the north fork of the Kettle River as far as Franklin camp. It is the intention of the department to have the line extended into the city and connected up with the local telephone exchange.

Montreal, Que.—Tenders will be received up till December 10th for the construction of two steel wharf transit sheds, Sections 24 and 25, Harbor of Montreal. Plans and specifications may be obtained from Mr. F. W. Cowie, Chief

MEXICAN EAGLE ASPHALT

TRADE MARK

Most adhesive, toughest and most ductile of all pure asphalts

William Street, Winnipeg, paved with Mexican Eagle Asphalt.

The highest quality of any asphaltum imported into Canada

Write for prices and particulars to

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

Engineer, Montreal, Que. Signed, David Seath, Secretary, 57 Common Street, Montreal.

▲—**Ottawa, Ont.**—Tenders will be received up till December 11th for the roofing of St. Gabriel shed No. 1, Ottawa Street, Lachine Canal. Plans and specifications may be obtained from the office of the Chief Engineer, Department of Railways and Canals Ottawa, Ont. Signed, L. K. Jones, Esq., Ass't Deputy Minister and Secretary, Department of Railways and Canals.

Ottawa, Ont.—Tenders will be received up till January 8th for the construction of a steel twin-screw ice-breaking steamer to be delivered at the King's wharf in Quebec City. Plans and specifications may be obtained from the office of the Purchasing Agent, Marine and Fisheries Department, Ottawa, Ont. Signed, Alex. Johnston, Esq., Deputy Minister of Marine and Fisheries.

Ottawa, Ont.—Tenders are expected to be called for very shortly for the new government ice-breaker which is to be built for the St. Lawrence next year. Plans and specifications will be accessible at the Montreal offices of the marine department in the Shaughnessy building. They call for an 8,000-ton twin-screw steel ship, 292 feet long, 56 feet 9 inches wide and 32 feet deep. The crew will number 90, and with the exception of the 10,000-ton Russian steamer Hermak, the new boat will be the largest in the world.

Ottawa, Ont.—On the 18th of April, 1913, the Bell Telephone Company will open the Carling exchange, now under construction in Ottawa. This will improve the service throughout the city, and will accommodate about 2,500 subscribers when it is opened.

✚—**Ottawa, Ont.**—The Dominion Government has awarded the contract for addition and alterations to Orillia public buildings to C. WEBB & SON, at a cost of $31,485.

Port Arthur, Ont.—The Miles Car and Manufacturing Company of Cleveland, Ohio, may establish a plant at either Port Arthur or Fort William. The company has written Manager Robinson, of the local railway, concerning facilities for extending its business in Canada and at this centre.

Quebec, Que.—The plans for the new Union Station at Quebec have been enlarged, the Government having reconsidered its ideas as to the nature and extent of the joint occupancy.

Steveston, Lulu Island, B.C.—Reeve Bridge has stated that he has received assurance that the Columbia Cold Storage Company will construct at once its building and equipment at a cost of over $170,000, and to be completed if possible by next April. Already arrangements have been made for the construction of a spur from the British Columbia Electric Railway to serve the plant and warehouse.

Sydney, N.B.—Mr. Gillies, president of the city board of trade, has written to the Hon. J. D. Hazen, Minister of Marine and Fisheries, on behalf of the board, to request the government to act in regard to keeping open from Jan. 20th to April 1st, the Sydney harbor. If an ice-breaker were in operation during this period, there would result great remunerative advantage to the city.

Vancouver, B.C.—Tenders have been called for by the Great Northern Railway Company for the excavation for the site of their new passenger depot to be built in this city. It is expected that the work will commence shortly. The earth removed will be used to fill in between the piling on the city's harbor work.

Vancouver, B.C.—The only information given by Mr. J. J. Hill and Mr. Louis W. Hill, while in Vancouver, concerning the terminal improvement schemes of the G.N.R., was that plans for the new joint passenger depot for the G.N.R. and N.P.R. lines at False Creek are being prepared.

CURRENT NEWS.

Fredericton, N.B.—The Dominion Bridge Company's erecting crew are starting to place the superstructures on the steel bridges on the Kettle Valley road. They are starting work at Centreville and will work south to Gagetown as rapidly as possible.

Fredericton, N. B.—The Foundations, Limited, have completed their work at the Highway Bridge and the greater part of their plant has already been shipped to Montreal.

Fredericton, N.B.—Messrs. A. E. Trites and Son, the construction contractors on the Gibson and Minto Railway, have completed the balasting work on the railway. The entire work is now practically complete.

Hanna, Alta.—The Alberta Pacific Elevator Company, Hanna, have their new house here well on towards completion. The cribbing has all been completed, the roof is on and the interior work will be completed with all haste. It is hoped that it will soon be ready for business as the National Elevator here is overtaxed.

London, Ont.—City Engineer W. N. Ashplant is rushing the contractors for the Wharncliffe bridge at their top speed, and it is expected that the concrete work will be completed early in December at the latest. The piling on the West London pier has already been driven, and concrete work must be stopped when frost sets in. But piling on the South London pier for the new bridge will continue during the winter; since the South London abutment work is on the high side of the river, and is not in danger of flooding.

Moose Jaw, Sask.—A start has been made by J. D. Wheeler, grading contractor, on the site of the temporary freight and station terminals of the Grand Trunk Pacific on Main Street North, and the work is to be rushed with all possible speed to completion. There is considerable cutting to be done, and also a large fill where the spur track will leave the main line.

Newcastle, N.B.—Work on the new wireless station here is progressing rapidly. The main steel tower has been commenced, the remainder of the steel work for it having arrived recently from England. Four of the six wooden towers are now over two hundred feet high and rapidly nearing completion, as is the power-house, which is being built of concrete and steel.

New Liskeard, Ont.—Good progress is being made upon the laying of water mains from the Dunn Springs to connect with New Liskeard's water supply. Mr. Hiram Proctor is the engineer in charge.

New Westminster, B.C.—Work has been begun filling in the piling built off Eighth Street for the new harbor work. The dredge John A. Lee is anchored off the head of Lulu Island and has begun loading the scows with the sand and silt which will be employed in the filling.

Penticton, N.B.—On the Kettle Valley Railway, on the west fork of Kettle River, between Beaverdell and the summit, splendid progress is being made. The grade is already finished to the summit, and the steel is within ten miles. The work on the tunnel on the Penticton side of the summit is progressing satisfactorily.

Port Arthur, Ont.—The double track on the C.P.R. between Port Arthur and Navilus on the eastern division has been completed, the connecting link being made by the finishing of construction on Current River bridge.

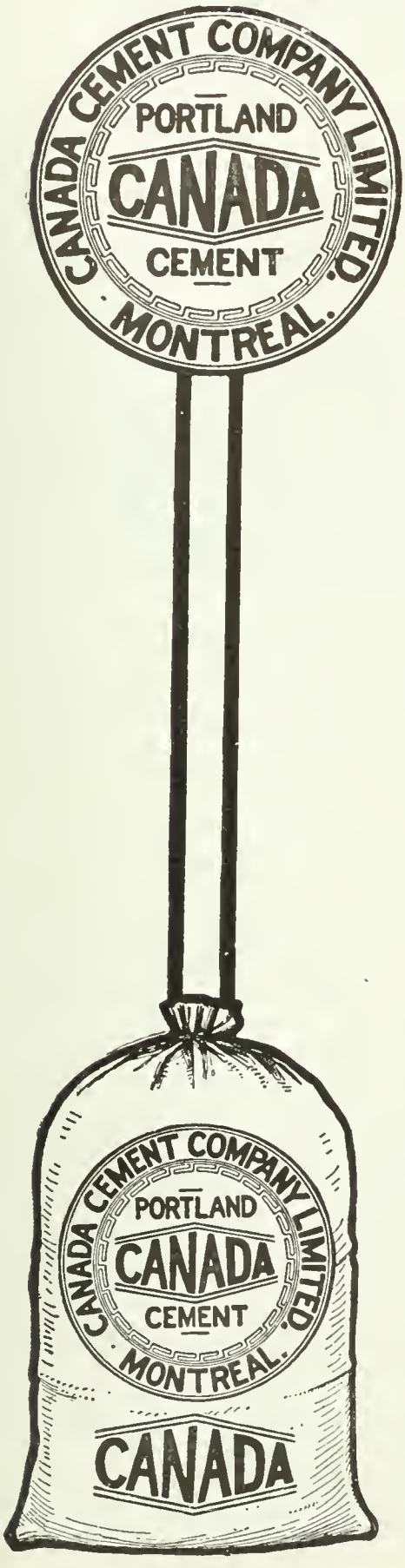
Sarnia, Ont.—Surveyors for the Government are now in Sarnia making an extensive survey of the proposed new harbor. The work will be carried on through the winter until it is completed.

Smithers, B.C.—What is probably the highest suspension bridge in the world has just been completed across the Bulkley River at Hagwilgate. It is 250 feet above the river, and is 600 feet in length. Moreover, it is one of the biggest single span suspension bridges in the world. Its one span being 451 feet long. Aside from the work of the Grand Trunk Pacific, this bridge is the biggest engineering project ever undertaken in the Northern Interior of British Columbia. It was built by George Cradock and Company, of Wakefield, England, and is the largest single bridge contract ever undertaken by that firm. The structure is of a special stiffened type, suspended from catenaries of locked coil cables which do not rotate or lengthen. The bridge is as rigid as it is possible to make it. In addition to its guaranteed carrying capacity allowance is made for meeting any extra strains that may be put upon it such as wind or other stresses.

St. Catharines, Ont.—The civic council has decided to stop all work on the Ontario Street bridge until spring.

St. John, N.B.—Mr. Josephy McVey, of McVey and Son, has stated that the company will complete the sub-structure of the new bridge at the Falls on schedule time, so that the Dominion Bridge Company may commence work on the superstructure. Mr. McVey's firm has already blasted between 4 and 5 thousand cubic feet of rock on the Carleton side of the Falls to prepare for the masonry work to support the spandial arch. His company will build the retaining wall, and also

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the buildin of permanent structures is now generally adm tted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

sink four anchor holes, two on each side of the Falls, each 30 feet deep in the ledge, for the Dominion Bridge Company.

Sydney, N.B.—An extension to Sydney's "White Way" is now on foot, and every effort is being made to have the work completed before Christmas.

Vancouver, B.C.—Pouring of concrete has begun on the Main Street end of the Georgia-Harris bridge, and the contractors are laying about 400 cubic yards a day, working two shifts of eight hours each. There are about 2,500 cubic yards to lay in this section, but Mr. A. P. Hueckel, engineer in charge, expects the work to take about ten days in all. The retaining wall at Georgia Street is finished as well as the foundations for the pillars across the C.P.R. yards to False Creek. The contractors expect to have the structural steel for this portion of the bridge partly on hand about the beginning of next month. Depending on what pieces are shipped first, they will begin the steel fabric at once, working right through the winter.

Vancouver, B.C.—The harbor work is once more in operation, and filling in back of the dock already built is in progress. The dredge has been anchored at the head of Lulu Island and scoops up sand and silt from the river bed to fill the scows. Later this will be covered with rock and gravel. Pile-driving will be resumed shortly.

Vegreville, Alta.—The town authorities have succeeded in disposing of $30,000 worth of debentures. Work has accordingly begun toward connecting the unfinished water main with the water tank, which is nearing completion, and also toward piping natural gas from the town well to light the streets. The present electric light plant is unable to keep pace with the town's growth.

Victoria, B.C.—Premier McBride has announced that the various proposals respecting the construction of Second Narrows bridge will be taken up by the provincial executive. He has received a communication from the directors of the Burrard Inlet Tunnel and Bridge Company, asking for an early statement as to the government's intentions in the matter. The government, as has already been announced, has been asked to assume control of the project. Sir Richard McBride discussed the matter with Sir John Wolfe Barry, bridge engineer, while in England, and has one or two schemes to lay before the provincial cabinet.

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout & Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Canada.—Leslie Bradford, separation of metallic sulphides from gangue; Hugh Arthur Thomson, ozone producers, with treatment bottle attachments, for the destruction of tubercule bacilli; Chas. C. Wakefield, intermittent driving mechanism for lubricators; Harry G. Akers and Alex. Bonnington, fixation of nitrogen. James M. Wilson, rotary pumps and motors; Gustaf E. Ohrn, methods and apparatus for concentrating ore.

TRADE ENQUIRIES.

The following enquiries relating to Canadian trade have been received: 1786.—Firm of undoubted standing in Nurnberg, Germany, having extensive connection in Europe, would undertake to represent a first-class Canadian exporter of asbestos, mica and mineral products. 1709.—Electrical and Mechanical Engineer, resident in Toronto, having undertaken manufacturers' agency, contemplates three or four months' tour through Great Britain, and desires to communicate with reliable Canadian manufacturers with a view to introducing their goods. Enquirer is familiar with machinery generally, but will handle any manufactured line. 1808.—Samples and prices of wire are asked for by a Cape Town firm of importers. 1821.—Samples and prices of wire are asked for by a South African importer.

The names of the firms making these enquiries, with their addresses, can be obtained upon application to: "The Enquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary, and Chambre de Commerce du District du Montreal.

NEW INCORPORATIONS.

Medicine Hat, Alta.—The Redcliffe Gas and Oil Company, Limited, $300,000.

Edmonton, Alta.—Coalondyke Coal Mining Company, Limited, $200,000.

Lacombe, Alta.—The Middle West Construction Company, Limited, $50,000.

Prince Rupert, B.C.—North Pacific Iron Mines, Limited, $600,000.

Fort Steele, B.C.—Fort Steele Waterworks Company, Limited, $20,000.

Swift Current, Sask.—The Swift Current Concrete Products Company, Limited, $50,000.

Vancouver, B.C.—Consolidated Contractors, Limited, $250,000. Maclennan Construction Company, Limited, $25,000.

Toronto, Ont.—Blodgett Re-Inforced Safety Tube Company, Limited, $100,000. W. H. Cook, G. B. Jackson, A. I. Shortt.

Windsor, Ont.—McNaughton-McKay Electric Company, Limited, $40,000. A. McKay, J. R. McNaughton, F. H. Boyer.

Montreal, Que.—Electrical Properties, Limited, $1,000,000. C. A. Pope, G. Barclay, W. B. Scott. White Smelting and Refining Works, Limited, $20,000. J. W. Richards, J. A. T. Richards, P. du H. Richards.

Calgary, Alta.—The Eagle Oil Company of Calgary, Limited, $10,000. Sorenson Stock Company, Limited, $10,000. The Independent Oil Company, Limited, $250,000 Standard Oil Fields of Alberta, Limited, $650,000. United Oil of Alberta, Limited, $2,500,000. Sentinel Oil Company, Limited, $150,000. Great Northern Oil and Development Company, Limited, $200,000. The Herron Elder Gas and Oil Development Company, Limited, $1,500,000. The Pacific Oil and Refining Company, Limited, $500,000. Mountain House Oil Company, Limited, $100,000. The Deep-Well Oil and Development Company, Limited, $200,000. The Western Pacific Oil Company, Limited, $250,000. Alberta Hydro-Electric Company, Limited, $1,000,000.

MONTREAL MARKET LETTER

Montreal, November 25th, 1913.

The local iron and steel trade is marking time, and no more. So far as can be learned there is only one branch of the iron and steel industry which is in really comfortable shape just now, and this is the structural steel industry. It is stated that the bridge companies have orders on hand far into the future, and that this is more or less true in respect to all structural steel companies. So far as concerns iron furnaces and rolling mills, these are in rather a doubtful position. Prices are certainly lower than they were some time ago; but it is claimed, on the other hand, that the operating costs have been reduced considerably. Also, the output of some of the concerns has varied noticeably, so that profits are likely to make a better showing than might at first be supposed. Prices of pig iron have not shown any alteration of late; but the basis of quotations will probably be changed next week. Notwithstanding the declines which are taking place from time to time in the United States, the local market would seem to be practically unaffected, quotations being much the same in every instance as heretofore.

Reports from the United States are to the effect that car orders during the past year are likely to be very little more than half those for 1912; and at the moment it does not seem likely that this proportion will be greatly altered by the results of the next month. Orders for all sorts of iron and steel products seem to be falling off, and advices are to the effect that the earnings of the United States Steel Corporation are likely to be considerably affected thereby. In Canada orders for cars have certainly not been coming out as freely as they were a year ago, and at the moment there is every likelihood that some of the car companies will have to slow down during the coming winter.

Sold in Canada by

AZTEC OIL & ASPHALT REFINING CO. of Canada

311 Shaughnessy Bldg., Montreal

Refined by

THE U.S ASPHALT REFINING CO.

AZTEC ASPHALT

Canadian municipal and highway engineers and road contractors should buy Aztec Asphalt on account of the qualities possessed by its bitumen. It is not—like other asphalts—merely "over 99 percent bitumen." Aztec is over 99 percent bitumen of special qualities that make it particularly suitable for Canadian requirements.

AZTEC BITUMEN

is solid, high-grade and best suited to Canadian conditions, because neither frost nor hot weather injures it. Aztec retains its tenacity under all conditions, also resisting all water action.

The extremes of temperature in most Canadian cities make asphalt more of a "problem" for Canadian engineers than it is for engineers in any other part of the Continent. Other asphalts that are entirely successful in South America, Mexico, Europe or in central or southern parts of the United States, might fail in Canada because of the extremes in temperature here.

For Canada asphalt must not only be pure (nearly 100 per cent bitumen) but the bitumen *must retain its tenacity at all temperatures*. In this regard Aztec excels. It is impervious to water, stays malleable even when buried under snow or ice for long periods, does not soften noticeably in summer and has great coherence, resisting wave tendencies.

Aztec is refined near Baltimore, Md., from liquid asphalt, or maltha, imported from Vera Cruz (Mexico), the land of the Aztecs. It is the expert North American labor, added to the high character of the Mexican maltha, that accounts for Aztec's superior qualities.

We would be pleased, upon request, to quote, send samples or mail further literature regarding Aztec Asphalt.

TRADE MARK

COMMERCIAL USES

Aztec is supplied with the consistency best suited to the special purpose for which it is required. Prompt deliveries on asphalt for

ROOFING
INSULATING
PIPE DIP
WATERPROOFING
BLOCK FILLER
RUBBER MAKING

For sheet asphalt or for road binder—either mixed or penetration method—Aztec excels.

AZTEC OIL & ASPHALT REFINING CO. of Canada

311 Shaughnessy Bldg., Montreal

SOLE CANADIAN IMPORTERS

TENDERS CALLED FOR

TENDERS FOR A COMPLETE MECHANICAL FILTRATION PLANT.

BOILERS, STEAM TURBO-GENERATOR PLANT AND ALL APPURTENANCES.

Tenders will be received by registered post only addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on

Tuesday, January 20th, 1914,

for the installation of a complete Mechanical Filtration Plant, Boilers, Steam Turbo-generator Plant and all appurtenances at Toronto Island.

Specifications and Tender forms may be obtained upon application at the office of Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City by-law must be strictly complied with, or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or, in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, November 25th, 1913.

DEPARTMENT OF RAILWAYS AND CANALS.

LACHINE CANAL.

NOTICE TO CONTRACTORS.

ROOFING ST. GABRIEL SHED No. 1.

Sealed tenders, addressed to the undersigned and endorsed "Tender for Roofing of St. Gabriel Shed No. 1, Ottawa Street, Lachine Canal," will be received at this office till **12 o'clock noon, Thursday, December 11th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer of the Quebec Canals, New Birks Building, Montreal, Que.

An accepted bank cheque on a chartered bank of Canada for the sum of $500.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,
L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 22nd November, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it. 51421.

BURRARD PENINSULA JOINT SEWERAGE BOARD.

TRUNK SEWERS. CONTRACT No. 1.

Sealed tenders for the construction of Trunk Sewers endorsed as above and addressed to the undersigned will be received until **2 o'clock p.m., December 1st,** at the offices of the Board 514/518 Birks' Building, Vancouver.

The proposed works comprise approximately ten thousand (10,000) feet of concrete sewer, with appurtenances, varying in diameter from 6 ft. 6 in. to 4 ft., including all work and the finishing of all material. Alternative tenders for monolithic and pipe sewers will be considered.

Plans, specifications, forms of tender and contract can be seen at the offices of the Board on and after November 20th, and copies of same may be obtained from A. D. Creer, Engineer to the Board, on payment of a sum of $50.00 (by marked cheque), which will be refunded on the return of all plans and documents supplied.

No tender will be considered unless accompanied by a certified cheque upon a Vancouver branch of a Chartered Bank, payable to the order of the Board, for a sum equal to 5 per cent. of the amount of the contract. The cheques of unsuccessful tenderers will be refunded to them upon the contract being awarded, and the cheque of successful tenderer will be returned upon execution and delivery of contract and bond for due performance thereof.

The right to reject any or all tenders is reserved, and no tender will be considered which is not in conformity with the specifications.

By order of the Board,
G. W. PHIPPS,
Secretary.

514 Birks' Building, Vancouver, B.C.

TENDERS FOR MACHINERY AND EQUIPMENT.

Tenders will be received by the Bowness Improvement Company at their offices, 202 Eighth Avenue West, Calgary, Alberta, until 5 p.m., December 31, 1913, for the following machinery and equipment:—

"L." One 200 k.w. Traction Motor Generator.
"M." One four panel Switch Board.
"N." One 250 k.v.a. Generator.
"O." One Vertical Single Acting Multi-Cylinder Gas Engine.

Bidders must enclose certified cheque in the amount of 5 per cent. of their tenders. Cheques of unsuccessful tenderers will be returned immediately after contracts are awarded. Specifications may be obtained from the engineer, and may be seen in the offices of *The Canadian Engineer*, 820 Union Bank Building, Winnipeg, 62 Church Street, Toronto and 628 Transportation Building, Montreal.

The lowest or any tender not necessarily accepted.

T. L. TURNBULL,
Consulting Engineer,
202 Eighth Avenue West,
Calgary, Alberta.

TENDERS FOR PUMPING PLANT, ETC.

Sealed tenders will be received by C. F. Monroe, Township Clerk, for a pumping plant for use in the new Waterworks System of the Township of Stamford, County of Welland. The source of water supply being one or more 8-inch wells.

Tenders will also be received for Wrought Iron, Cast Iron and Steel pipes, in sizes from ¾ inch to 10 inch, with valves, Fire Hydrants, etc.

Quantities and other information may be obtained from J. C. Gardner, Township Engineer, Niagara Falls, Ont.

Tenders must be in the hands of the Township Clerk not later than 2 o'clock p.m., Monday, December 1st, 1913. The lowest or any tender not necessarily accepted.

C. F. MONROE,
Township Clerk, South End P.O.

Steel Bridge For Sale

An excellent opportunity is offered to bridge constructors, contractors, etc., for obtaining a substantial, well-built steel bridge ready for immediate delivery at a moderate price. This bridge was formerly in use by the Canadian Pacific Railway over the St. Lawrence River at Lachine, P.Q., and was recently replaced by a double track structure. It is in excellent condition.

FOUR SPANS FOR SALE

LENGTHS AS FOLLOWS:

Two 408 foot Thro' Spans.
Two 269 foot Deck Spans.

Continuous over five supports.

408 foot spans weigh 682 tons each.
269 foot spans weigh 353 tons each.

Total Weight 2070 Tons.

LOADING:
Approx. equivalent to Cooper's E30.
WIDTH: 20′ 0″ C to C Trusses.
DEPTH: 40′ 0″ C to C Chords.

TENDERS FOR PURCHASE OF THIS BRIDGE

WILL BE RECEIVED BY

E. N. BENDER, GENERAL PURCHASING AGENT

Canadian Pacific Railway, Montreal

Second-Hand Machinery

Advertisements under this heading three cents per word per insertion, if not "displayed." Minimum 50 cents per insertion.

New and Second-hand

Contractors' Machinery For Sale

IMMEDIATE DELIVERY.

1—8"x12", double cylinder, double drum hoist with boiler (new).
1—7"x12", double cylinder, double drum hoist with boiler (new).
1—7"x10", double cylinder, double drum hoist with boiler (used).
1—6"x12", double cylinder, double drum hoist with boiler (new).
1—6½"x8", double cylinder, double drum hoist without boiler (new).
1—6½"x8", double cylinder, single drum hoist with boiler (used).
1—5"x7", double cylinder, single drum hoist without boiler (new).
1—10"x10"x10", Steam Driven Air Compressor (new).
1—8"x10"x8", Steam Driven Air Compressor (used).
1—No. 3, Ransome Concrete Mixer on skids (used).
1—No. 2, Ransome Concrete Mixer on wheels (used).
4", 5" and 6" Centrifugal Pumps d.-c. to Vertical Engines (new).
3", 3" and 4" Centrifugal Pumps, d.-c. to Gasoline Engines (new).
5" and 6", Belt Driven Centrifugal Pumps (used).

H. W. PETRIE, Limited

Front Street West TORONTO, ONT.

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

CITY OF MOOSE JAW.

WANTED—CITY ENGINEER.

Applications addressed to the undersigned will be received for the position of City Engineer for the city of Moose Jaw.

Apply, giving experience, reference and salary required.

E. B. BONNELL,
City Clerk.

Dated at Moose Jaw this 12th day of November, 1913.

FIRM OF PUBLIC WORKS CONTRACTORS require the services of a first-class civil engineer to take charge of engineering department on large canal contract in Canada. Must be thoroughly experienced in this particular class of work. State experience, age, salary required, and give references. All applications will be treated in strict confidence. Apply Box 178, *The Canadian Engineer*, Toronto.

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PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 122,662, granted on December 14th, 1909, to Harry Arthur Westmoreland, of London, England, for Dropper and Standard, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh & Smart, 53 Queen Street, Ottawa, Canada. Russel S. Smart, resident.

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NEW INCORPORATIONS.

Montreal, Que.—Armstrong, Whitworth, of Canada, Limited, $2,000,000. Sir E. P. Cranwill, Right Hon. Sir George H. Murray, S. W. A. Noble. Roger Miller and Company, (P.E.I.), Limited, $200,000. W. R. L. Shanks, F. G. Bush, G. R. Drennan. British Manufacturers' Association of Canada, Limited, $10,000. L. A. David, L. J. Maurice, Dugas, L. E. A. d'Argy-Mailhoot.

Calgary, Alta.—The Shale Brick Company, Limited, $100,000. Western Prairies Oil Development Company, Limited, $250,000. Lucky Mary Oil and Natural Gas Company, Limited, $200,000. Huron and Bruce Oil and Natural Gas Company, Limited, $200,000. The Scottish Oil Company, Limited, $10,000. Marine Oil Products, Limited, $500,000. The Golden West Oil and Gas Syndicate, Limited, $500,000 Great West Oil Lands, Limited, $250,000. Rabbit Foot Oi and Gas Company, Limited, $500,000.

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QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
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BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, November 24th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1 40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3 45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25 lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3 50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21 25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2 10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, November 26th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¾-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washaco, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2 in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3 55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, November 25th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3 16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7.16, $4.75; ½, $4.50, 9-16, $4.50; ⅝, $4.40; ¾ $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie cut, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.80; 26, $4.70; 24, $4.80 22, $4.20; 20, $4.10 per cwt.

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English or 30-gauge American, $4.90; 30-gauge American $5.15. Fleur de Lis 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $2.55; ¾-inch, $4; 1-inch, $5.55; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—¼-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in. $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; tire cauld, $4.50 base; tire steel, $3 base; cast tool steel, 1b., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Dec 4, 1913

Contents of this issue on page 807

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

RAILWAY ECONOMICS

IMPORTANT FACTORS OF THE SUBJECT AS APPLIED MORE PARTICULARLY TO THE RAILWAYS OF CANADA—QUESTIONS AFFECTING LOCATION AND CONSTRUCTION, REVENUE ESTIMATES AND OPERATING COSTS

By J. L. BUSFIELD, B.Sc., A.C.G.I., and W. H. ABBOTT.

RAILWAY economics is a subject to which much attention has been given by railway engineers in recent years. There has been so much construction undertaken by the different railways latterly, that a great amount of data has had to be compiled on the subject of economics. The following table is illustrative of the amount of work that was undertaken and completed by the larger railways in Canada during the year 1912:

Canadian Northern Ontario Railway	195	miles
Canadian Northern Railway	304	"
Canadian Pacific Railway	360	"
Grand Trunk Pacific Railway	608	"
Intercolonial Railway	17	"
Timiskaming and Northern Ontario Railway	30	"
National Transcontinental Railway	358	"

making a total of 1,872 miles of railway in one year.

The problem of transportation in this Dominion is one peculiar to itself, and is made more difficult to deal with on account of the lack of precedent. The conditions cannot well be compared with those in the United States, either as they are now, or as they were when the large transcontinental railways were first developed on the south side of the border, consequently the subject has to be dealt with largely from first principles.

Economics of Location and Construction.—This branch of the subject deals with the relations between the cost of operation and the cost of construction, of any particular section of railway and finding the best location, of that section of railway, which will give the most economical combination of cost and operating expenses and at the same time give the maximum revenue.

There are two classes of location, one being the location of a new line of railway between two points hitherto unconnected, the other being the relocation of an existing piece of railway in order to give more economical and better financial returns.

In the case of an entirely new project it is usual to make a preliminary examination of several different routes and then make a comparison of the following estimated features:—

Probable revenue from each line.
Cost of construction.
Annual traffic—gross tonnage.
Cost of handling such traffic,

and, in addition to these specific items, the effect of future changes in traffic or operating conditions must be considered. This latter is one of the most important items in this country as the railways, more particularly in the Western Provinces, have built and are building lines through practically unsettled districts basing their estimates of the volume of traffic and sources of revenue on the future settlement of the districts adjacent to the railway, the general effect of railway development being to increase the population of that part of the country served by the new line, due to better transportation facilities.

In the case, however, of the relocation of an existing line, besides taking into account the increased efficiency obtainable by the new route or line (which can be computed more accurately than in the case of an entirely new line) allowance has to be made for the possible injury to existing facilities and also for the value of the facilities on the old route which have to be abandoned. In this instance the net income has to be increased to such an extent that a proper return will be obtained on the capital outlay necessary to make the entire change.

Probable Revenue.—There are several methods of estimating the probable revenue or the volume of traffic of a section of proposed railway. The first method is to make a comparison between the whole population of the country and the gross earnings from the operation of all the railways, and then to assume a similar amount per capita for the projected railway. This method is quick and easy, but is very approximate and is really more suitable for a country more developed than Canada, such as the United States, but it is of interest to note that the gross earnings of Canadian railways average about $29 per capita per annum of the whole population of Canada.

A second method is to estimate the probable earnings per mile of railway by a comparison of the earnings per mile of some existing railway or railways similarly situated. The gross earnings per mile is a very variable quantity on different railways and only a very approximate idea can be obtained by this method, but the following table illustrates this more clearly:

TABLE I.

Name of railway.	Gross earnings	Mileage.	Gross earnings per mile.
Intercolonial	$ 11,003,410	1,462.89	$ 7,520
Canadian Northern	20,860,093	4,272.92	4,811
Canadian Northern Ont.	881,953	492.35	1,792
Canadian Northern Que.	1,327,534	369.27	3,597
Canadian Pacific	116,233,812	10,813.70	10,748
Grand Trunk	35,801,975	3,105.82	11,526
Canada Atlantic	2,173,363	459.26	4,766
Halifax & South Western	478,031	378.32	1,264
Timiskaming & Northern Ontario	1,935,421	302.28	6,408

The above railways are selected from those with a greater mileage than 300, but the following table gives similar figures for five of the smaller roads:

TABLE II.

Name of railway.	Gross earnings.	Mileage.	Gross earnings per mile
Algoma Central and Hudson Bay	$545,054	134	$4,067
Bay of Quinte	238,333	89	2,689
Kingston & Pembroke	225,936	109	2,054
Midland Ry. of Manitoba	61,155	98	624
New Brunswick & P.E.I.	37,726	36	1,048

A third method is that of estimating the receipts per head of tributary population. This method is only applicable to those parts of the country where a fairly accurate estimate can be made of the location and magnitude of the population. In Eastern Canada maps can be obtained from the Dominion Government giving the location of all existing railways, highways, buildings, etc., on a scale of one mile per inch. These are a great help in making the population estimate. The proposed road will usually pass through some territories in which it may reckon on obtaining all the traffic. An example of this is where a new railway location is through a valley separated from other railways by intervening hills. The new railway can, in a case like this, assume that it will receive all the traffic from that district. In the case of a new railway passing through a town or village already served by a railway, it cannot expect to obtain half the traffic from that town, but only a proportion of it, depending on the relative importance of the two railways, the transportation facilities to and from the depots, distance from the centre of population, nature of the roads, convenience of the train service and sundry other features.

A fourth method is to make a comparison of the production or the producing character of the country which the railway will tap and that of some territory as nearly similar as possible, and note the revenue of the railway serving that territory. An even better way is to combine the third and fourth methods and compare the new and existing roads by means of their tributary population and by dividing the gross earnings of the existing line by its tributary population, a fair approximation is obtained to the probable gross earnings per capita of tributary population of the proposed route. Allowance has to be made, however, for the different character of the locality served by the existing railway.

The fifth and last method of estimating the probable revenue is probably the most accurate. This method is to make a very close estimate of the amount of business that will be obtained from all the different sources of revenue. This requires a great deal of careful study of all the manufactories, mines, lumber mills, farms and every industry located near the proposed route. It is not difficult to make such an estimate when the railway is being built through a country well populated and not previously served by a railway. But in a great many parts of Canada an estimate of the revenue cannot be based on the existing conditions but only on the future estimated conditions of the country after it has been developed by the railway itself. A factory may also be located in the country to be served and it is usually safe to assume that its business will be increased by the advent of the railway. With regard to farms, an experienced man can make a close estimate of the business to be obtained from them, and the distances their produce will have to be transported to the nearest market. In making this estimate other transportation facilities for the farmers have to be considered. Each proposed station on the route will have to be studied independently and information of each source of revenue gathered together, and also information as to the probable markets for the products at each point. The following table gives the percentages of the different sources of revenue for freight traffic for all the railways in the Dominion of Canada and also for the United States.

TABLE III.

Sources of revenue.	Percentage Canada.	Percentage U.S.
Products of agriculture	19.33	8.13
Products of animals	3.53	2.10
Products of mines	35.20	56.23
Products of forests	15.82	11.67
Manufacturers	18.16	14.42
Merchandise	3.03	3.69
Miscellaneous	4.93	3.72
	100.00	100.00

The relations between freight and passenger earnings varies for different parts of the country, but is approximately the same for all the roads in the same locality. The following table gives the proportions of freight, passenger and other earnings on different Canadian railways:

TABLE IV.

	Freight revenue. %	Passenger revenue. %	Other revenue. %
Alberta Ry. and Irrigation Co.	71	25	4
British Yukon Railway	75	24	1
Intercolonial Railway	65	32	3
Prince Edward Island Railway	48	50	2
Canadian Northern Railway	74	19	7
Can. Northern Ontario Ry.	68	29	3
Can. Northern Quebec Ry.	72	26	2
Canadian Pacific Railway	68	30	2
Central Ontario Railway	68	29	3
Dominion Atlantic Railway	57	42	1
Grand Trunk Railway	63	35	2
Halifax & South Western Ry.	51	48	1
Kingston & Pembroke Railway	72	29	1
Ottawa & New York Railway.	54	43	3
Quebec Central Railway	68	31	1
Quebec & Lake St. John Ry.	63	34	2
St. Lawrence & Adirondack Ry.	60	39	1
Timiskaming & Nor. Ont. Ry.	56	39	5
Vancouver, Victoria & Eastern Railway	66	32	2

Whatever method is used for estimating the volume of traffic there are always a number of conditions which affect this volume in different ways. For instance, the proximity to the probable source of traffic is a feature to which great attention should be paid. In Eastern Canada where there is keen competition between different railways the locating engineer must subordinate all other requirements to that of locating the road where it will be in a position to obtain the maximum of business. It is always advisable to spend more money on freight and passenger facilities in the cities and towns served by the road, even at the expense of cheaper construction on the line between the cities. There are some good local examples of railways going to great expense to reach the heart of the business districts of the towns and cities where there is or is likely to be competition from other railways. The Campbellford, Lake Ontario & Western

Railway (C.P.R.) has constructed its new line of railway through the busiest part of Trenton, Belleville and other towns of Ontario in order to be in a better position to obtain the local traffic from these towns than the Grand Trunk Railway, which is already established, in many cases, on the outskirts of the towns. Another important instance of this is the construction of the Mount Royal Tunnel by the Canadian Northern Railway at Montreal. This great undertaking will bring the lines of the C.N.R. right into the heart of the hotel and shopping district of the city, to a passenger terminal, and will also give access for the freight traffic to the warehouse and business districts of the city. This question of terminal facilities naturally depends on the limit of capital which may be expended on the terminals without financially wrecking the whole undertaking. The proposal to defer the time of building into the heart of a city is one which should not be considered as it invariably becomes a more and more expensive undertaking as time advances.

Cost of Construction.—In Canada—where there are long stretches of thinly populated country on all transcontinental lines—it was only natural that originally many miles were built of the cheapest construction possible without very much attention being paid to the future requirements, but even though the traffic from these sections is practically nil and they are non-revenue producing, they form links in the chain across the continent and the lines should be built in such a way as to ensure economy of operation for the heavy through traffic. Great sums are now being spent by the Canadian railways improving the grades and alignment on some of the non-revenue producing sections in order to reduce the cost of operation of the whole system.

The type of construction to be adopted naturally will depend entirely on the estimated volume of traffic. If the traffic expected is light, then it would not be a good policy to build the railway at great expense in order to reduce the operating expenses, thus having very high fixed charges, but if the traffic over the road is to be very heavy, then a greater expense of construction per mile would be warranted in order to give a high operating efficiency, i.e., to keep the cost of hauling trains over the road at a minimum. The interest and maintenance charges for a poorly located and constructed road may be $2,500 per mile per annum or more, and the direct cost of hauling one ton over a mile of that road will be nearly a cent. Increasing the efficiency of the location and construction of the railway will necessarily increase the annual interest and maintenance charges, but the cost of hauling each ton will be reduced in greater proportions due to the increase in possible train loads over the better grades of track. There has been, due to these circumstances, a demand for every improvement in location and construction which would enable a railway to conduct transportation more economically.

Having made the preliminary surveys of the alternative routes between any two points, an estimate of the cost of construction of the different lines is made by collecting all the materials of a kind under one head and obtaining unit prices for all the different classifications. A form somewhat similar to the following may well be used for making these preliminary estimates of cost—spaces being left on the right hand side for filling in the actual completed cost of the work, thus serving as a better guide for future estimates.

Item.	Quantity.	Estimated cost. Price.	Subtotal.	Total.	Cost completed. Total.	Price per unit.

The road may be built entirely by contract or by day labor under charge of the engineer or superintendent. The contract method is more usual. The chief engineer will have the entire charge of the work of construction and will, with the assistance of the attorney of the company, after consultation with the officers of the company, draw up all the specifications and contracts for the work. The following table gives the approximate percentages of the different items that go to make up the total cost of building a mile of a standard single-track railway suitable for heavy traffic.

TABLE V.—Percentage of Cost.

1.	Right of way	5·5
2.	Proportionate expense of terminals	13·9
3.	Bridges and culverts	11·0
4.	Grading	33·0
5.	Track laying	19·4
6.	Ballasting	8·4
7.	Fencing	1·4
8.	Telegraph service	0·5
9.	Stations and water supply	3·3
10.	Engineering	1·9
11.	General and legal expenses	1·7
		100.0

Considering these items separately, the cost of right-of-way is one that is naturally extremely variable and will often depend on the publicity given to the whole scheme before the right-of-way agents are able to get the necessary options on the lands. Frequently right-of-way can be obtained cheaper by a carefully studied location. For instance, if the railway is so located that it cuts through farms at right angles to their length the danger is not so great as in the case where the railway locates right down the centre of a long and narrow farm, leaving two even narrower strips on either side. When possible, the best location through cultivated or pasture land is parallel and adjacent to the lot lines.

The second item is one which varies with the nature of the railway and the towns it serves. It is higher for locations where there are large cities and towns comparatively close together, requiring greater expense on terminal facilities per mile of road than in places like the Western Provinces, where the towns are far apart. But even in some of the small western towns large terminals are being built to take care of the increased traffic induced by the growth of the country.

Items three to seven are ones in which considerable economies can be made if necessitated by the financial status of the company. For example, it has already been stated that money should be expended on first-class terminal facilities, even at the expense of cheaper construction between the terminals. This can be quite satisfactorily done by using more or less temporary construction for some of the smaller bridges and culverts which can be built cheaply, without sacrificing the operating efficiency of the road, and they can easily be replaced by permanent structures when this expense is warranted by the earnings of the road. Similarly in the case of the grading, temporary wooden trestles can be built instead of heavy em-

bankments, but it is not advisable to put in heavier grades in order to save earthwork unless it is absolutely necessary. These trestles can be filled in eventually at a cheaper cost per cubic yard owing to the track being already laid from which the filling can be readily dumped from side dump cars by a rapid unloader. In the case, however, of there being a large cut immediately adjacent to the proposed fill, it is, of course, more economical to use the material from the cut to make the fill when the road is first constructed.

Economies can be made in the tracklaying and ballasting items without seriously effecting the cost of operation, but the maintenance charges will necessarily be higher with light rails and poor ballast. The expense of replacing the light rails and re-ballasting the line will not be disproportionately great.

The other items in the cost of construction are comparatively small percentages and big reductions in them do not make very much reduction in the total cost per mile, but large economies in any of them are apt to cause, indirectly, greater expenses in some of the larger items, or a loss of revenue to the road. That it is a false economy to cut down engineering and legal expenses is becoming more generally recognized among the larger railways. Thousands of dollars may be saved on the construction of a road by having well-organized and equipped engineering staffs working under the guidance of competent men. Similarly economies in station buildings, freight sheds, etc., are apt to adversely affect the revenue of the line.

Annual Traffic—Gross Tonnage.—A comparison of the annual traffic and gross tonnage must be made of the different routes under discussion. The amount of the gross tonnage has to be estimated in a way similar to that already described as the fifth method of estimating probable revenue. The probable gross tonnage must be carefully analyzed so as to obtain figures which will not only apply to the whole route but also to the sections between the intermediate towns. It will be as well to note at this point that it is desirable in estimating gross revenue and gross tonnage to be on the safe side by keeping the figures on the low side in the case of the former and on the high side for the latter. This will prove to give the most satisfactory results in the long run.

Cost of Handling the Traffic.—The features controlling this item are distance, curvature and grades, and we will deal with each of these features in the order named.

Distance.—This is the item on which the rates chargeable for passenger and freight services are based. This is apt to be rather contrary to the value of the service rendered and also to the cost of rendering that service. If the railway adopts a very costly construction in order to reduce the distance betweeen any two points it will be able to give a better and quicker service both for passenger and freight traffic between these points, but, by a strict mileage rate, the actual compensation would be lower than for a longer and cheaper route. On some of the roads in the States serving the large business centres this feature of the increased value of short routes and quick service is illustrated by the fact that an extra charge is made on the fast passenger trains over and above the regular fares between the two points. The actual value of the transportation to a passenger who wishes to go from, say, Montreal to Toronto, is inestimable. If he is travelling purely for pleasure, or for a whim, the money value to him approaches nothing, but if he has to attend to important business the actual value to him of being able to attend to it personally may be many times the cost of his ticket.

The cost of transportation between any two points is only slightly influenced by small changes of distance as it is ruling grades and curvature of the line which most seriously affect this cost, as will be shown later. The effect of change of distance on maintenance of way charges (except in the case where it is a change of a few feet only) is fully proportional to the amount of that change. The expenses of labor and material, etc., will naturally be proportionately increased because it is assumed that in the case of a shorter route there will only be employed sufficient section gangs to properly take care of that line. If the length is increased, either additional gangs will have to be employed or else the existing ones would have to be reinforced.

The cost of bridges, road crossings, culverts and other fixtures of this nature would have to be considered separately for each route, as in some cases the number of bridges, etc., would be identical on the different routes, hence there would be no effect on the cost of structures by a change of distance. With regard to the maintenance of equipment any added train mileage will naturally increase the depreciation of rolling stock and increase the shop expenses, repairs and renewals. The actual mileage run by locomotives, passenger and freight cars is only one of the contributory causes of their deterioration. They deteriorate with age, strains due to stopping and starting, etc. The following table illustrates the effect of large and small change of distance on operating expenses:

TABLE VI.

	Normal average.	Cost per mile p.c. large.	small.
Maintenance of way and structures	20.09	18.11	15.53
Maintenance of equipment	22.74	9.18	8.50
Traffic expenses	3.08	0.00	0.00
Conducting transportation	50.54	21.69	9.21
General expenses	3.65	0.00	0.00
	100.00	48.98	33.24

In the above calculations it has been assumed that the business done by the road is fixed and invariable and would be unaffected by any changes in the length of the line. A change of length in order to reach a possible source of traffic would naturally affect the tonnage and consequently the number of trains required to handle it, but the rest of the line might be so burdened by an excess haul that the traffic might be discouraged. A saving in time between two points by a reduction of distance is—except in a very few cases—not to be effected except by a great expenditure which can hardly be justified by the time saved. The reduction in distance will have no effect on the freight business so far as the small saving in time is concerned, and may tend to reduce the rate considerably between the two points under discussion. The effect on the passenger traffic (except in the case of competing lines between large business centres) is comparatively small and the speed of trains is controlled to a large degree by the curvature and grades of the line.

Curvature.—Curvature increases the resistance to traction and, when uncompensated on grades, may be said to increase the rate of grade. When a curve is located on the ruling grade it has a controlling effect on the length of trains. Insofar as passenger traffic is concerned, curvature has very little effect beyond limiting the

speed of trains when the sharpness of the curves is over a certain amount varying with different conditions. On competing lines, however, this may be a serious matter, not only on account of time lost, but also due to the apprehension of danger, and because the curvature may produce rough and unpleasant riding. These objections to curvature may be almost entirely eliminated as regards the number of trains required to handle the traffic as the only feature which might control this is the possible increase of a ruling grade by an uncompensated curve, and this may readily be eliminated by compensating curves on ruling grades. On minor grades uncompensated curvature has but little effect, as it merely increases the rate of grade, and unless the original grade plus the increase in grade due to curvature does not exceed the ruling grade it will not limit the tonnage of trains in any way. If, however, the combined effect would be to make the resistance more than that due to ruling grades, then trains loaded up to the maximum for those grades would be liable to stall on the curve.

Grades on the lower side of a stopping place need not be compensated for curvature, because the resistance due to the curve will reduce the work required in braking the trains. When a curve occurs above a stopping place it should be compensated in an even greater degree than ordinarily.

Curves should evidently be compensated an amount equal to that grade which would produce the same resistance as the curve. The resistance due to curvature being a variable quantity depending on the speed of trains, compensation for fast passenger trains may be made quite low, but for slow and heavy freight trains, which are the most important, it must be gradually increased. Webb advises 0.04% to 0.05% per degree for ordinary degrees of curvature. The maximum degree of curvature permissible on any road is a matter on which opinions differ considerably. Some roads limit their engineers to a maximum curvature of 6 degrees, others leave this to the judgment of the engineer. There is no serious objection up to a certain limit to a few sharp curves where the amount saved may be sufficient to justify their introduction. One limiting feature of the maximum curvature is the ruling grade. For instance, where the ruling grade on a line is 0.4% and the rate of compensation has been fixed at 0.4% per degree of curve, it is obvious that a ten-degree curve is the maximum permissible, as this degree has theoretically the same resistance as a .4% grade, and if the 10-degree curve was located on a ruling grade to be correctly compensated the grade would have to be eliminated entirely.

Curvature has a very marked effect on the maintenance and operating expenses of a line. Rails on curves wear much more rapidly than those on tangents; it has been computed that the wear on a rail on a 10-degree curve is 226% of the rail wear on a tangent, under similar conditions of traffic, and that it is approximately proportional to the degree of curve. Ties are also adversely affected by curvature owing to increased rail cutting, and they need more frequent respiking. Wellington states that the deterioration of ties is also proportional to the degree of curve. That part of the roadbed under sharp curves has to be more frequently reballasted, especially when the superelevation is high. The expense of repairs and renewals becomes greater owing to the harder wear on locomotive tires and wheels, thus increasing shop expenses.

The increase of tractive resistance due to curvature naturally tends to increase the fuel consumption of locomotives. Webb charges 44 of the average cost per train mile for an addition of 528 degrees of central angle into a mile of track. In some mountainous regions where a number of sharp curves are unavoidable operating expenses may be sometimes increased by locating these curves in deep cuts, thus necessitating the use of watchmen to warn trains of obstructions due to snow slides, etc., or, as an alternative, the speed of trains must be reduced as they pass these places.

The following table (abbreviated from Webb) gives some idea of the items affected by curvature, being based on the addition of 528 degrees of central angle into a mile of track.

TABLE VII.

Item.	Normal average.	Cost per mile per cent.
Maintenance of way	20.09	5.93
Maintenance of equipment	22.74	28.70
Traffic expenses	3.08	0.00
Conducting transportation	50.44	5.02
General expenses	3.65	0.00
	100.00	39.65

It will be seen from this table that an addition of 528 degrees of central angle into a mile of track increases the expenses per train mile by 39.65% of the average cost per train mile. Assuming that the increased expense is directly proportional to the amount of curvature, which, in the majority of cases, is very nearly true, then one degree of additional central angle per mile would increase the train expenses by .075%. If, again, we assume that the average cost per train mile to be $1, the cost per annum per daily train would be 27.375c. This result is, of course, entirely approximate but will give a better idea of the value of a proposed change than any unbased estimate, and will show whether the improvement will be justified, due to possible increase in business.

Grades.—The effect of grades on train expenses is of the greatest importance. Tonnage of trains is fixed by the ruling grade on the section of line under consideration, a heavy ruling grade necessitates shorter trains and consequently more of them. Gross receipts from traffic is a fixed quantity regardless of the number of trains necessary to handle it, while the cost of handling the traffic will be nearly proportional to the number of trains. A reduction of ruling grade, on the other hand, reducing as it does the number of trains and therefore the operating expenses, will justify a large expenditure to accomplish this result. Where the line runs through comparatively level stretches of country with light grades, very little can be done to favorably affect the grade, but humps and sags in otherwise uniform grades may be eliminated. No figures on the resistance to movement of a train on straight level track can be considered accurate for all cases, as they depend on speed, length of trains, character of cars, and condition of weather and roadbed, but 10 lb. per ton is frequently taken for average conditions and velocities. This is equivalent to the retarding effect of a 0.5% grade.

The rate of ruling grades are necessarily limited by the general character of the road. A road designed to meet the requirements of light traffic would naturally not be justified in a large expenditure to reduce the rate of ruling grade, whereas on a road built for heavy traffic this would be of prime importance. Methods of operating the trains will, to a large extent, minimize the effect of ruling grades, the road being divided into divisions, at the termini of which sorting yards may be located, and the trains

increased or decreased when the grades on the next division make this advisable. If the road has necessarily to pass over a summit between two points and the natural grade is very high it may be advisable to use pusher engines on this high grade, a lower rate can then be used for the ruling grade.

On most roads the ruling grades affect only the heavier class of freight trains, the lighter freight and passenger trains being usually well under the maximum tonnage capacity of their locomotives. The cost of operating is dependent on the number of trains and not on their tonnage, and an extra train means an extra locomotive, train crew, etc., and this extra engine and train will also increase the maintenance of way charges due to the additional wear and tear of the track.

A small saving is made by having fewer cars per train due to the lighter work on the engines, when hauling over the minor grades and level sections. The following table gives an idea of the effect on different items of operating (n + 1) trains on heavy ruling grades compared with the cost of operating "n" trains on light grades, the tonnage being the same in both cases:

TABLE VIII.

Item.	Normal average.	Cost per mile per cent.
Maintenance of way	20.09	7.45
Maintenance of equipment	22.74	5.88
Traffic expenses	3.08	0.00
Transportation	50.44	28.30
General expenses	3.65	0.00
	100.00	41.63

In estimating the probable train mileage of a new road the estimated tonnage, ruling grades and the type of engine to be used must all be taken into account. It is possible to get an approximation of the hauling capacity of any type of locomotive over the ruling grades. In practice the engine is not loaded up to capacity, the reduction being dependent upon the rate of grade and its length. In general, this reduction will be as follows:

Grades of 0.3% to 0.6%, reduction 25% to 16%
Grades of 0.7% to 1.0%, reduction 14% to 10%

Dividing the estimated tonnage by the hauling capacity of the engine and multiplying by the length of the line will give the train mileage. Multiplying this by the cost per train mile will give the yearly cost of operating. The saving resulting from adopting a lower ruling grade or using pusher engines in isolated cases of heavy grades may thus be determined.

The last of the 92 leaves for the miter gates of the Panama Canal locks was lowered into place on its hinge pintle on Thursday, October 30th. This was the side wall leaf of the lower operating gate in the east flight at Miraflores Locks. The lower operating gates at Miraflores are the largest in the Canal construction, each of the lower leaves being 82 feet high and weighing over 700 tons. The swinging of a leaf means the completion of its erection, sheathing, and most of the riveting and reaming, but it is a step toward final adjustment. The work of lining up and babbiting the nickel steel bearing plates at both ends of a leaf can be completed only after the leaf is swinging in operating position, and the leaves are yet to be tested, painted inside and out, and fitted with foot-walk and handrail.

ELECTRIC LOCOMOTIVES FOR MOUNT ROYAL TUNNEL.

VARIOUS features of the tunnelling of Mount Royal, by the Canadian Northern Railway, in order to reach a terminal in the centre of the city of Montreal, have been described in *The Canadian Engineer* during the past year. Attention is directed to Jan. 16th issue, outlining the essential engineering aspects of the scheme; to Feb. 6th issue for an article descriptive of the early operations and the plant equipment; to Feb. 27th issue dealing with the precise survey work in connection with its location, and to the issue of June 12th, where mention was made of the remarkable speed with which operations were progressing. In Oct. 9th issue the announcement was made of the contract for the electrification of the tunnel having been let, as, in the design, considerations of cleanliness and health pointed to the use of electricity as the motive power. The present article contains a few points of interest with respect to the design of the locomotives selected.

The equipment for the electrification of the tunnel and terminals, for which the Canadian General Electric Company, Limited, has the contract, includes 6 electric locomotives designed for an operating potential of 2,400 volts with overhead trolley construction. Two of these locomotives, operated and controlled as a single unit, will have ample capacity and suitable speed requirements for handling the heavy transcontinental passenger trains—1,130 tons trailing load—within the Montreal terminal zone. A single locomotive will successfully handle the freight trains—1,000 tons trailing load—and the local passenger service—500 tons trailing load.

Locomotives.—The general type of the locomotive proposed is that known as the box cab, articulated running gear type of locomotive. Its estimated weight is 83.0 tons. The locomotive has four axles with all of the weight upon the eight driving wheels, thus securing the maximum adhesive weight on drivers. The running gear consists of two 4-wheel trucks, articulated together by a heavy hinge. The equalization of the trucks is accomplished by a heavy locomotive type semi-elliptic leaf spring over each journal box, connected through spring hangers to the frame and to the equalizer bars. Practically a 3-point suspension is thus supplied through the side equalization of one of the trucks and both side and cross equalization of the other truck. With the Miner friction draft gear mounted in the end frame casting of the truck, this type of construction restricts the hauling and buffing stresses of the truck side frames and articulated joint, instead of through the cab centre plate. This relieves the cab and apparatus from the effect of severe shocks.

Both the box cab and platform are built of plates, sheets, angles and heavy channels, and are thoroughly reinforced throughout. The box cab is divided into three compartments: the apparatus compartment in the centre and the two operators' compartments at the ends. Each operator's compartment has a full complement of apparatus, consisting of controller, control switches, meter, air brake control apparatus, air gauges, pantagraph control and heaters, thus providing the locomotive with a complete double-end control. All apparatus subject to 2,400-volt potential is located in the centre apparatus compartment and properly screened to protect against accidental contact. The location and general arrange-

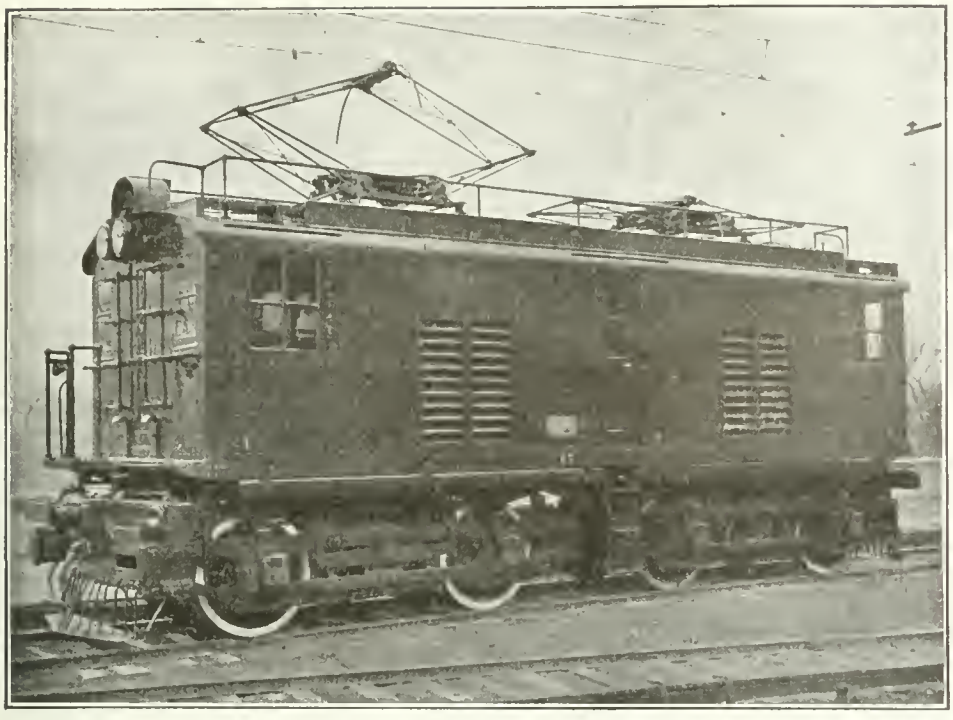

Fig. 1.

ment of this apparatus is such as to provide easy access from all sides for inspection, cleaning and repairs.

Control Equipment.—The Sprague-General Electric Type "M" multiple unit double-end control equipment is proposed for the locomotives, all the control points being proportioned and adjusted so as to secure a smooth and even acceleration, at all times, corresponding to a current consumption near the slipping point of the wheels. The transition between series and series-parallel is effected by a special electro-pneumatically operated change-over switch and the motor fields will always be on the ground side of the armature.

A motor generator set will supply 125-volt energy for the operation of the control and a 2,400-volt air compressor of 100 cubic feet free air piston displacement is provided as part of the air brake equipment. Two air-operated roller pantagraphs and a properly insulated bus line are located upon the roof. The bus line will supply power to two or more units from the pantagraphs of any of these units.

The motor equipment consists of four C.G.E. -229 commutating pole type motors wound for 1,200 volts and insulated for 2,400 volts, so that two may be connected permanently in series and operated on a 2,400-volt circuit. These motors are geared to the wheels through twin gears, there being one pinion on each end of the armature shafts. The C.G.E.-229 motor is especially designed for locomotive service and is provided with forced ventilation by a blower located in the apparatus compartment. The locomotives are geared for a free running speed on tangent, level track of approximately 45 miles per hour and will be operated as two-speed machines with ten points in series and nine points series-parallel.

The air brake equipment will be the straight air and automatic type so as to combine the desirable features for train operation through an equalizing reservoir and the independent operation of the brakes upon the locomotive. Provision is made for the multiple operation of the compressors upon all locomotives when operating in multiple so as to distribute the duty upon all the compressors in the train.

Operation of Motors.—The motors will be operated by the Sprague-General Electric Type "M" two-speed control arranged to operate the motors in series and series-parallel. The external regulating resistance is divided into two parts, each part being directly connected to a pair of motors permanently connected in series. The two pairs of motors, with their resistances, are all connected in series on the first point of the control, the resistance being varied through the first nine points on the controller and finally short circuited on the tenth, or running point. The two pairs of motors are then similarly operated in series-parallel and all resistances cut out on the last or full speed running point.

A special electro-pneumatically operated change-over switch is used to make the transition between series and series-parallel so that there will be no appreciable

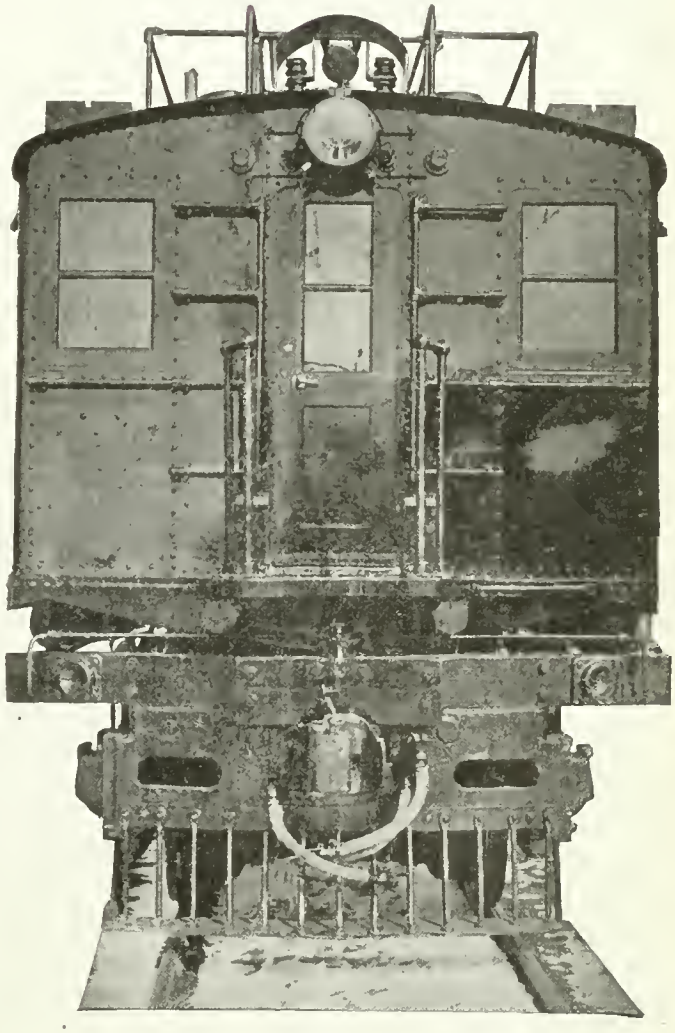

Fig. 2.

reduction in tractive effort during the change. A smooth transition between all points, both rheostatic and transitional, insures motor operation close to the slipping point of the wheels and a steady, gradual acceleration at all times.

The motors have sufficient capacity to slip the wheels, the slipping point serving as a current limit to prevent overloading. Either pair of motors may be cut out, in case of emergency, by means of a special handle on the change-over switch.

Controllers.—The master controllers receive their energizing current at a potential of 125 volts from the motor generator set and provide for operating the contactors so that they close the motor circuits under different combinations and regulate the external motor resistances to give 10 points series and 9 points parallel. The controller is of the non-automatic type and has two handles: one regulating the applied voltage at the motors and the other for controlling the direction of rotation of the motors. Each of the above handles control a single cylinder.

Pantograph Trolleys.—The overhead trolleys are of the pantograph type, mounted on insulated bases and pneumatically operated. A hand pump is provided for raising the trolley in case a locomotive has been standing some time and has no air supply.

Automatic Stops.—Provision is made for automatically opening the control circuit and cutting off all power from the locomotive, in case the engineer over-runs a signal set against him. At the same time a special valve is opened which will set the emergency air brake.

The huge scheme, undertaken at a cost of £3,500,000 sterling, of the provision of a water supply for the gold fields of Western Australia, is a wonderful piece of hydraulic engineering work, and is now well advanced. The primary purpose of the work was not to insure the subsistence of a large community of people, but to maintain and develop a staple industry established in a practically waterless district 400 miles from the western coast of the state. A daily supply of 5,600,000 gallons was to be provided, of which 5,000,000 were for use in the gold fields. The source of supply is an artificial reservoir, from which the water is pumped through a steel conduit 80 inches in diameter by means of eight pumping installations to the main distributing reservoir at Bulla Bulling. This reservoir is 308 miles from the main reservoir and is 1,200 feet above the lowest outlet level of the latter. The water then gravitates a distance of 44½ miles to the Coolgardie service reservoir and the Kalgoorlie service reservoir. The details of all the ironwork used in the construction of the weir were drawn out in the state and all the ironwork used was obtained from Great Britain, and it says much for the accuracy displayed in the drawings that on being grouped together as the work progressed all parts fitted correctly into their proper places. An interesting feature of the work at Kalgoorlie was the use of camels for excavation purposes. According to figures supplied for the use of the Christian Science Monitor by Neil McQueen, the district engineer, 86 camels were used for the excavation work, which was in stiff clay, in connection with the Kalgoorlie reservoir. This reservoir will be lined with a bitumen asphalt compound invented by P. V. O'Brien, the chief engineer in charge, and will be roofed with corrugated iron to keep dust out of the water and prevent evaporation. The reservoir, which is circular, has a diameter of 378 feet and a depth of 22 feet at the deepest part. Its capacity is 10,000,000 gallons.

THE CORROSION OF PIPES BY RAW AND TREATED WATERS.

THE lengthy series of investigations based upon the corrosion of iron pipes by water supply was carried on during 1912 by the Department of Water Supply, Gas and Electricity of New York City. The results of these experiments are contained in a paper read recently before the American Public Health Association by Mr. Frank E. Hale, from whose paper the following information is deduced:—

The presence of carbonic acid is the most potent factor in connection with the presence of dissolved oxygen. The action of these two agents is modified by the presence of other salts, increased by nitrates which furnish oxygen by reduction, and decreased by carbonates which help to form protective coatings upon the pipe. The chemical action takes place in the following order:

The first reaction is the solution of iron as bicarbonate by carbonic acid with the formation of hydrogen. The dissolved oxygen in the water which is near the iron surface oxidizes some of the hydrogen back to water. After the oxygen near the iron is used up the hydrogen remains as a gas. In the cold reaction of the experiments the amount of hydrogen oxidized was found to be about 20 per cent. The dissolved oxygen at the same time oxidizes the soluble iron bicarbonate to insoluble red iron, setting free again the carbonic acid. The carbonic acid set free again dissolves more iron, and is again set free, until all of the dissolved oxygen is exhausted. The red iron oxide then acts as oxidizer until it is completely reduced to black magnetic iron oxide, setting free carbonic acid again. Reduction does not take place beyond this stage. After all dissolved oxygen has been used up nitrates are completely reduced to ammonia, serving to supply oxygen. After all possible sources of oxygen are exhausted the carbonic acid disolves more iron, which is probably thrown out of solution finally as insoluble basic carbonate of iron, since after complete reaction there is only about 0.2 to 0.7 p.p.m. iron in solution, no free carbonic acid, no dissolved oxygen, no nitrate, sometimes no bicarbonic acid, and under some conditions caustic lime is present. The alkalinity of hard waters is reduced to about 25 p.p.m.

The carbonic acid for the solvent action may be derived from three sources—the free carbonic acid, the bicarbonic acid, and the neutral carbonate. In the latter case the carbonate hydrolyzes so that there are in solution neutral carbonate, lime hydrate and carbonic acid. This takes place when the water reaches the stage that only neutral carbonate is present. The carbonic acid set free dissolves the iron. The presence of lime hydrate was proven by titration with phenolphtalein and methyl orange.

The rapidity of corrosive action is affected by the source of carbonic acid in order as given above, and the amount of soluble iron present during the active stages of corrosion varies with the above order of source of carbonic acid.

Another source of carbonic acid is that set free in alum-treated waters. This is really mostly bicarbonic acid set free. The amount set free per grain of alum per gallon is not, as sometimes stated, 6.8 p.p.m., but about 3.5 p.p.m. (determined by analysis).

It must be understood that the facts as given above apply to new pipe with a clean iron surface and to complete reaction.

Attempts to remove dissolved oxygen from water appear to me to be hopeless as well as expensive, because a consideration of the above reaction brings out a fact that

seems to me to have escaped general attention, and that is that 15 per cent. of the oxygen in the iron oxides formed by complete reaction, if all the hydrogen were set free, comes from the water and not from the dissolved oxygen, and the greater part of the hydrogen is set free.

A very large amount of iron is corroded for each part per million of dissolved oxygen through the catalytic action of carbonic acid and water. For example, 10 p.p.m. of dissolved oxygen produces 126 p.p.m. Fe_3O_4 expressed as Fe, whereas if the hydrogen were oxidized and not set free the amount which 10 p.p.m. oxygen could produce would be only 31 p.p.m. iron. In our experiments 75 to 80 per cent. of this theoretical amount of iron was produced, the difference from theory being due to oxidation of hydrogen. This is a variable quantity, but about 85 per cent. of the hydrogen oxidized was oxidized during the first 15 minutes, which substantiates the idea expressed previously that oxidation of hydrogen takes place only at the surface of the iron while dissolved oxygen is present near the iron. The presence of hydrogen gas is easily shown and has been proven by many investigators. Any hydrogen set free means an equivalent amount of oxygen obtained from the water to oxidize the iron.

Experiments Conducted With Three Kinds of Pipe.—The experiments were carried out with Byers wrought iron pipe (protected with an inside coat), Reading wrought iron pipe, lack mild steel, and galvanized wrought iron. The first three showed no difference in the corrosive action when carried to completion, but the steel appeared to corrode most rapidly. The galvanized iron showed great resistance at first, but gradually—especially with alkaline water—the action increased somewhat, though in the time of our experiments the highest amount was only about one-third that of the other pipes.

Experiments with regard to speed of reaction brought out some surprising facts.

About 50 per cent. of the iron produced by corrosion in the cold is produced in two to three hours.

With Croton water (5 p.p.m. free carbonic acid) the action is practically complete in 15 hours. This explains the greater tendency in house service—especially in new services—to show rusty water when first drawn in the morning, since the action is complete over night.

The rate of corrosion is increased proportionately to the increase in free carbonic acid. The action cold was complete in seven to eight hours with Croton water containing 25 to 50 p.p.m. free carbonic acid. The total iron was also somewhat increased with the higher free carbonic acid. The carbonic acid hastens the action by dissolving the iron more rapidly. There being more iron in solution, oxidation is hastened. Analyses for soluble iron and dissolved oxygen proved this to be true. The carbonic acid increases the total iron by forming basic carbonate of iron which is left unoxidized after available oxygen is exhausted.

Alum-treated water showed no appreciably greater corrosive action either in speed or total amount of iron than untreated water. This is due to the comparatively slight increase in free carbonic acid (3.5 p.p.m. per grain of alum per gallon).

Neutralization of the free carbonic acid retards the corrosive action. Neutralization of the free carbonic acid by lime hydrate or by sodium carbonate retards the corrosive action. Neutralization of the free and half-bound carbonic acid by lime hydrate, provided there is no excess caustic, still further retards the corrosive action, and also reduces the total iron produced by cold action 33 per cent., and by hot action 50 per cent. Neutralization of carbonic acid retards corrosion by reducing the amount of dissolving agent, hence the amount of soluble iron present at any moment, and thus slows up the oxidation.

The slightest excess caustic (a few p.p.m.) up to considerable excess hastens corrosion to almost indentically the same degree as does increasing the free carbonic acid to 25 to 50 p.p.m. A large excess of soda-ash acts likewise. The action of alkalis has been noted by Cushman and others.

Excess alkali hastens the corrosion by hastening the absorption of oxygen by the iron in solution, though this is smaller in amount at any time. Until the excess of alkali is sufficient to prevent hydrolysis of carbonates the corrosion takes place. Analyses proved that the oxygen is absorbed faster and that only traces of iron are in solution at any time. Compare in this connection the Levy method of determining dissolved oxygen in water—i.e., oxidation of ferrous salts in alkaline condition.

Red Water Trouble Caused by an Excess of Iron Dissolved or Suspended.—The excess of alkali necessary to stop corrosion completely is 100 to 125 p.p.m. excess lime hydrate over that needed to neutralize the free and half-bound carbonic acid. Only slightly more is needed to stop corrosion hot than cold. This amount of excess alkali acts by completely preventing solution of iron, for the oxygen still oxidizes the surface of the iron and is completely gone in twenty-four hours, although no iron over the original amount appears in the water.

The above facts show that whatever helps to put iron into solution is the real cause of red water trouble. It is the iron in the water, dissolved or suspended, which causes trouble—not the iron clinging to the pipe.

All corrosive action was hastened by heat (120-150° F.), so that complete reaction was accomplished in one and a half to three hours on the clean iron surface. Heat hastens corrosion in at least four ways—by hastening the chemical action of solution of iron, by increasing the amount of free carbonic acid since heat sets free the half-bound carbonic acid of the alkalinity, by creating convection currents that cause the dissolved iron to diffuse more rapidly and hence come in contact with the dissolved oxygen faster, and by hastening the oxidation and precipitation chemically of the dissolved iron.

The water of the Flatbush Water Company, which has a hardness of about 140 p.p.m., contains only two-thirds as much oxygen as Croton water and 10 p.p.m. free carbonic acid, produced corrosion as rapidly as Croton water on the clean iron surface and a total amount proportional to the oxygen and carbonic acid content as required by theory. Yet in service this water causes no complaint and is generally free from iron and turbidity. This is undoubtedly due to protective scale formed on the pipe, probably consisting of both iron oxide and carbonate of lime. As previously stated, the alkalinity of hard waters is reduced to about 25 p.p.m., when the action goes to completion.

Dissolved oxygen disappears rapidly in all cases. In the first fifteen minutes 23 to 37 per cent. were used up due to oxidation of both hydrogen and dissoved iron.

The relative speed of oxidation is best seen in comparing percentages of oxygen used up to one and a half hours.

So long as there is oxygen in solution the reaction takes place rapidly and almost proportional to time and the iron precipitate is red (Fe_2O_3). After exhaustion of the oxygen the reaction becomes slower, the red oxide being reduced to the lower black oxide, turning green to

brown to black. The color of the precipitate gives a good indication of the progress of the action.

While there is dissolved oxygen present there is iron in solution, depending upon the amount of active carbonic acid. Soon after the oxygen disappeared it was but rarely that more than 0.5 to 1.0 p.p.m. iron was in solution. It is obvious that the amount of dissolved iron is greater with increase in the active carbonic acid.

The amount of oxygen within wide limits does not seem to affect the rate of corrosion materially, but the total amount of iron removed from the pipes in complete reaction, other factors remaining the same, is directly proportional to the dissolved oxygen in the water.

When iron pipe is exposed to the continuous action of water, as in service, a protective coating forms according to the nature of the water. Its action is to delay corrosion rather than to stop it, and to reduce the amount of iron appearing in the water. The corrosion goes on slowly, but the oxides cling to the iron, increasing the amount of scale. In cold action the greatest protection was acquired experimentally in ten days, and then remained constant. Flatbush and Brooklyn waters caused a better protective coating than Croton water. The iron produced in 24 hours dropped from 114 and 84 p.p.m. respectively for the two former to 21 p.p.m., Fe, for the Croton, and its modifications from 56-102 to 29-35 p.p.m., Fe. Croton was tried in four modifications—untreated; with free carbonic acid neutralized by sodium carbonic acid; neutralized by lime hydrate to bicarbonate, and treated with one grain of alum per gallon.

In hot action the protective coating formed in two days. Flatbush water reached the lowest level of 3 p.p.m. iron with an average of 8. Brooklyn water reached 4 p.p.m. iron with an average of 9. Untreated Croton fluctuated high and low with an average of 41 p.p.m. iron. The alum-treated Croton averaged 26. The soda-neutralized Croton averaged 23 p.p.m., Fe. All the averages, cold and hot, include results from the tenth to the twenty-first day.

The pipes which had acquired a protective coating from these different waters were subjected for 24 hours to the action of untreated Croton water and to Croton water containing 20-27 p.p.m. free carbonic acid. The water with increased carbonic acid produced an average of 38 p.p.m. iron from the pipes with scale formed in cold action, against 24 p.p.m. produced by untreated Croton (5 p.p.m. CO_2). On the pipes with scale produced in hot action about the same relative quantities were produced, 34 against 22 p.p.m., Fe, showing that water containing the greater amount of carbonic acid causes more corrosion upon pipes protected by scale.

The scale produced by Flatbush, Brooklyn and soda-neutralized Croton water proved the more protective.

General Summary.—Extensive corrosion takes place rapidly in new pipe while the iron is fairly clean from incrustation. This explains the abundance of complaints of iron rust in new service installation.

Concerning the kind of pipe, there is little doubt that steel pipe is most readily attached, wrought iron next, and galvanized iron the least. The latter is far preferable for use. Lead pipe should never be used any more than absolutely necessary because of the danger of accumulative poisoning with minute amounts of lead (less than 0.5 p.p.m.).

The chief agent in dissolving the iron is carbonic acid, as it is also the chief agent in holding iron in solution.

The chief agent in carrying the rusting to the greatest extent is oxygen.

Through the catalytic action of active carbonic acid about 70 per cent. of the oxygen in the iron rust comes from the water by chemical decomposition, hydrogen gas being set free. The remainder only, about 30 per cent., is furnished by the dissolved oxygen in the water.

Soft Water Containing Much Free Carbonic Acid Causes the Most Trouble.—Waters which give the most trouble are very soft and contain considerable free carbonic acid.

Hard waters rarely cause complaint, as they form an excellent protective coating on the pipes.

The action in distribution services probably never reaches completion on account of protecting scale of oxide, etc., which retards corrosive action. The scale varies with different waters in protective properties. Tap samples in New York City have shown no appreciable diminution in dissolved oxygen or in free carbonic acid, so that only slight corrosion can have taken place in proportion to volume of water and possible reaction. Even hot services have shown the usual amount of carbonic acid and more oxygen than would saturate the water at the temperature when drawn.

Since in distribution services there is no exhaustion of oxygen, any increase in free carbonic acid may mean a possible increase of soluble iron in the water, which would be precipitated in the hot water supply.

Neutralization of free and half-bound carbonic acid is impracticable as it tends to hasten corrosion if there be the slightest excess of hydrate, removes zinc when hot from galvanized pipe, interferes with alum precipitation and color removal, and produces considerable precipitation of calcium carbonate in the water, which would deposit in the pipe system, meters, etc., unless previously removed by filtration or sedimentation.

Neutralization of only free carbonic acid is feasible, since it retards corrosion and reduces the amount of soluble iron.

Either soda-ash or lime oxide may be used. Both reduce the corrosive action, cold or hot. Only sufficient lime should be used to form bicarbonate. This reagent increases the hardness 1.1 p.p.m. for every 1 p.p.m. free carbonic acid neutralized to bicarbonate. About 5.3 lbs. CaO per 1,000,000 gals. of water are required for each 1 p.p.m. carbonic acid. It is best handled dry. It costs about 2 cents per 1,000,000 gals. per 1 p.p.m. carbonic acid.

Soda-ash is more soluble, can be handled in concentrated solution and consequently in small-sized tanks, and probably with better regulation of dosage would not increase the hardness, but, on the contrary, would decrease the lime sulphate in the water, changing it to sodium sulphate, thus improving the water for boiler use and for other industrial purposes. It also apparently helps to form a better protective coating on the pipe. About 20.2 lbs. soda-ash per 1,000,000 gals. of water are required for each 1 p.p.m. carbonic acid. This would cost about 20 cents per 1,000,000 gals. for each 1 p.p.m. carbonic acid. Soda-ash has been used successfully on a small scale to obviate red water trouble. The great difference in cost is due to the greater molecular weight, less combining power and greater cost per pound. The cost must be considered in connection with the degree and advantage of the change of sulphates to carbonates, etc.

Aeration of water by splashing followed by neutralization of residual free carbonic acid (about 5 p.p.m.) is probably the best practice.

FIXED CARBON DEPENDS ON CRUDE

CHICAGO EXPERT SAYS THAT HIGH FIXED CARBON IN REFINED ASPHALT IS NOT AN INDICATION OF CRACKED OIL IF CRUDE ALSO HAS HIGH FIXED CARBON

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(NOTE.—*Mr. Law, in our issue of November 20th, and Col. Howard, issue November 27th, favored the elimination of the Fixed Carbon Test. Mr. Pullar advanced an original suggestion in our issue of November 13th—that the Fixed Carbon Test be retained in specifications but that all asphalts be classified according to their sources and a different maximum limit be imposed for each class. In the following article Mr. Kirschbraun agrees with Mr. Pullar that the test has certain usefulness, and urges consideration of the liquid crude when imposing a maximum limit for fixed carbon in the refined product. He gives a formula establishing the permissible fixed carbon in any asphalt refined from crude of known fixed carbon, but it is of the empirical class of formulae against which Mr. Law presented strong arguments in his article. This shows the difference of opinion among engineers and chemists on this test.* THE CANADIAN ENGINEER *would like to hear from municipal highway or consulting engineers or road contractors who may have definite opinions regarding the Fixed Carbon Test.*—EDITOR.)

SINCE Mexican asphalt has come upon the market, there has arisen considerable comment upon the value of fixed carbon tests. Mexican asphalt has generally shown a high fixed carbon figure, and in many cases it fails to meet specification requirements where the usual maximum is given. On this account, rather than upon the merits of the matter, various producers have advised the elimination of this requirement in specifications. While the arguments presented in this direction are rather of a commercial origin, there is no question but that there should at least be a revision of this clause if retained in asphalt specifications.

In the following discussion the writer shows that the fixed carbon figure in asphalts produced from liquid crude is dependent, among other conditions, upon the nature of the crude from which such asphalt is obtained. It will be observed that the hydrocarbons yielding fixed carbon are, in the course of distillation, retained in the asphaltic product. This product will then have a normal fixed carbon figure represented by the quotient of the fixed carbon in the crude, divided by the percentage yield of asphalt. This applies under theoretically ideal refining conditions.

For example, if we have a crude showing 8% of fixed carbon and the yield of asphalt obtained therefrom is 50%, we should normally have a product giving 10% of fixed carbon. On the other hand, if we have a crude showing 4% of fixed carbon, the product should normally give 8%, on the basis of 50% yield.

If, however, refining conditions are not perfect, there will be formed decomposition products, the hydrocarbons of which yield fixed carbons, and thereby give to the resulting product an increased fixed carbon figure over and above that derived from the normal content of the crude. This is a matter of fact observation. The fixed carbon figure, thereby becomes an index of this decomposition, and herein lies the significance of the test as also the danger of its application.

It is evident that the results must be properly interpreted in the light of the above conditions, and this is only possible when the character of the crude is known, and also the yield of asphalt obtained therefrom. This is a simple matter when applied to refinery control or to inspection work at refineries, but presents some difficulties when applied in specifications generally. It is thought, however, that to those having a sufficiently wide knowledge of crude materials and methods employed in production, this would prove no special difficulty, even though it should be necessary to make tests of crudes and laboratory products in order to determine proper standards.

In the light of the present knowledge of the subject, the writer has arrived at the following tentative conclusions regarding the value of the fixed carbon test:—

(1) As a matter of refinery control it is extremely valuable in gauging the efficiency of the distilling operation.

(2) To the asphalt chemist familiar with crudes and methods of obtaining asphalt therefrom, it is a valuable indication of the care used in refining.

(3) If the fixed carbon requirement is embodied in specifications no fixed maximum should be stated unless such limit takes into consideration the effect of the character of the crude material. In order, therefore, to properly incorporate a fixed carbon requirement in specifications, the writer would suggest a clause (this referring to material of approximately 50 penetration) somewhat as follows:—

"The yield of fixed carbon obtained upon ignition of the asphalt cement must not exceed 14%, unless the amount is smaller than 3% in excess of the quotient of the fixed carbon from the crude, divided by percentage yield of asphalt."

To state this mathematically and to better advantage, the fixed carbon in the asphalt cement should not exceed

$$\frac{\text{Fixed carbon from crude}}{\text{Per cent. yield asphalt}} + 3\%$$

In other words, where the test shows in excess of 14% of fixed carbon, the above formula will apply if such excess is due to the character of the crude from which the asphalt is produced.

So far as known to the writer, the fixed carbon test was first generally applied to the bitumens of the paving industry by Mr. Clifford Richardson. Following, fixed carbon requirements have been largely introduced in specifications for paving asphalts and road binders. The value of this test has been subjected to considerable question, and in many instances much confusion has arisen through improper and empirical interpretation of results. Fixed carbon determinations must be properly considered in connection with other analytical data and further, in

connection with the character of the bitumens under examination. When so considered, the writer is of the opinion that the fixed carbon test has a decided value in specifications and is capable of yielding much information to the experienced asphalt analyst.

The writer explained in detail his understanding of the significance of fixed carbon determination in a paper before the American Society for the Advancement of Science, and presented the following laboratory data and explanations thereof, upon which his conclusions have been based.

Fortunately, the method of determining fixed carbon is fairly well standardized, and unlike many other methods employed in the examination of asphalts, the procedure at least is uniform. The method used is that recommended by the committee on coal analysis of the American Chemical Society, published in Vol. 21 (1899) page 1116. Briefly, it may be described as follows: A sample of one gram of the bitumen to be examined is weighed into a previously tarred platinum crucible of about 30 c.c. capacity, provided with a close-fitting cover. This is ignited for exactly seven minutes on a platinum triangle over a bunsen burner carefully regulated so as to give a flame 6-8 cm. high to the top of inner cone and fully 20 cm. high to the tip. The platinum crucible is placed ½ cm. above the tip of the inner cone. The ignition should be carried out in a place free from draft and permitting a steady flame. At the end of 7 minutes the crucible is removed from the flame, cooled in a desiccator and weighed. It is then returned to the flame, uncovered, turned on its side to give access to air, and ignited until all carbonaceous matter is removed. The cover is ignited to remove deposited carbon upon the under side. The crucible and cover are again cooled and weighed, the weight subtracted from that previously obtained, representing the fixed carbon.

When the bitumen carries mineral matter containing carbonates, the ash in the crucible is treated with a few c.cs. of a saturated solution of ammonium carbonate, dried, and ignited at a low heat to remove excess of carbonate and the corrected weight of ash obtained. The percentage of fixed carbon is calculated to the weight of the original sample, less the mineral matter obtained in the ashing. When notable amounts of "free carbon" are present in the bitumen, the results may be reported as fixed carbon less free carbon. The author, however, prefers to report the fixed carbon as obtained for the reason that the organic non-bituminous residues reported by the usual methods of extraction are probably seldom actual elemental carbon, but more often highly dehydrogenized hydrocarbon or hydrocarbon derivatives.

In cases where it is desired to obtain a fixed carbon figure apart from such non-bituminous matter, a portion of the soluble bitumen may be recovered from extraction for this purpose. In the hands of a single operator, uniform and consistent results may be obtained by this standard method, but skilled analysts are known to vary considerably upon check determinations. The heating value of the gas available in different localities is probably a large factor in this variation. Where certain natural gas is available for making this test, variations of 2 to 3% are known to result on this account. The quality of gas used is, of course, beyond the control of the analyst, although in the larger cities the heating value of artificial gas is fairly well regulated.

Aside from this, however, other considerations enter into the accuracy of the determinations—the exact size of the crucible, the tightness of the cover, freedom from draft, the position of the crucible in the flame and the exact size of the flame are all important factors. Considerable stress should be laid upon this latter. The standard method permits of variation of 2 cm. in the height of the inner cone and the exact length of the flame is limited only to a minimum. In the author's laboratory a bunsen burner of the Chaddock type is used for these determinations. This affords a protected and steady flame. The same burner is used for all determinations. The flame is adjusted to a scale laid off on a wood rod, graduated at a point level with 8 cm. and 20 cm. above the top of the burner. Before making the ignition, the rod is placed on the hip of the burner and the flame adjusted exactly in accordance with the graduations. A further advantage results from the use of a Chaddock burner in that the distance of the triangle (on the crown) above the top of the burner is necessarily always constant.

The importance of a more exact regulation of the flame may be illustrated by the following experiment wherein determinations were made upon the same sample under varying conditions of the flame, all other factors being the same, the crucible adjusted in each case ½ cm. above the tip of the inner cone:—

8 cm. cone, 20 cm. flame.....	13.59
6 cm. cone, full flame 25 cm. ...	12.64
8 cm. cone, 20 cm. flame	13.55
6 cm. cone, full flame 25 cm. ...	12.52

The determinations were made in the order given so that the effect of the manipulation in changing the flame, might be observed on the duplication of results. It is evident that very exact conditions of manipulation are necessary to obtain consistent results in these determinations. The discrepancies resulting from careless manipulation or even from variation of the flame with the limits given as standard may be sufficiently great to invalidate the correctness of deductions or proper interpretation of the results. It is believed that these factors are accountable for much of the lack of confidence in fixed carbon tests, and that with closer attention, a high degree of accuracy may be attained. Where conditions of gaseous fuel give comparatively high results, there should at least be no difficulty in making relatively correct and consistent determinations and specifications in such case can be modified and interpreted accordingly.

Some discussion of the derivation of the fixed carbon yielded by bitumens upon ignition is pertinent in considering the significance of fixed carbon and its consequent value in specifications. The character of the hydrocarbons present in the bitumen is a determining factor in their yield of fixed carbon. According to Richardson, this data shows the "relative proportions of carbon and hydrogen in the bitumen under examination. In the cases of paraffine hydrocarbons of the formula $C_n H_{2n} + 2$ no fixed carbon is left on ignition, while the amount increases with each diminution of the proportion of hydrogen to carbon, until in Grahamite as much as 50% is found, where the relation of carbon to hydrogen is as 8 to 1".

In other words, the yield of fixed carbon in bitumen is commensurate with the degree of condensation of the particular classes of hydrocarbons present in such bitumens. This condensation is brought about by natural agencies in the native bitumens. The manufacture of solid bitumen from native liquid bitumens involves the production of more of condensed aggregations of hydrocarbons as the resultant product. This is a function of the process used, and may be effected by means of de-

hydrogenization by air or sulphur, by oxygenation, by the splitting off of hydrocarbon, or merely by the concentration of more condensed hydrocarbon through the removal of lighter ones by distillation. Several means of condensation may be employed in the same process.

Remembering that fixed carbon is a measure of condensation of any given aggregation of asphalt hydrocarbons; and that such hydrocarbons may vary in degree of condensation to the extent that they become insoluble in certain fluxes, in carbon tetrachloride, and even in the usual solvents for bitumen, the value of this test will be further and more specifically discussed. It is the belief of the writer that the fixed carbon characteristics of various paving bitumens are significant in three particulars:—

First, as a means of identifying and classifying native bitumens; second, as a check upon the suitability of flux combinations with hard bitumens; and third, in the production of oil asphalts, as an important means of determining and controlling the quality and uniformity of the product. With reference to the value of fixed carbon as a means of identification of native bitumens, little need be said. In connection with other data, this feature affords an important item of identification.

As is well known, the Grahamites yield very high fixed carbon, ranging from 30% to 55%. The solid native asphalts used in the paving industry yield approximately 9% to 26% of fixed carbon. Gilsonites show 12% to 17%, the harder varieties giving the higher yield. Distinction between Gilsonite firsts and seconds and their quality is indicated by fixed carbon. The fixed carbon characteristics of the individual paving asphalts are fairly well defined for each kind and this feature affords a means of check of uniformity of such natural products and sometimes of the uniformity of their refinement. This function of the fixed carbon test is not directly pertinent to specifications so far as identification is concerned, but is of much value to the analyst in affording knowledge as to the material dealt with, and correlating with such knowledge a proper treatment in fluxing and handling.

Fixed carbon, as applied to native asphalts or partially fluxed refined products, has no place in specifications. The preparation of asphaltic cements or binders from hard, highly condensed bitumens is a matter of great importance. As previously indicated, such highly condensed products vary in solubility in the different kinds of fluxes available for softening purposes, some fluxes being totally unable to dissolve these products. The life and cementing powers of asphaltic binders are directly dependent upon the permanency and extent of solution of the harder in the liquid hydrocarbons present. The reference to solution is made here, not in the strict sense of the word, but by considering combinations of this character as colloidal systems of widely varying degrees of dispersion.

Certain of these highly condensed bitumens, such as pitch produced by cracking paraffine oils, are entirely insoluble in paraffine flux, so that only a mechanical mixture of oil and solid results from attempts to flux them. They are likewise insoluble in semi-asphaltic fluxes, but are dissolved by strictly asphaltic fluxes. With other highly condensed bitumens a granular or non-homogeneous compound results with paraffine fluxes, representing a minor degree of solubility, increasing generally as the flux or refined asphalts contain more of the heavy asphaltic malthenes which are of high solvent character. The effect of the presence of the heavy asphaltic malthenes is to "dilute" the highly condensed hydrocarbons, which yield high fixed carbon, thus producing bituminous cement of proportionately lower fixed carbon yield.

Some illustration of the variation of fixed carbon in cements in accordance with the character of the flux may be tabulated below (all cements between 50 and 60 penetration).

Fixed Carbon in Bituminous Cements with the following Fluxes:—

	Paraffine.	Illinois.	Texas.	Calif.	Character of Cement.
Grahamite	14.5%	...	...	...	Punky, non-homogeneous
"	...	13.3%	...	..	Dull, greasy, short.
"	...	..	12.4%	...	Bright.
"	...	..	..	12.4%	Bright, ductile.
Calif. "B"	16.3%	..	...	...	Dull, short granular.
"	...	15.2%	...	...	Dull, granular.
"	...	...	13.6%	...	Slightly granular.
"	...	...	...	12.6%	Homogeneous, ductile.
Cuban	13.9%	...	...	...	Dull, short
"	...	13.6%	...	...	Bright.
"	...	...	11.9%	...	Bright, ductile.
"	...	...	...	11.9%	Bright, ductile.

There is no mechanical method of measuring the condition of solution of these combinations, but the physical appearance, together with the ductility, gives a general index of this feature. The reference to "punky" indicates a putty-like condition, similar to shoe polish, and will be recognized by those familiar with bituminous products thus described. In the preceding illustration the same lot of flux was used throughout, so that this factor remained the same. In the use of California flux, the higher fixed carbon yield of this offsets, in some instances, the dilution of the hard bitumen.

In fluxing combinations, there is a generally improved condition of solution as the more asphaltic fluxes are used in combinations with the hard bitumens. The higher fixed carbon figures are associated with an imperfect state of solution, and the lower ones with more satisfactory combinations or greater degree of dispersion or, if the term might be used, with a better "grading" of hydrocarbons from heavy to light. The foregoing tabulation is not directed to any particular type of bituminous cement, but is given rather as illustrating the principles involved in this feature of the discussion.

It must not be assumed that a comparatively low fixed carbon yield without reference to other tests necessarily signifies in all cases a proper flux combination, but in dealing with hard bitumens fluxed back to paving consistency, the writer believes the reverse may be correctly stated, that a high yield of fixed carbon invariably signifies an improper fluxing, producing a cement of lower or impermanent binding value.

This may be often recognized by the physical appearance, homogeneity or ductility of the cement. If these latter characteristics remained permanent through ageing, it might be safe to place complete reliance upon them for determining these features, but as a matter of fact, combinations of the kind referred to are particularly liable to change and their appearance when fresh and especially their ductility is subject to great loss upon standing, so that the significance of a high fixed carbon content is of evident importance in such connection.

Fixed carbon, of course, varies with the consistency, naturally decreasing in a given combination as the amount of flux used and the consistency increases. It is evident that an apparently low fixed carbon yield obtained at a high consistency may be in reality excessive. For example, a fixed carbon yield of 12% in a fluxed cement may not appear excessive when considered alone, but if associated with consistency of 200 penetration would be of undoubted significance. Therefore, this must be interpreted in accordance with consistency, and the correct significance may be conveniently arrived at by preparing

a curve for the given combination covering a sufficiently wide range of consistency to give the relationship desired. Such a curve is given hereinafter for an oil asphalt cement.

Where specifications are so drawn as to cover the character of fluxes used in the cement and carefully prescribe the kinds and amount which may be employed under various conditions, a fixed carbon requirement is hardly necessary. However, very large quantities of prepared cements and binders for bituminous roads and pavements are now purchased and used under such conditions as to make it impracticable to govern the fluxing operations directly. Under such conditions, particularly when a number of bitumens, rather than a single combination may be compounded into the marketed product, the value of a fixed carbon requirement in the specification as applied to the cement, becomes apparent.

The foregoing discussion has referred only to conditions in which hard, highly condensed bitumens are fluxed to paving consistency. In dealing with asphaltic products brought to grade by distillation from liquid native bitumens, a somewhat different and more important significance may be attached to fixed carbon. As has

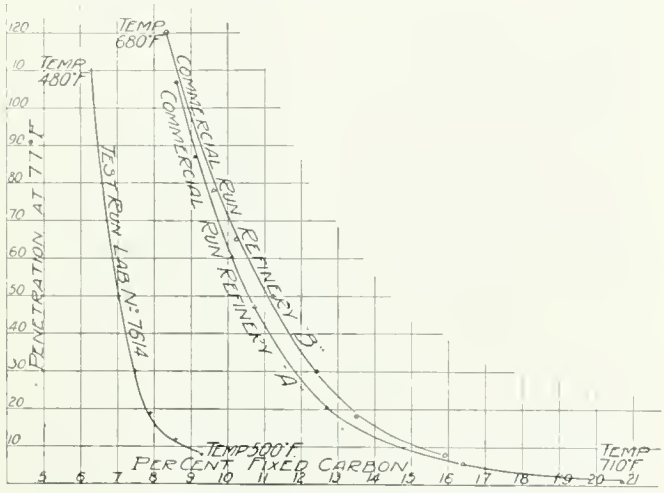

Fig. 1.

been previously stated, the formation of this class of materials involves the production of more condensed products than the liquid bitumen from which they are made. In the distillation of liquid bitumens for asphalt, it is recognized that it is desirable to avoid cracking or the splitting off of hydrocarbon so far as possible, in order that the residual may retain its binding strength and permanency to the greatest possible useful extent.

The splitting off of hydrocarbon may take place to a comparatively slight degree, or it may go so far as to evidence itself in the production of "carbenes" or even of insoluble hydrocarbon and free carbon. For a bitumen of a given character, the splitting off of hydrocarbon with subsequent condensation evidences itself by greater fixed carbon yield. It follows, therefore, that the yield of fixed carbon in solid bitumens produced by distillation, becomes an index of the extent to which the splitting off reaction takes place as compared with a simple concentrating of condensed hydrocarbons already present in the crude bitumen. Fixed carbon thereby affords an index of the severity of heat treatment, ranging from evidences of lesser degree to the accompaniment by carbenes or insoluble hydrocarbon or free carbon.

Where solid bitumens are produced by condensation of residum with air, without distillation taking place, a normal fixed carbon content will result from such condensation, greater, of course, than that of the residuum. If, however, the residuum be cracked or partially decomposed in preparation, and abnormally higher fixed carbon will result; likewise if the air treatment be so conducted as to result in distillation by splitting up of hydrocarbon, the product will show higher yield of fixed carbon.

In order to illustrate the effect of heat treatment in the distillation of native liquid bitumen, the writer has prepared data giving the range of fixed carbon figures upon samples taken at various intervals from a still during a commercial run of residual asphalt under known temperature conditions. A lot of the same crude as used in this run was subjected to careful distillation in a laboratory still under conditions, including lower temperature, which minimized, if not entirely avoided, all splitting up or cracking action.

The results are given here in graphical form in Fig. 1, wherein the commercial run referred to is designated refinery "A." The results obtained upon a series of commercial samples from refinery "B" are likewise given, although no data was obtainable in connection with these samples as to temperature conditions during their preparation.

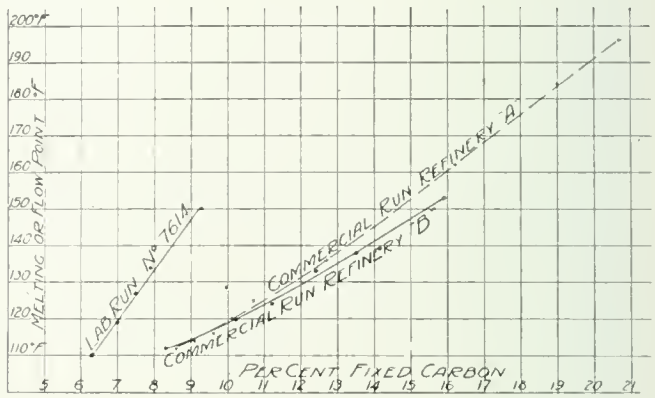

Fig. 2.

Fig. 1 gives the relationship between consistency and fixed carbon. A sharp turn in the curves is noted at the harder consistencies, which might be construed as representing conditions of greater severity. This, however, is not strictly the case but is due rather to the imperfection of the penetration test which does not accurately measure relative hardness, particularly at the low penetrations.

In Fig. 2, the flow or melting point relationship with fixed carbon is given, the former representing relative hardness to a more accurate extent. It is noted that these latter curves approach a straight line, indicating nearly direct variation between these elements. It is apparent that a difference of some 200° F. in heat treatment of the bitumen results in a showing of materially different fixed carbon characteristics in the resulting products.

At the low temperatures the distillation follows closely to a true concentration of condensed hydrocarbons originally present in the crude. The difference between this and the commercial run is evidently represented by additional condensation due to the higher heat treatment in splitting off hydrocarbon.

The writer considers the fixed carbon characteristics of the commercial runs given as representing the better grades of this kind of product now available commercially upon the market. As an illustration of the effect of this

action to an undesirable degree, are given a few analyses of the residual products of like asphaltic base crude, the first two of which were produced from the same crude as in the preparation of samples of series "A."

Pen.	42	46	80	41	26	22	46	32
Fxd. C	14.7%	14.3%	16.8%	16.9%	16 6%	20.0%	17.0%	18.6%
Sol CS_2	99.8%	99.3%	99.7%	99.7%	99.7%	97.2%	99.0%	98.0%
Sol CCl_4	98.8%	96.5%	96.0%	97.9%	96.9%	86.6%	94.4%	90.9%
Ductility	115+cm	110+cm	110+cm	60.0cm	55.0cm	18.0cm	7.0cm	4.5cm

Of the above cements, the third has a history of service test. It was laid in a sheet pavement in 1910 on a residence street. The pavement marked well in 1910 and passed through the winter with one crack. The following summer it was harder but still marked. It cracked usually severely in the winter of 1911. In the summer of 1912 it was very hard in the hottest weather but showed freely the calk marks of previous traffic, the pavement being too stiff to iron out. The general appearance indicated very rapid hardening of the cement.

Inspection of these results shows the effect of condensation in various degrees to the final stages where the material has retained but little binding value and is characterized by little ductility, by the presence of considerable amounts of carbenes and by insoluble carbonaceous matter. It will be of interest to locate the fixed carbon points of these samples in comparison with the curves given for the acceptable grades of the commercial article.

Attention may be called at this point to the fact that some crude oils normally give rise to asphaltic residues of much higher fixed carbon yield than the materials used in the foregoing illustration. This is possibly due to an originally large content of highly condensed hydrocarbons, and to the nature of the particular hydrocarbons present. In such cases a relatively high fixed carbon content in the residual product is not necessarily related to the severity of heat treatment and in dealing with such residuals, specifications and proper interpretation of fixed carbon characteristics must be based upon data obtained by careful run of the crude under known conditions.

The effect of the character of crude upon the fixed carbon yield of product prepared therefrom, is illustrated upon two samples treated by test runs as previously illustrated.

	Gravity.	Crude Fixed Carbon.	Fixed Carbon in Distillation.	Fixed Carbon in Product.	Yield Product.
Crude A	12.5°Be	3.7%	.02%	6.3%	60%
Crude M	18.0°Be	7.5%	...	15.8%	50%

It will be noted that by careful distillation the formation of condensation products is small and that the value of 15.8% of fixed carbon obtained in the residual of crude "M" is quite normal for this, although it would not be so for crude "A."

It will be seen that the determination of fixed carbon in asphalts produced by distillation, affords an important means of control of the quality, uniformity and care used in preparation of the product. The excess of fixed carbon yield above that normally resulting by concentration from the condensed hydrocarbons present in the crude, is a measure of condensation produced by the effects of the heat treatment in splitting off of hydrocarbon.

It is apparent that the best practice should limit this action to the minimum and that specifications should control this by a fixed carbon limit within which the product will retain to a useful and permanent extent, the qualities necessary for pavement and road construction.

It must be understood that the fixed carbon test, like others employed in the examination of bitumens, must be interpreted and applied in specifications upon the basis of a broad understanding of the relationship between the various chemical and physical characteristics of paving bitumens and their origin and methods of preparation for the market.

OIL AND GAS IN WESTERN ALBERTA.

The Geological Survey has received a sample of the oil recently struck by the Calgary Petroleum Products Company at a well situated at Black Diamond, sixteen miles west of Okotoks, Alta. This oil was struck at a depth of about 1,560 feet. It is what is technically known as a "white oil," being transparent and of an amber color. It is phenomenally light for a natural mineral oil, having a specific gravity of about 62 Baume. Evidently it consists largely of gasoline. In fact it has been successfully used in its raw state in place of gasoline in an automobile.

White oils are rarely found in quantity. They would appear to be the result of filtration through clay strata, under pressure, of the lighter portions of ordinary petroleum. That this has occurred in the present instance is made probable by the fact that at a higher horizon in this well a flow of gas of 2,000,000 feet a day, was struck. This gas is also peculiar in the large amount of gasoline it contains. It probably represents a further stage in the process of filtration.

The amount of oil present has not yet been determined, so that the commercial value of the strike is still unproved. If the amount of gas encountered in the higher level is any criterion, this may prove to be the exceptional case and a considerable quantity of oil, for a white oil, be obtained.

Whether oil is present in large quantities or not, the strike is of importance, as the white oils are usually found only in the vicinity of large bodies of the ordinary petroleum. Thus it is an excellent indicator.

Mr. D. B. Dowling, of the Geological Survey, who visited the well shortly before the strike was made, reports that the well is located on an anticline, in shales of the Pierre formation, and that the oil was encountered in underlying Belly River beds. On either side of the anticline overlying Edmonton beds are exposed. Going eastward, therefore, the covering will rapidly thicken. Westward toward Moose Mountain, according to the work of D. D. Cairnes, of the Survey, the formations are folded into a number of anticlines, bringing lower formations to the surface, and in Moose Mountain faults are encountered. Between this faulted ground and the well are several anticlines where prospecting for oil might be undertaken. These anticlines probably run in the direction of the main structural lines, that is, roughly parallel to the mountain ranges. Mr. D. B. Dowling, of the Geological Survey, is now in the field, having been commissioned by the Director to examine the well and make a study of the geology of the district.

It is not often that a complete electric light station sails away after having done good service to a town. Such an unusual happening is reported from the Township of Ocos, in Guatemala, which, having enjoyed the benefits of electric lighting, has unwillingly reverted to oil lamps, its powerhouse having gone to sea. Four years ago a liner was imprisoned in the lagoon without suffering any damage. An enterprising engineer thereupon used the ship's dynamos for supplying the whole township with current for lighting. The scheme was a great success until a salvage company appeared. The connecting cables were severed, the vessel went back to sea, and Ocos was temporarily left in darkness.

OVER-OXIDATION OF STEEL.

MESSRS. W. R. Shimer and F. O. Kichline, in a paper read before the New York meeting of the American Institute of Mining Engineers, describe some investigations carried out for the purpose of studying, both by chemical and metallographical means, the extent of over-oxidation of steel that can be accomplished by excessive over-blowing in a Bessemer converter. In addition they give some results of basic open-hearth and crucible steels.

The experiments were carried on in a Bessemer converter blowing steel for the duplex process. The hot metal used, with one exception, had the following composition:—*C*, 3.50 per cent.; *Mn*, 0.70 per cent.; *P*, 0.450 per cent.; *S*, 0.050 per cent.; *Si*, 1.20 per cent.

In the basic open-hearth heat a test sample was taken just before adding ferro-manganese. The bath had been boiled down "flat" and held for some time. The following is the analysis:—*C*, 0.05 per cent.; *Mn*, 0.05 per cent.; *P*, 0.023 per cent.; *S*, 0.055 per cent.; *O*, 0.024 per cent. It will be noted that the oxygen content of this heat is low, in spite of the fact that the heat was boiled down flat and held some time at a high temperature, thereby affording the best conditions for over-oxidation. Results on finished open-hearth steel are of interest; the drillings for these determinations were not taken from test blocks, but from the finished product.

Rail Steel.

Heat No.	Oxygen. Per cent.
E—21,276	0.018
E—17,244	0.015 0.016
E—22,377	0.018
E—17,441	0.017
E—21,428	0.019
E—24,202	0.019
E—26,065	0.017

Structural Steel (about 0.19 per cent. C.)

Heat No.	Oxygen. Per cent.
E—14,096	0.024
E—17,104	0.022
E—22,068	0.019
E—22,277	0.015
E—24,063	0.014

Oxygen determinations were run on a few 0.60 per cent. carbon crucible steels, and showed the following oxygen contents:—

Sample No. 1.—Test dipped out of a 90-lb. crucible and cast into a small test block; oxygen, 0.014 per cent.

Sample No. 2.—Test dipped out of a 1-ton ladle; same heat as sample No. 1; oxygen, 0.014 per cent.

Sample No. 3.—Finished rolled bar; oxygen, 0.010 per cent.

Sample No. 4.—Rolled bar picked out at random from the stock rack; oxygen, 0.010 per cent.

Samples 1 and 2 were dipped out of the bath and cast into small moulds, and were, therefore, somewhat porous, which no doubt accounts for their showing slightly higher oxygen than the finished bars, which were solid.

The results obtained from converter metal may be summarized as follows. Every effort at over-oxidation was made, both by over-blowing and by ore addition:—

The highest oxygen contents obtained by over-blowing, were 0.074 (in Test 2); 0.064 per cent. (in Test 8) and 0.049 (in Test 11), notwithstanding that the samples were taken immediately, in order to get the highest oxygen possible. Also the samples were cooled quickly so that no gas could escape during casting.

While oxidizing with ore, we obtained 0.029, 0.028 and 0.033 per cent. oxygen, by taking test samples immediately after the ore began working through the metal. When time was allowed for the oxygen to escape after the ore addition, a content of 0.017 per cent. oxygen was found.

A basic open-hearth heat, under oxidizing conditions, gave only 0.024 per cent. oxygen.

It appears that either an unfinished heat or an over-ored heat will produce slag inclusions, such as manganese silicate, instead of iron oxide.

From these results, considering the manner in which they were taken, we may conclude that excessive oxygen leaves a bath of molten steel in a very short time. Also that deoxidation is readily effected by the addition of hot metal.

Under the same conditions, the higher the carbon the lower the oxygen.

Finally, it seems highly improbable that, under the usual conditions of Bessemer and open-hearth practice, with the addition of recarburizers, that a steel of over 0.030 per cent. oxygen can be obtained, and that the highest obtainable under any conditions, without recarburizing, can hardly be over 0.075 per cent. Results higher than this must be from drillings improperly taken, or from oxidation that occurred during pouring.

NEW YORK'S NEW CANAL.

Progress on New York State Barge Canal furnished the subject for a lecture given on October 30th by State Engineer John A. Bensel before the New York State Waterways Association Convention. Mr. Bensel stated that at present more than 250 miles of the canal are completed to the dimension size, and all of the more important structures are more than 80 per cent. finished. The construction work of the past year has called for an expenditure of $13,000,000; and the total work up to date, for about $64,000,000; while the remaining contracts will have need of an additional disbursement of $82,000,000. Mr. Bensel urged particularly in his lecture that the utmost care be taken to obtain the best possible management for the terminals in New York, Brooklyn, Utica, Buffalo, Albany and all other cities. Work on these is progressing very rapidly. About 35 contracts have been let, and the Albany terminal is already in use in a commercial way.

GERMAN IRON AND STEEL PRODUCTION.

According to the returns of the Association of German Iron and Steel Manufacturers, the total production of raw iron in Germany and Luxemburg during the first six months of 1913 amounted to 9,567,666 metric tons, as compared with 8,564,988 during the first six months of 1912. The production of foundry pig increased from 1,581,754 tons in 1912 to 1,812,434 in 1913; of Thomas iron from 5,482,432 to 6,049,330; and of steel and spiegel iron from 1,037,902 to 1,269,563. The production of Bessemer and puddle decreased as compared with 1912, the former from 193,763 to 174,483 tons and the latter from 269,137 to 261,856 tons.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

Engineers as Citizens 807
The Fixed Carbon Test 808

Leading Articles:

Railway Economics 791
Electric Locomotives for Mount Royal Tunnel.. 796
The Corrosion of Pipes by Raw and Treated Waters 798
Fixed Carbon Depends on Crude 801
Over-Oxidation of Steel 806
Letters to the Editor 808
The Timiskaming Dam of the Ottawa River Storage System 810
Production of Malleable Castings 813
Automatic Railways 814
The Rotary Type Air Pump 817

Coast to Coast 818
Personals 820
Coming Meetings 820
Railway Orders 822
Construction News 76
Technical and Municipal Societies 94

ENGINEERS AS CITIZENS.

It has frequently been suggested that more of the meetings of the various branches of different engineering societies be devoted to the discussion of civic engineering problems, not necessarily those only that are immediately concerned with an engineer's particular technical work, but problems of a more or less general engineering nature. This suggestion was recalled and strongly upheld by Mr. R. D. Mershon at a joint meeting of the Western Society of Engineers and the American Institute of Electrical Engineers in Chicago, his opinion being that individuals taking part in such discussions would be almost likely to bring to bear in public affairs the conclusions there arrived at, and the ideas that would crystallize in their own minds as a result of such discussions.

One feature of the engineer's life that should be more strongly emphasized and urged by engineering societies is this desirability of his taking a greater part than he has done heretofore, in public affairs, especially in the civic affairs of the immediate community. Practically all economical problems are engineering problems, and the engineer cannot avoid taking his own responsible share in their solution.

The engineer's excuse is that he is an exceedingly busy man, and the result is that unless he has the opportunities made fairly easy for him, he is not likely to get out and interest himself in matters respecting the city's welfare. Those who read the address of Dr. Swain, presented at the Ottawa meeting of the American Society of Civil Engineers last June, and reproduced in our issues of June 26th and July 3rd, doubtless profited a good deal by his illustrations of the personal responsibility which the engineer owes to the community. As to the engineer's capabilities in this direction, the speaker stated:

"If there is anything in training and experience, may we not believe that engineers, as a class, have the training, temper and experience, which will best enable men to judge sanely and solve wisely the social problems that confront us?" When one realizes that the problem of administering the affairs of a city involves the preservation of the health, safety, property, and order of the community, and are, therefore, dominantly of an engineering character, it appears strange that we do not find more of our engineers occupying positions of greater responsibility in the administration of civic affairs.

In some European countries the method of handling civic affairs is quite different from the method in this country. In Germany, the position of mayor is not elective. The work is regarded as a profession, and the individual is not elected, but employed. Recently there was an advertisement for a mayor in one of the German technical papers, and it specified that he should be an engineer.

The findings would be interesting if one were to study the relations between engineering interests and social conditions in general. It is stated, for example, that Illinois, one of the great agricultural states, has progressed to a point where 49 per cent. of its people get their livelihood from something connected with engineering interests. It would be interesting, therefore, to parallel with this, some measure of the attention which engineers pay to legislative and constructive action, public welfare, and social problems of that nature; and it is certain that there has not been enough of co-operation on his part in the past. Although there are no men better qualified, one is safe in stating that there are none that

fall farther behind in such obligations than do the engineers.

THE FIXED CARBON TEST.

Specifications have been issued this week by the city of Toronto for the supply of asphalt for 1914. Practically the same specifications are retained which were used for this year's supply, the clause limiting the maximum amount of fixed carbon to fifteen per cent. remaining the same as in the 1913 specifications.

In view of the differences of opinion regarding the value of the fixed carbon test, as indicated by the series of articles by various prominent chemists now appearing in *The Canadian Engineer*, thorough experiments will be made and much research work done during the coming year by the chemical and engineering staffs of Toronto, in order to determine whether the test should be retained in, or excluded from, the specifications, or retained in a modified form. It was felt by the Department of Works, however, that so little time remained for such an investigation this year, that the 1913 specifications would have to be used again for the 1914 supply, but that the experiments made during 1914 might result in considerable change in the 1915 specifications.

The objections to Mr. Kirschbraun's suggestion that were made by a prominent municipal engineer who was shown an advance proof of Mr. Kirschbraun's article, which appears in this week's issue, were that it would be impracticable to carry out the suggestions made in the article, as no city could be sure that it was securing the refinement from a certain lot of crude, even if it were able to secure a dependable analysis of that crude, nor would they know the percentage of refinement. That, of course, bears out the very argument urged by many chemists against the inclusion of the fixed carbon test in specifications, namely, that this test cannot be included in such a way that it will be both fair to the contractors tendering and also enforcible in a practicable way.

EDITORIAL COMMENT.

The transformation wrought in the geography of the world by the construction of the Panama Canal, and the consequent changes to be expected in the world's commerce, involve preparations in the form of new harbors, new docks, and additional railways, remarkable alike in extent and in rapidity of construction. Contemplated as a whole, and when the element of time is taken into account, these undertakings constitute an engineering project of variety and magnitude unprecedented in the history of transport development.

* * * *

The Dominion Government has under consideration some new regulations to govern the development of the oil resources of Western Canada. It is reported that Mr. Cunningham Craig, of Birmingham, and Prof. Chadwick, of London, Eng., have investigated conditions as they exist, and that a draft of new regulations has been prepared and at present their applicability is being considered by the Department of the Interior. It is also stated that western men have forwarded a suggestion that the old regulations be revised so that for purposes of development claims may be grouped instead of requiring each claim to be singly developed.

A discussion on the causes of the deterioration of fire-bricks during use was recently presented by Mr. Geo. Rigg, in which the conclusion is reached that, other things being equal, the resistance to the action of corrosive slags and gases is greater the more compact and close-textured the brick is found to be. Spalling of close-textured brick is due to the use of unsuitable clay, or poor workmanship, or both. It is possible to prepare close-textured fire-brick containing considerable amounts of coarse material, provided that sufficient care be taken in sizing the grog, so that the interstices between the larger fragments shall be filled as completely as possible by smaller fragments.

LETTERS TO THE EDITOR.

Features of the Springfield (O.) Sewage Disposal Plant.

Sir,—Referring to the article "A Departure from Common Practice in Sewage Disposal" in your issue of October 23, 1913, we beg to call attention to the fact that the so-called "vertical circulation" is neither new nor original with Mr. Potter, as it is an essential feature of the process set forth in our Travis and Ault (Hampton Tank) patent, application for which was filed September 13, 1910. The "Adjustable weir" which he uses for the regulation of this "vertical circulation" is also embodied in another of our applications for patents and follows the lines of explanations and information given by our engineer to Mr. Potter while he was designing the Springfield plant.

We notified the mayor of Springfield on October 25, 1913, and Mr. Potter on October 27, 1913, that the tanks at Springfield were an infringement on the Cameron septic process patent and of the Travis and Ault (Hampton Tank) patent, both of which are controlled by this company, and that we should take all necessary steps to protect our rights.

We call attention to these points that engineers and municipalities may know the facts and avoid any unintentional infringement of our patent rights.

STERILIZATION COMPANY.

Newark, N.J., Nov. 8th, 1913.

* * * *

[Upon receipt of the above the attention of Mr. Potter, who submitted the article referred to, was called to it, and his reply is as follows:—Ed.]

Sir,—Answering the letter of November 8th from the Sterilization Company, of Newark, N.J., I regret that I am compelled to say that there are statements in that letter and in letters to which they refer which are at variance with the facts.

The writer first saw a representative of this company a month after the designs for Springfield were completed. These designs were completed before the middle of February, 1912. The plans were then taken to Springfield by the writer in person for submission to the city authorities. The completion of the drafting of the finished plans took two weeks longer and were forwarded to the writer (then in the southwest) on March 1, 1912. These plans were finally approved by the municipal authorities at Springfield on March 15th, and the work ordered advertised for April 4th.

On March 1st the writer received a letter under date of February 23rd from the Sterilization Company, admitting that they were informed by his office that the plans

were based upon other designs than theirs, and requesting consideration of their method.

The writer returned to New York on March 19th, after an absence of a month, and the following day a representative of the Sterilization Company called. For the first time the writer conferred with this company in reference to their system and its application at Springfield. They were advised that the Springfield designs would not be altered, but in response to their request were informed that if they desired to submit an alternate bid based upon their own plans at the public letting on April 4th, such bid would be given consideration if accompanied by guarantees of efficiency.

On the 26th of March a sketch plan was submitted by the Sterilization Company, showing what they proposed to offer, and on the 29th of March a letter was received from them giving a bill of material required for their plan. They found that it was impossible for them to submit a proposition on the sewage disposal plant as a whole, but requested the submission of their tank plans to general contractors.

Discussing the merits of the contention of the Sterilization Company that the Springfield tank is an infringement upon their patents, the writer desires to point out that there is a distinct difference between the Hampton tank and the Springfield tanks. In the former, from ten to twenty per cent. of the entire sewage flow travels horizontally through the digestion chamber towards the outlet setting up a substantial disturbance throughout the digestion chamber where quiescence is more desirable. The debouchment of over ten per cent. of the flow from the digestion chamber very seriously interferes with the ultimate reduction of the sludge. In the Springfield tanks openings are placed along the pipe provided to draw off the relatively small quantity of liquid (less than two per cent.) from the digestion chamber needed to set up a downward circulation in the settling tank.

Furthermore, the discharge of from ten per cent. to twenty per cent. of the liquid from the digestion chamber in the Hampton tank will require separate treatment of the two effluents, otherwise the efficiency of subsequent treatment, if both flows re-unite, is impaired. In the Springfield tank, on the other hand, the small flow from the digestion chamber cannot seriously affect the effluent from the settling tank. In the Springfield tank there is absolutely no horizontal flow towards the outlet end of the tank.

From a structural standpoint, the Springfield tank as built is more effective than other types, in that while the time of retention in the settling tank is the same as in other tanks, the velocity of flow in the tanks is from half to two-thirds less, a condition tending to produce a greater deposition of solids.

It is to be hoped that this discussion will eventually lead to some definite conclusion as to this much-mooted question of sewage disposal patent infringement. It should be noted that this company alleges infringement of the Cameron septic tank patents controlled by them. According to the Winchester, Ky., case, the admission of the use of a two-story tank is considered by the Sterilization Company as *prima facie* evidence of an infringement of patents now controlled by them. The payment to Dr. Imhoff of his license fee where his tank is used, does not give immunity from suit by the Sterilization Company as owners of the Cameron process.

In view of the charge of the Sterilization Company that the Springfield tanks are an infringement of the Cameron patent, the following editorial comment from the "Engineering News," Feb. 6th, 1913, is of interest:—

"In its decision of Jan. 20, 1913, the U.S. Supreme Court declared in unmistakable terms that the United States patent on the Cameron septic tank expired on Nov. 8, 1909, 'with the British patent for the same invention.' To sustain any claim to the contrary, it would therefore seem to be necessary to get the Supreme Court to reverse its decision, either on a re-hearing of this case or by carrying some other case to the U.S. Supreme Court."

Yours truly,

ALEXANDER POTTER.

New York, Nov. 18th, 1913.

THE EFFECT OF DRILLED HOLES ON STRENGTH OF STRUCTURAL STEEL.*

A series of experiments to determine the effect on the elastic limit and tensile strength of structural steel of drilling and punching holes is described by C. Birault, chief of the department of testing materials of l'Ecole Centrale, Paris. In the first series of experiments, three bars were cut from one piece of steel. One was ruptured in its original condition; the second after perforation with two holes by drilling, and the third, after perforation with two holes by punching. The holes in each case were 15 mm. diameter, spaced three diameters centre to centre. The plain bar elongated much further than the other two, while the bar with drilled holes elongated more than that with punched holes. The fracture of the punched bar did not take place along the diameter of the holes, due probably to fissures caused by the action of the punch. The drilled holes broke at their central diameters.

The following is an average of the results of three sets of tests:—

Plain bar, elastic limit, 24.5 kg.; tensile strength, 40.06 kg.; drilled bar, elastic limit, 30.03 kg.; tensile strength, 45.4 gk.; punched bar, elastic limit, 33.3 kg.; tensile strength, 37.3 kg.

In each case, the elastic limit was higher in the perforated bars than in the plain bars, with the increase in favor of the punched holes over drilled holes, while the reverse is true as regards tensile strength. The bars with drilled holes have 12.3 per cent. greater average elastic limit and 9.2 per cent. greater average strength than plain bars of the same steel. In the case of punched bars, the elastic limit increased 13.5 per cent. and the tensile strength 8 per cent. compared with plain bars of the same steel.

In the second series of tests, bars were perforated with driled holes of various diameters to determine the effect on the physical properties of the steel compared with plain bars of the same steel. Holes 11, 8 and 6 mm. diameter, were drilled and tested as a comparison against the plain steel. The following elastic limits were shown:

Plain bar, 28.9 kg.; 11 mm. holes, 32.3 kg.; 8 mm. holes, 32.0 kg.; 6 mm. holes, 33.7 kg.

The tensile strength of the various bars tested was as follows: Plain bar, 45.2 kg.; 11 mm. holes, 50.4 kg.; 8 mm. holes, 48.7 kg.; 6 mm. holes, 53.0 kg.

As to why there are such increases in the physical properties of bars with drilled holes over plain bars, the

*Abstracted from Le Genie Civil, July 19, 1913.

author states that in bringing into contact the fractured ends of the plain bars, it is found that there is a hollow space near the centre where the metal has evidently drawn away first, the break then proceeding gradually to the two sides. If, however, the metal is perforated with holes that are smooth, as in drilled holes, and not having fissures as in punched ones, this tendency of the metal to separate is removed, and the mean resistance to rupture is more uniform.

The author claims to have established the fact that the resistance to rupture of solid bars and perforated bars of the same metal is not proportional to the sections of the bars, proper allowance being made for the perforations. Section for section the advantage is in favor of the perforated bars, if the holes have been drilled and not punched. The holes weaken the steel much less than would be expected, provided care is taken to drill the holes, or to ream them after they have been punched.

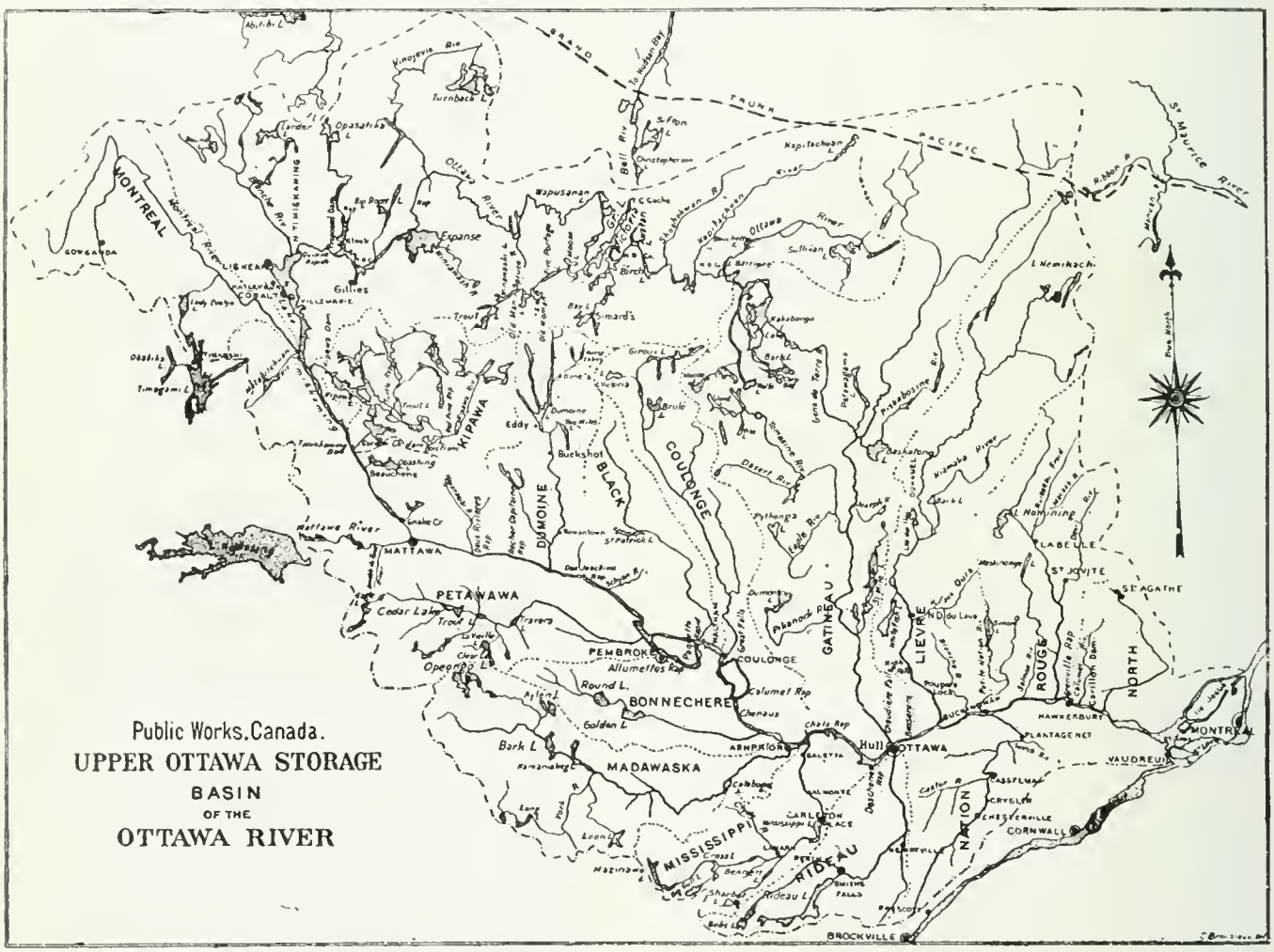
THE TIMISKAMING DAM OF THE OTTAWA RIVER STORAGE SYSTEM.

By J. A. MacDonald, Ottawa, Ont.

IN the Aug. 7th, 1913, issue of *The Canadian Engineer* an article entitled "The Ottawa River Storage System" outlined the objects of the extensive conservation works which are being built by the Department of Public Works, Canada, in the Upper Ottawa Basin. The reader's attention is directed to that article for general information respecting this development, and for the illustrations, several of which refer to the following description of the design and construction of one of the units of the system, viz., the dam at the outlet of Timiskaming Lake.

At Mattawa, 300 miles above Montreal, which is the discharge point of the Timiskaming basin, including part of Timagami and Kipawa Lake basins (see Fig. 1), the yearly mean flow is 25,000 cubic feet per second from an area of 30,300 square mile feet. The Timiskaming basin, including everything from the source of the Quinze down to Mattawa, has an area of 20,000 square miles.

The Timiskaming storage dam, which is situated at the foot of Timiskaming Lake, was designed for the purpose of emptying the lake to its lowest level before floods and then filling it to the highest attainable stage for winter consumption. The lake itself stretches from Timiskaming Station to New Liskeard, Ont., and Murray, Que., a distance of 60 miles. It is navigable by steamboat and, in fact, until the Timiskaming and Northern Ontario Railway was built, afforded the only transport up to Ville-Marie and to the clay belt of Northern Ontario.


Public Works.Canada.
UPPER OTTAWA STORAGE
BASIN
OF THE
OTTAWA RIVER
MONTREAL
MATTAWA
PETAWAWA
PEMBROKE
COULONGE
BONNECHERE
MADAWASKA
Hull
OTTAWA
GATINEAU
LIEVRE
ROUGE
NORTH
MONTREAL
HAWKESBURY
VAUDREUIL
CORNWALL
BROCKVILLE
MISSISSIPPI
RIDEAU
NATION
KIPAWA
DUMOINE
BLACK
COULONGE
Timagami L.
Lake Temiskaming
Ottawa River
Mattawa River
Trout L.
Cedar Lake
Round L.
Golden L.
Bark L.
Allumettes Rap.
Chaudiere Falls
Rideau Falls
Rideau L.
Carleton Place
Almonte
Arnprior
Calumet Rap.
Chenaux
Deschenes Rap.
Pembroke
Eddy
Buckshot
Gillies
Expanse
Birch L.
Kipawa
Desert Rapids
Pythonga
Pickanock Rapids
Coulonge Falls
Dumoine Rapids
Lake Nipissing
St. Maurice River
Ribon
Lake Nemiskachi
Lake Nominingue
Labelle
St. Jovite
Ste. Agathe
Lac du Loup
Plantagenet
Vaudreuil
Cornwall
Brockville
Kinojevis Rapids
Turnback L.
Onaping
Kapiskogan L.
Kapiskogan R.
Sturgeon R.
Wapusanon L.
Coucke
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The immediate drainage is very limited as the shores are high and steep, but this lake receives all the drainage of the Kipawa, Quinze, Expanse, Blanche, and Montreal systems, a total area of 18,000 square miles down to Timiskaming Station. The lake is narrow, practically a river for 12 miles up to Opimaka Narrows, then about a mile in width for 30 miles further up to Silver Centre, where it becomes wider until a maximum width is attained at the head of the lake between Haileybury and Murray.

Outlet of Timiskaming.—While there are many inlets to this lake, the only outlet is at its south end, where, through the Long Sault Rapids, the waters fall 59 feet in six miles into Seven League Lake, and thence by three other rapids, descends 30 feet more to Mattawa. The discharge averages 110,000 c.f.s. during May, but it shrinks to about 10,000 at low stages during winter time.

18-in. and 15 by 15-in. stop-logs. These sluiceways are illustrated in Figs. 2, 3 and 4. The still platform is at elevation 570 or 19 feet below standard level of reservoir. It would have been preferable to have had the sill 5 feet lower, but the excavation necessary to cut down the approach channel would have doubled the cost.

Between the island and Ontario shore, the width was about 400 feet, so the design was made for 16 sluiceways each 20 feet wide with a pier 5 feet wide between. These are illustrated in Fig. 3, of the article to which reference has already been made. The piers have recesses to hold a movable curtain wall formed by horizontal timbers, 18 inches square, that can be hoisted out one by one. This is a removable dam and during spring floods all the timbers will be lifted out, leaving a larger exit than under natural conditions, because the Ontario channel has been

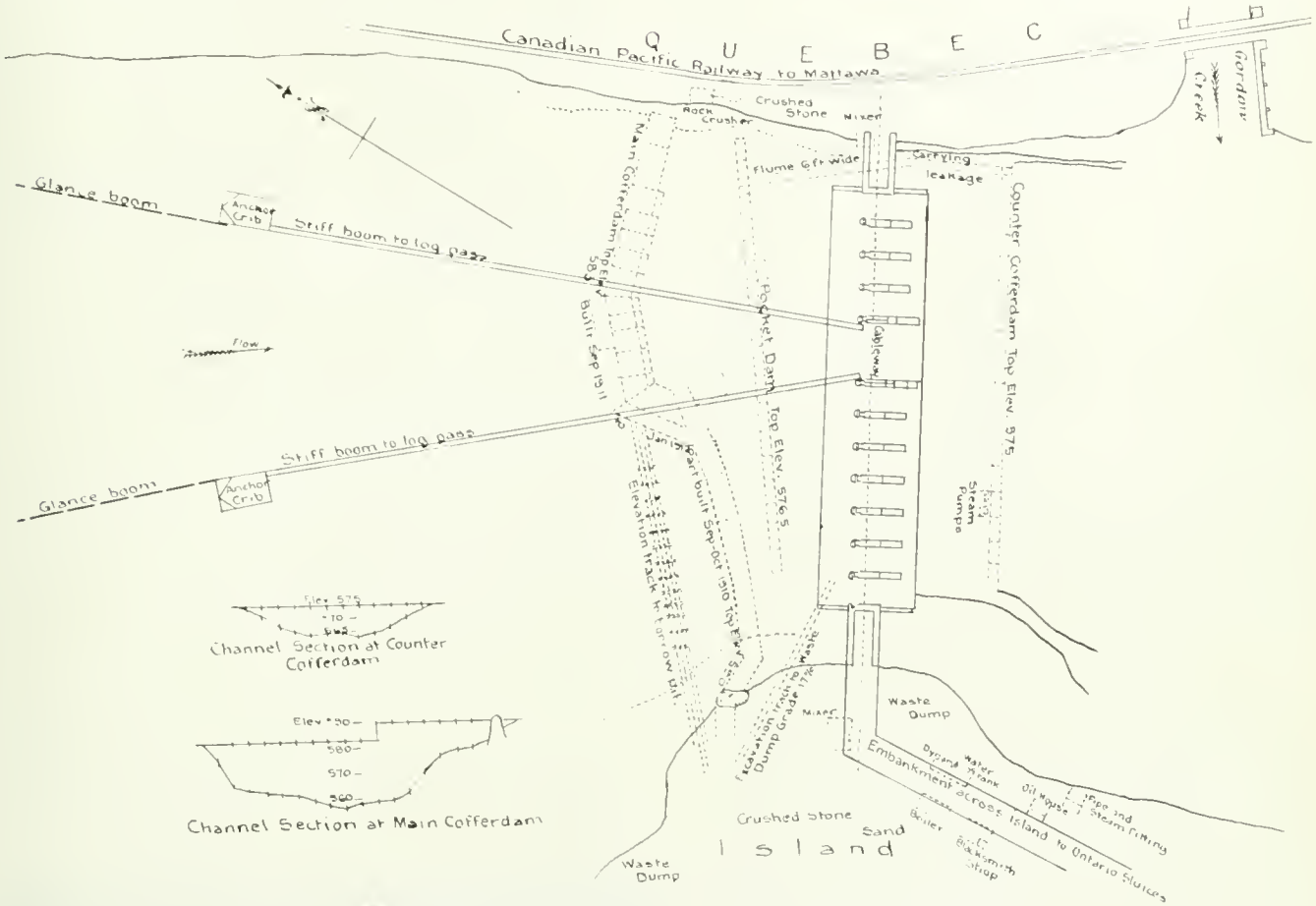


Fig. 2.—Arrangement of Regulation Work in the Quebec Channel.

The holding of Lake Timiskaming at a maintained surface level of 588, which was considered to be the best level to prevent damage by flooding, gives a storage depth of 20 feet. The sluiceways will thus drain down the lake to that amount between and augment the low water flow, for at least 150 days, by about 4,000 c.f.s.

Design of Sluiceways.—For the Quebec channel the design for a boulder foundation consisted of a monolithic slab of concrete 3 feet thick, extending from 22 to 26 feet up-stream to 12 feet down-stream, to be built across the river with a cut-off wall of varying depth along the up-stream and down-stream edges. The upper cut-off has been built 10 feet and that down-stream 5 feet in depth.

Upon this platform rest 11 piers 20 feet apart and two U-shaped abutments 48½ by 25½ feet with 5 foot walls. The sluiceways are arranged to be closed by 18 by

deepened. To draw off the lower layer of storage during March, however, deeper sluice openings are required, and so advantage of the depth in the Quebec Channel was taken to place those sills at elevation 565, or 5 feet lower.

The minimum discharge through the Timiskaming sluices should be about 20,000 c.f.s. and lake surface must be at 573.95 elevation to discharge the total amount.

As designed, the lake surface can only be drawn down to elevation 573.95, instead of elevation 573.05, so a layer 0.9 feet thick is rendered unavoidable. However, lowering the Ontario Channel would double the cost, and such an outlay was not warranted.

The Foundation.—The foundation of the sluices is shown in the accompanying Fig. 3. It consists of a concrete platform 3 feet thick, strong enough to support a pier. To prevent a scour, a cut-off was made 10 feet deep

across the upper face, and another 10 feet deep along the lower side. In addition a concrete apron, 25 ft. wide protects the bottom from scouring under the driving water at entry, and a 50-foot apron below prevents wearing away of material by the rapidly flowing water.

For the cofferdam, soundings were taken to determine the shape of the river bottom upon which the cribs were to rest and the bottom of each crib was built to fit its particular place. This was a difficult matter, as over the whole area there were nests of large glacial boulders 8 and 10 feet in diameter, and closely packed in a layer of gravel averaging 3 feet in depth above river sand.

The foundation generally was a mass of boulders, as stated, embedded in compact sand, but 25% of the area toward the island side was sand with only occasional boulders. This was saturated with water which seeped through over practically its entire surface and the sand readily drifted off in the current when disturbed. To cover this with a concrete slab was difficult as scouring constantly took place along the edges. It was found after trial that it was impracticable to drive sheet piling owing to the stones that were encountered.

Owing to the slow rate of excavation it proved best to first lay the foundation slab in unconnected pieces and

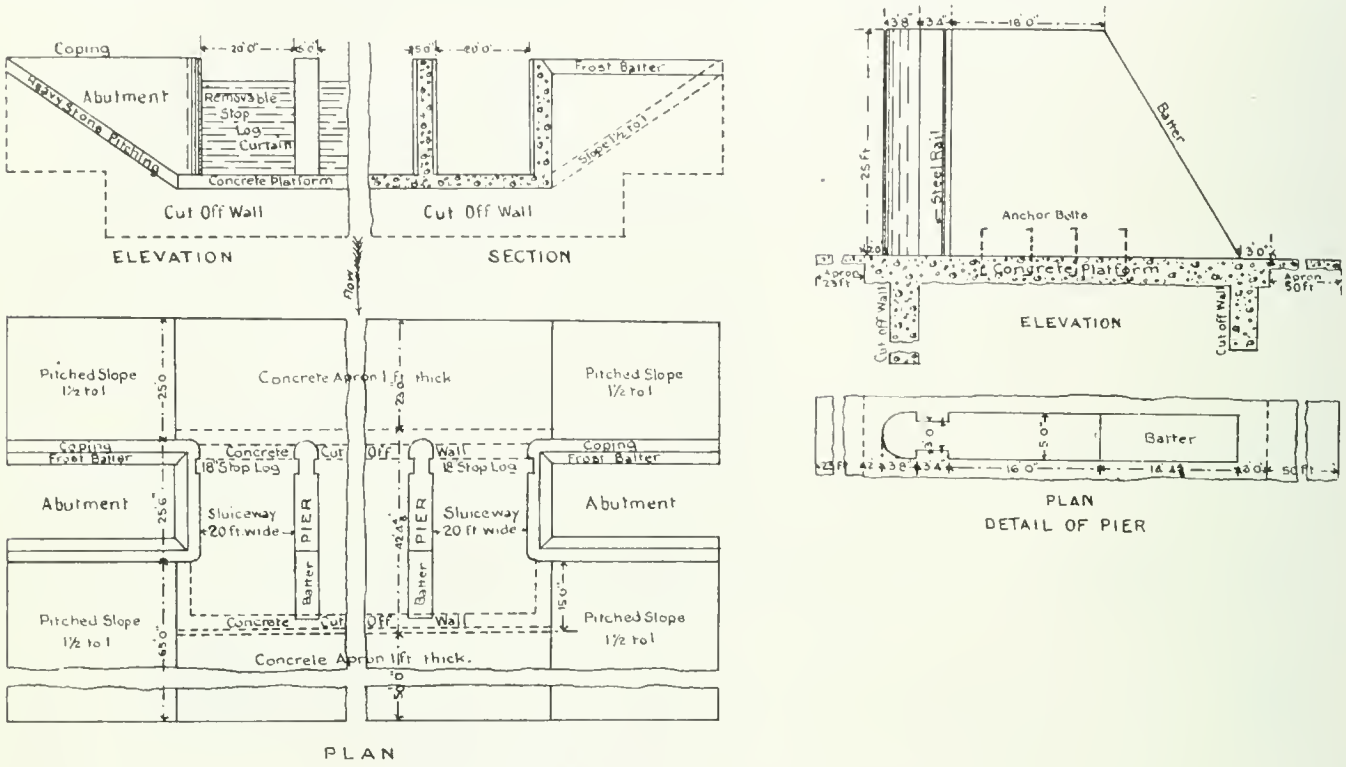


Fig. 3.—General Plan of Concrete Sluiceways.

For general information it may be observed that each crib is a crate formed of 10- to 12-inch timber built in courses "log cabin" fashion. In this case the cribs or boxes were 20 to 35 feet in the direction of the current and 18 to 30 feet long, the depth averaging 20.5 feet. Each crib had cross ties between the up- and downstream faces, at 6-foot intervals in each course and longitudinal to provide rigidity, leaving a series of pockets into which the stone filling was loaded.

To set the individual cribs in place, in a rushing current 20 feet deep, was a difficult matter, and for this purpose an anchor crib was built and sunk above the line of cofferdam. Each crib was built on shore to a height of about 12 feet, then launched, attached to the anchor crib with a 1¼-inch wire cable, and gradually lowered downstream to the line of cofferdam. By side lines of wire cable leading to the island and the Quebec shore, the crib was brought to its place. As the channel was narrowed by placing cribs in this fashion, the velocity of the current increased. This condition was provided for by a heavy wire rope tackle attached to the end of the 1¼-inch cable and passed around the drum of the alligator's winding engine. The power thus secured was ample, the alligator being well anchored, and cribs could be set within an inch of their proper line.

fill in afterwards as occasion allowed. In like manner several of the piers were built before the east end of the platform had been laid, but no difficulty was found in making good junctions.

Fig. 4.—Ontario Sluiceways, Timiskaming Dam, Showing Swiftly Flowing Approach Current.

At first the whole structure, abutments and piers were built only to elevation 583, or 10 ft. below final height. This was high enough to withstand flood water and in case of an early rise it was thought best to bring everything to a safe height. Time, however, allowed the finishing of the whole structure to full height by the end of April. Since then the bridge across the sluices has

been completed and the work is now being put into a neat and finished condition.

Work on this dam began in the spring of 1909, and was continued by the Canadian Government until its completion this year. The construction of the dam was under the direction of Mr. C. R. Coutlee, engineer-in-charge, and he directly under Mr. A. St. Laurent, Assistant Deputy Minister of Public Works. The above information is largely from a recently issued report to the Minister of Public Works.

PRODUCTION OF MALLEABLE CASTINGS.

MR. RICHARD MOLDENKE has extracted from an address given before the Connecticut Valley Section of the American Chemical Society, Hartford, Conn., the following section, and has published it as an article on the production of malleable castings, considering particularly the special uses of the several melting methods, systems of work, composition of the product, and annealing.

"Malleable making processes are the crucible, cupola, Bessemer converter, air-furnace, open-hearth, and electric. The crucible process makes the finest malleable as it does the finest steel, with the exception of the electric furnace. You find the crucible made casting only in Europe where the malleable is more expensive than the steel casting.

"The cupola is for such castings as pipe-fittings, agricultural work, and those things that require only a little better strength than the gray casing of the same kind, but more malleability. Cupola malleable is a little cheaper than the air-furnace or open-hearth product. In all malleable melting processes, inasmuch as the iron is low in silicon and consequently sets quickly, it loses its life easily; and especially if it has been oxidized at all it must be gotten into the mold fast. Consequently a gray iron molder must be shown how to pour malleable; a little twist of the wrist throws the iron into the mold; otherwise it may be short poured. In cupola melting there is always a very low coke ratio; melting is done on a high bed; perhaps higher than it ought to be, but it is necessary to get the iron very hot and as free from oxidization as possible.

"The Bessemer process is used only in Europe. They blow their heats to where the silicon is down to the right point, stop the heat, dioxidize and pour. With the long anneal, in which the metal is decarbonized, they should make serviceable castings.

"The air-furnace is principally used for "malleable" in this country. Malleable air-furnaces are constructed differently than are air-furnaces for gray iron work. For gray iron they have large cross-sections and are comparatively short. For malleable very long furnaces are used, a long flame being desired. The heat to melt, whether in air-furnace or open-hearth, does not come from the direct action of the flame so much as it does from the radiation of the interior brickwork. The idea in the air-furnace and in the open-hearth furnace is to get the brickwork lining so hot that the radiation downward upon the charge does the actual melting, and does it fast. I have seen a pound of coal used for melting every pound of iron, whereas it ought to be about four pounds of iron to the pound of coal when you run three heats in one day and average them all up. The first heat with the colder furnace is a little harder on the coal supply than the others.

"Not unusually you will find that you can look through the brickwork into the interior, there being plenty of spaces where cold air is drawn in. The radiation of the lining does the business and every square inch of the interior of the furnace should do its work.

"I have seen men throw coal all over the bed of fire and then take the slicebar and poke it up, whereas the right way to do is to pile the coal at the door, shut the door, allow this coal to coke slightly, and then carefully push it over the entire area. Then repeat the operation, and repeat periodically instead of having the fireman using his shovel and bar all the time.

"If we get more than 25 per cent. excess free air in the malleable furnace we begin to get trouble. If that 25 per cent. in excess can be allowed uniformly, we get that magnificent incandescence which does the melting properly.

"Starting with, say, 0.95 silicon in the mixture if the heat is made sharp and short this silicon content will be lowered to the 0.65 required for the ordinary run of castings nicely, and it will drop from 0.65 to 0.60 from the beginning to the end of tapping, whereas with a long, slow melting the iron may be 0.65 at the beginning of tapping and down to 0.55 at the end of the heat or a loss of twice the silicon. When this occurs the iron has begun to oxidize. Another thing: Take a bath of iron in the air-furnace which is deep near the bridge, and feathers out to nothing at the stack. If there is any one thing dangerous in the air-furnace it is that thin, feather edge at the end; because there all the gases are swept over it, and the heat is transmitted into a very thin body of metal. Consequently, the temperature rises very fast at that spot; and the iron is liable to burn.

"The open-hearth furnace is the best melting process except the obsolete crucible and the electric. The open-hearth furnace melting process is applicable only where there is enough work to keep the furnace running steady. Melting ratios are: cupola, 1 to 8; air-furnace, 1 to 4; open-hearth furnace, 1 to 6. Air in the open-hearth furnace has about 1,000 degrees F. heat. A good heat of 10 tons in the air-furnace may take four hours, but we can run the same heat in two and a half hours in the open-hearth (from end of charging to beginning of tapping).

"In making malleable you have a great big bath of molten iron, hot on top, and cooler on the bottom. Test plugs show crystalline and white fractures; the composition is right. You draw the colder iron from the bottom first. Top of charge comes down maybe an hour later. In the meantime the oxidizing reaction goes on; the slag has been taken off; there is a direct contact with the gases, the metal is damaged. It should really be taken from the top first. The ideal method of getting iron out of an air-furnace is to take it from the top. The tilting furnace gives this result. I patented a three-spout arrangement for my furnaces, thus taking off six or seven tons from the top; then the next six or seven tons below; then break the breast out and get the rest of it from the bottom. In my open-hearth practice I never skim, but let the slag cover the iron.

"The composition of a malleable casting, so far as the silicon is concerned, depends on its thickness entirely. In ordinary work the silicon should be about 0.65. For very heavy work I used to turn my silicon down to 0.45. In the old days of charcoal iron my regular silicon was 0.35 (charcoal iron could be used as low in silicon as 0.10). With coke irons it is not wise to have pig iron with less than 0.75 silicon in stock. In making cold-blast

charcoal iron you have a very small furnace to begin with; charcoal which eagerly absorbs oxygen as a fuel and hence the iron sponge formed melts with the least chance of oxidation. With the hot and more powerful blast, there is a little further penetration of free oxygen; with the consequent greater oxidation of the iron sponge as it melts, and hence a weaker iron. With coke fuel there is a very serious entrance of free oxygen. Coke does not unite with the oxygen in burning as fast as in the case with the charcoal. The difference between charcoal and coke irons lies only in this oxidation question.

"In annealing, the idea is to get the castings up to the annealing heat quick, hold them at annealing heat for a given time—60 hours is best—then to let them cool gradually. Pack the castings in oxide of iron. We use puddle scale, a silicate and oxide of iron, the flakes from the pots. They are almost pure iron oxide. In some railroad work, as tie-plates, these can be put loose in the oven, practically make a retort of it and use no packing whatever. The castings look rough but are good enough for the purpose.

"As to temperature of the anneal—the old-fashioned way of looking at the cracks in the brickwork to see the white line is very good if the eye of a man does not change. I prefer the LeChatelier pyrometer. Temperature at the coldest point of the coldest pot should be 1,350 degrees F.; it may go as low as 1,250 or it may be as high as 1,400. For cupola iron, the temperature must be about 200 degrees higher, because the iron was melted in contact with the fuel, and has a higher sulphur content, which obstructs the annealing changes at lower temperatures."

NEW POWER STATION AT KAMLOOPS.

The opening of the Kamloops, B.C., power station took place on October 28th. This station will be a component part of the extensive hydro-electric system, the total cost of which will amount to about half a million dollars, and which will give Kamloops all the additional power needed for many years. Work is now well under way at the Barriere River, 40 miles north of the city, where if necessary some 10,000 h.p. is capable of development. Some 2,000 h.p. is now being arranged for. This, along with present power, will run all the municipal industries and many more which may be established here in the future. The new power station is a reinforced concrete building, 80 by 90 feet in size.

The largest railway station in Europe, estimated to cost $35,000,000, is now under construction at Leipzig.

The Chino-French Bank has signed a contract for a loan to the Chinese Government of $30.000,000. Of this sum $12,000,000 is intended for the construction of the port of Pu-Kow, in the Province of Kiang-Su, and $12,000,000 for the building of a bridge between Hankow and Wu-Chang, over the Yank Tse River. The remainder, $6,000,000, goes to the Chinese Minister of Finance.

The new Gladstone Dock at Liverpool is 1,020 feet long, 120 feet wide, at the entrance, and carries a depth of water over the sills of 46 feet at high water of ordinary spring tides. This dock is the first instalment of a scheme involving the expenditure of $16,000,000. The proposed work includes also an entrance lock over 870 feet in length and 130 feet in width, and in the inside dock area there is to be a half-tide dock of 14¾ acres, two branch docks, each 400 feet wide, with a pier between them over 1,300 feet in length.

AUTOMATIC RAILWAYS.

By Reginald Trautschold, M.E.,
Consulting Engineer. New York City.

THE material-handling apparatus so far considered in these articles have all called for a supply of power from some outside source for performing their operations of conveying or elevating, or both, and their respective true economic value is largely a question of economy in consumption of power. In fact, their economic value might almost be said to depend upon their mechanical efficiency, the proportion of the total amount of power supplied converted into useful work—work actually performed; total energy supplied. There is one variety of equipment of the intermittent type for conveying, however, that performs such operation without necessitating the supply of any power and would thus appear to have an incalculable economic value. This is not quite true, for this peculiarly efficient system requires the performing of considerable preliminary work, the net mechanical efficiency of the material-handling system then necessitating the consideration of all work done, the preliminary work as well as the work that required no supply of power. However, the "automatic railway," the system referred to, is of particular interest and of very high economic value in many undertakings.

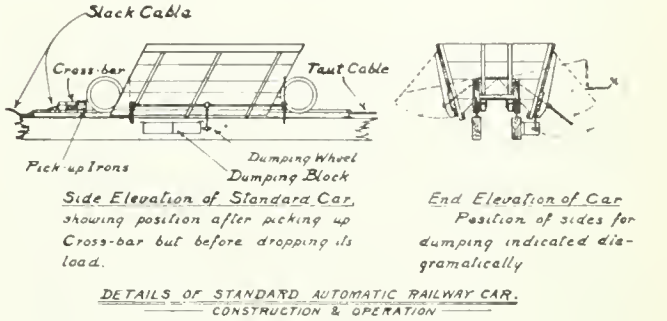
The automatic railway is based on the principle that the momentum of a body descending an inclined plane, like a falling body, is dependent upon the velocity at which it travels and the weight of the descending body and that if the energy required for bringing such a moving body to rest should be applied to another lighter body, or the same body after it has been lightened, it would cause the second body to rise until the energy consumed by such operation equalled that required to bring the first heavier body to a state of rest. Theoretically, the horizontal distance over which such automatic operation could be performed would be unlimited but the necessity of limiting the maximum speed of the descending body, the practical limit to the momentum that can be overcome and partially returned to the lightened body, etc., places a limitation of 600 feet for the operation of an automatic railway. Practical application of the principle calls for a car of special design for the conveyence of the load; a weight, attached to a cable, for operating the system; and a cross-bar, also attached to the cable, which is picked up by the descending car, as it approaches its discharging point, gradually raising the weight until the car stops—the car automatically dropping its load between the time that the loaded car picks up the cable and the time when the raised weight overcomes the momentum of the moving car. The weight, falling from its elevated position, then pushes the lightened car back along the track towards the loading point with sufficient force to return it to the starting point, there to be reloaded and the cycle repeated.

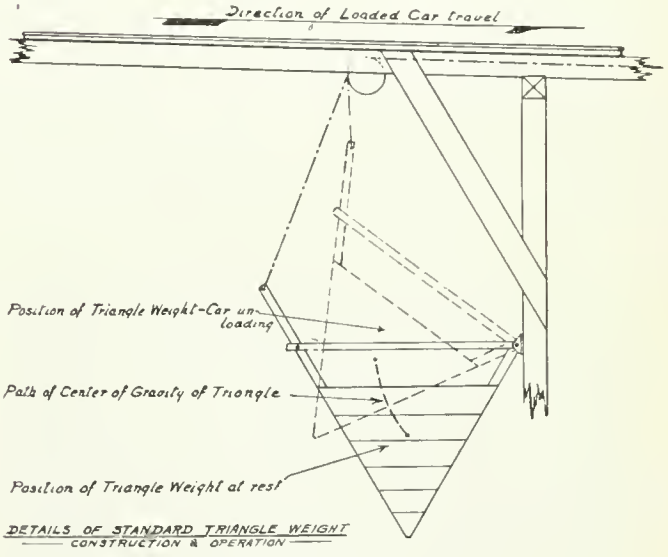
Ordinarily the inclination of the track for such operation is that which causes the car to attain a mean speed of 600 or 750 ft. per minute between loading and discharge points. Such speed is, of course, subject to considerable variation, as on a short railway the inclination of the track necessary for attaining such a mean speed would be excessive and in runs approaching 600 ft. in length, the mean speed attained by the car is frequently greater than 750 ft. per minute. The weight for arresting the travel of the car and to give the requisite shove to the returning car should advisably perform the first

operation gradually—that is, the resistance to the further forward travel of the car should advisably commence at a minimum and increase gradually to a maximum as the travel of the car grows slower—otherwise the shock of the car at its maximum speed with the cross-bar, which transmits the shock to the operating weight through the medium of the cable, would be too great for most satisfactory operation. The second operation, that of giving the emptied car sufficient shove to send it back to the loading point, requires application of power in somewhat different order. First, sufficient force should be applied to start the car quickly on its return journey and to enable the car to pick up its maximum return speed as rapidly as possible, after which sufficient force to overcome the resistance to the return travel of the car is all that is required, though it is advantageous to have force acting against the car—in the direction of its return travel—for as long as is feasible. The requirements for both these operations are closely attained by a weight so attached to a rigid support on one side and the operating cable on the other that, when not in use, the weight lies between and is balanced by the tension in the idle operating cable on one side and the rigid support on the other. The cable, picked up by a descending car, raises the weight which, on account of its pivoted attachment to the rigid support, swings about the arc of a circle, causing the pull on the weight to become gradually less effective as far as lifting power is concerned and thus gradually increasing the effective pull of the weight on the cable while, at the same time, the momentum of the descending car is greatly reduced by the discharge of the car load. On the descent of the weight to its position of rest, the pull of the weight on the cable is at a maximum at once and maintains powerful until the car picks up its speed, the speed of both car and cable increasing during this time from zero to that of top speed of returning car. Further descent of the weight tends to cause its fall to grow more rapid and the pull-in of the cable to become more rapid still, the effective pull of the weight on the cable meanwhile becoming less. The empty car having attained its maximum speed, then retards the acceleration of the pull-in of the cable thereby reducing somewhat the shock of impact of the weight on coming to rest—the shock in the cable caused by the completion of the fall of the weight. Any stretch in the operating cable is likewise neutralized, the only rigid connection of the cable being at the far end of the track so that a lengthened cable simply means a little further fall of the weight.

The car generally used on an automatic railway is of the double side dump type, of either one or two-ton capacity, and the automatic tripping device for actuating the release of the car sides is located at the side of the track between the point where the car picks up the "cross-bar" and the end of its travel. The "pick-up irons" for engaging and carrying forward the "cross-bar" are attached to the front of the car and the "cross-bar" is rigidly attached to the operating cable so that the forward travel of the "cross-bar" raises the operating weight until the momentum of the moving car is overcome. The "cross-bar" also gives the empty car the necessary shove for its return trip. The standard type of automatic railway car is built with a gable bottom, with sufficient pitch for rapid drop of load, so proportioned as to throw the load clear of the rails—the standard track gauge being 21 in., 0 to 0.,—and with the car wheels clear of the body proper. This arrangement permits the construction of a low car, presenting comparatively small surface to air resistance, with a wheel base that is not unduly long—in fact, the standard automatic railway car has a wheel base sufficiently short to enable it to take a curve of 30 ft. radius. Such curved sections of track must be confined to sections near the loading end of the railway, however, discharge of load requiring straight track, the operating cable having to be straight and free beyond the cross-bar.

The capacity of an automatic railway, though necessarily rather low when compared to that of a system for continuance conveyance or of one that permits the use of the car on its return trip, compares quite favorably with car-hauls and similar systems that also usually carry their load but one way—the mean speed of car travel being high and little time wasted in loading if the car is filled directly from an overhead hopper of adequate capacity. The car is usually comparatively small so that an expert operator is required to obtain a carrying capacity of 50 tons per hour on a railway 300 ft. long with a 1-ton car or of 90 tons per hour with a 2-ton car. Under the same conditions of service, doubling the length of the railway


Slack Cable
Cross-bar
Taut Cable
Pick-up Irons
Dumping Wheel
Dumping Block
Side Elevation of Standard Car, showing position after picking up Cross-bar but before dropping its load.
End Elevation of Car Position of sides for dumping indicated diagramatically
DETAILS OF STANDARD AUTOMATIC RAILWAY CAR. CONSTRUCTION & OPERATION


Direction of Loaded Car travel
Position of Triangle Weight-Car unloading
Path of Center of Gravity of Triangle
Position of Triangle Weight at rest
DETAILS OF STANDARD TRIANGLE WEIGHT CONSTRUCTION & OPERATION

Automatic Railway Details.

would not cut the carrying capacity in two nor would the difference in capacity between similar railways with 1- and 2-ton cars be so marked, about 38 tons per hour being obtainable with the smaller car and 65 tons per hour on the long railway with a 2-ton car. Such capacities require the handling of material weighing from 50 to 60 pounds per cubic foot and efficient loading of the car from an overhead hopper of adequate capacity and free discharge.

To arrive at the net cost of operation of an automatic railway requires consideration of each individual installation as so many conditions must be known that no law can be advanced for even approximate calculations. For

instance, in the case of four similar railways; two of 300 ft. and two of 600 ft. length, one 300-ft. railway equipped with a 1-ton and the other with a 2-ton car, the 600-ft. systems similarly equipped; all handling material of such weight as to carry their rated capacity on each trip and all so efficiently loaded as to be able to realize about the highest hourly capacity of each installation, the cost of labor chargeable to each ton carried would vary considerably, for but one good operator would be necessary in any case. The cost of operation per ton handled on the longer of the two systems with 1-ton cars would be but 30 per cent. more, as far as labor or attendance is concerned, than on the shorter railway, while similar comparison between the two 2-ton car systems would show a labor burden of 36 per cent. more for the longer than for the shorter system. A comparison of the two 300-ft. systems and the two 600-ft. would show an increased burden for labor per ton for the shorter installations of about 80 per cent. for the 1-ton car railway, and for the longer installations of about 70 per cent. more for the railway with the small car.

Installations of the same length and similar cost of construction would vary somewhat as to first cost, depending upon whether equipped with 1- or 2-ton cars and similar installations, as far as construction cost and size of car, but of different length, would also vary, it is true, but this variation would scarcely effect the economic value of the installation, as the burden imposed by interest on investment, taxes and insurance would be the only items to appreciably affect the net cost of operation. These items would in themselves not vary to any great extent, for initial cost of installation would not differ much between a 1-ton car or a 2-ton car railway, nor would the cost of similar installations of different length vary directly with the length of the railway; rather the cost per foot of railway would vary more nearly inversely as the hourly capacities of the systems. For instance, the cost per foot of a 300-ft. railway would average about 30 per cent. more than the unit cost of a similar railway 600 ft. long. The customarily necessary allowance to make for depreciation, renewals, etc., can almost be neglected in the ordinary automatic railway installation, as there are many instances on record where such systems have been in almost continuous daily operation for over 40 years with practically no depreciation evident, the originally installed car still being used, and no renewals except a very occasional new cable or possibly a new sheave or block.

The variable labor charge may also be greatly discounted, for, in the average installation, some attendance would very probably be required at the loading hopper if the operator of the railway was not present. The cost of elevating the material handled to the loading hopper or to the automatic railway car itself—installations occasionally being made where the car is loaded directly from the apparatus performing the preliminary work of elevating the material to be carried—is rarely more than would be required for similar operation by any other system that could be employed to handle the load to the point where the automatic railway car drops its load to bin or storage, not more than a few additional feet of elevating being required for the material to be discharged to a loading hopper of even the largest size ordinarily employed.

In operations requiring the knowledge of the exact weight of material handled, the automatic railway enables such records to be kept easily and economically, without the necessity of any delicate or complicated automatic weighing devices, etc. A platform car scale with double beam is the only accessory necessary. The operator simply records the weight of the empty car on one beam, then loads the car and balances the weight of the loaded car on the second beam, the reading on the second beam then gives directly the net weight of the load, which may be entered in a "tally book" while the car is traveling from the loading hopper to the discharge point and back. This semi-automatic weighing system accurately measures the exact amount of material that is discharged from the car, any material remaining in the car being accounted for in the next empty car reading and subtracted from the load dropped by the car on its next trip.

Possibly the greatest advantage of the automatic railway, however, is the reliance that may be placed on its continual operation. Once properly installed and adjusted, no attention at all is required other than an occasional inspection of cable, etc.—the car always automatically returns to the loading point after discharge of load, so is always ready for operation. High-grade ball or roller bearings are used for all rotating parts so lubrication is reduced to a minimum and the general high-grade of equipment that the system required for satisfactory operation minimizes the expense for incidental supplies of all kinds.

The disadvantages of the system are exceedingly few, one being its somewhat limited capacity. This, however, is no great detraction, for, requiring no supply of power for its operation, it costs practically nothing to have the system in operation for sufficient time to enable it to carry all the material that a power-consuming conveying system of greater hourly capacity could handle in considerably less time but with a charge for power, increased burden of depreciation, etc., and probably a heavier attendence charge for the shorter operative hours than that entailed in caring for the slower system. Another drawback to the automatic railway is its comparatively short operating range. This is limited to 600 ft. as the maximum, and it is doubtful whether railways shorter than 50 ft. in length would operate entirely satisfactorily owing to the comparatively short distance that the descending car would have in which to store up momentum sufficient for the operation of the system. However, this limitation does not affect many installations where the mechanical handling of materials is advisable if not necessary.

Although the automatic railway is primarily designed and adopted for the handling of material in bulk, which can be automatically dumped from a gable-bottomed car, modifications of this standard have been installed for handling materials in bags, etc. For such service, a special type of flat car is used equipped with a mechanism by which the car is held stationary on completing its forward travel, at the unloading point, the operating weight of the system being held in an elevated position at the same time. On unloading the flat car, the holding attachment is released and the operating weight of the system drops and pushes the unloaded car back to the loading point.

[NOTE—This article is the seventh of a series on "The Mechanical Handling of Materials," written for *The Canadian Engineer* by Mr. Trautschold.—Ed.]

Boston proposes to have a forty-foot channel in its harbor because there is now in commission and in prospect ships requiring that depth of water. Boston now has in its service mammoth liners drawing from 32 to 33½ feet. In July this port handled twice as many ocean passengers as Philadelphia, and four and one-half times as many as Baltimore.

THE ROTARY TYPE AIR PUMP.

During the past few years, there has been an increasing demand for rotary air pumps for use in connection with surface condensers in steam turbine plants. Such a system seems to have several advantages, chief among which is the factor of space efficiency, as well as general simplicity and absence of reciprocating parts.

The illustrations shown herewith relate to the Willans rotary air pump system, a product of Willans and Robinson, Limited, Rugby, England. This system is brought out under license for the Müller-Josse Patent, controlling a system extensively used on the continent in condensing plant construction in sizes ranging as high as 10,000 K.W. Fig. 1 shows a diagrammatic sketch of the two most common applications of this system, viz., the shunt and the series system. In either case, the air is extracted from the condenser by means of the air-ejector, and the condensed steam is withdrawn by a separate centrifugal pump drawing the water from the bottom of the condenser. The piping for this operation for both systems is well illustrated in Fig. 1. The two systems differ in the manner of supplying the water to the air-ejector. The shunt system is used where the head across the circulating pump, as given by the local conditions and the pipe and condenser friction, suffices for the purpose of extracting air. In such case, the main circulating pump is designed to deliver a greater quantity of water than is required as cooling water in the condenser, the surplus water being used as air-ejector water, and returned to the source of supply or to the suction side of the circulating pump.

Where the series system is used, the whole body of the condenser cooling water is passed through the air-ejector before entering the condenser. Thus, in the shunt system, the power required for extracting the air is determined by the surplus quantity of water at the given head, and in the series system by the given quantity of water at a surplus head. In neither case is a greater quantity of cooling water consumed than where a reciprocating air pump or any other rotary air pump is used. Only one simple centrifugal pump is needed for supplying the condenser cooling water and the air extraction water.

The power required in extracting the air is dependent on the design of the ejector and the power actually consumed in compressing the air. The ejector used is the outcome of exhaustive experiments, and is said to be equal at least to any other form of ejector, either stationary or rotary. To reduce to a minimum the power required in air compression, the line of compression should approach the isothermal as closely as possible and compression should be carried out at the lowest possible temperature, namely, the temperature of the cooling water. Generally speaking, other rotary air pump systems call for special water tanks for holding the water required for air extraction; moreover, this water heats up rapidly owing to the small quantity of water in the closed circuit, and provision requires to be made to change the water frequently. Even so, the temperature of the water cannot be maintained at the temperature of the circulating water supply, and consequently the power consumed in compressing the air might be expected to be somewhat less in the system under description. Exhaustive tests have shown that in power consumption a very high efficiency has been obtained by this system, higher, it is claimed than for any other air extraction system dispensing with reciprocating pumps.

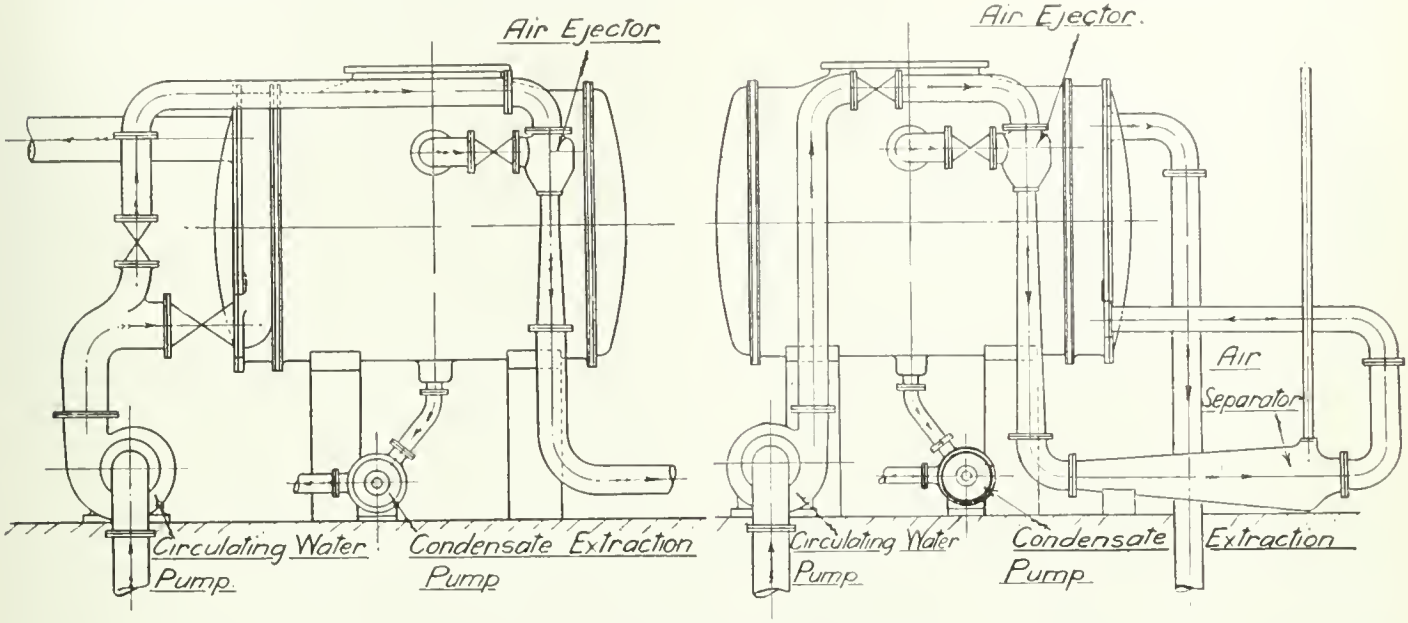


Fig. 1.—Shunt and Series Systems.

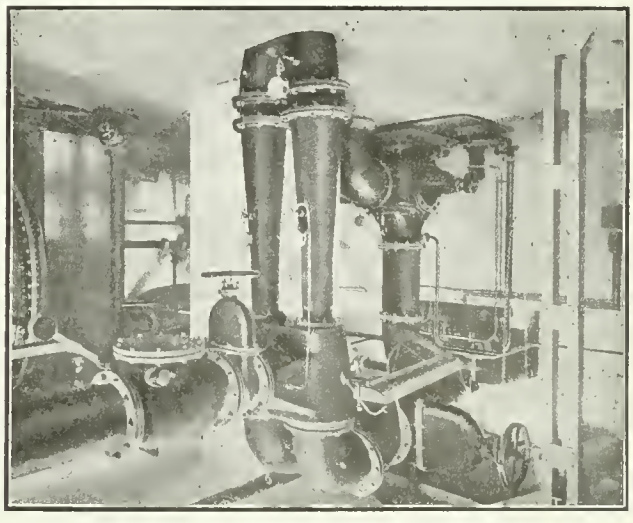


Fig. 2.—A 4,000-kw. Installation.

Fig. 2 shows a 4,000-K.W. surface condensing pump in operation. It might be stated that a total of 150,000 K.W. output measures the capacity of turbines for which condensing plants of this type have been built or are building.

COAST TO COAST.

Winnipeg, Man.—The first 25-mile stretch of the Winnipeg-Winnipeg Beach highway has been formally opened. The ceremony took the form of a luncheon, tendered by the municipalities interested, to Premier Roblin, Sir Rodmond and the Hon. Dr. Montague, minister of public works, and others taking a prominent interest in the construction.

Regina, Sask.—A report has been submitted to the street railway committee of the Regina city council covering the operation of the municipal street railway of the city for the eight months ending August 30th. This shows that after providing for operating expenses and capital charges there is a deficit of $31,872.34.

Vernon, B.C.—A great asset for tourist and travelling parties visiting the Okanagan Valley has been furnished by the completion recently of one and one-half miles of macadam road to connect Kelowna and Vernon. This road, which forms a contour highway, cut into the hillside above Kalamalka Lake, has been opened to traffic by a public ceremony conducted by those mainly by whose efforts it has been constructed, e.g., Hon. Price Ellison, Mr. G. A. Henderson, manager of the Bank of Montreal; Mr. Hamilton Lang, superintendent of roads, and his assistant, Mr. G. M. Watt.

Vancouver, B.C.—Discussing the progress of the work along the Kettle Valley line, Mr. J. J. Warren, president of the K.V.R., said of the 295 miles of track to be laid between Midway and Hope that steel had been installed for more than 100 miles and almost 200 miles of grading had been completed. In addition to the track laid through the Boundary, Kootenay, Kettle Valley and Okanagan districts, 25 miles of line have been finished from Merritt to Coldwater Junction. Machine shops and roundhouses have been established at Penticton and good progress is being made all along the route.

London, Ont.—During the year 1913, London's engineering department has expended $214,705.08 on local improvements; and up to date this is a record amount. This year is also on record as showing the inauguration of the municipal contract system, which has proven to be eminently satisfactory. Of the total expenditure, $5,500, or approximately 2½ per cent., covers the salaries for the engineering department and office expenses for the eight months of outside work. This is an entirely significant feature, since a 5 per cent. basis is considered low for engineering supervision and plans.

Owen Sound, Ont.—The great loss of life and wreckage of vessels on the Great Lakes has been attributed largely to the fact that national elevators are erected at harbors of the most difficult approach and of the least adequate protection. It is therefore being agitated among leading citizens of Owen Sound, that the Government be approached with a request to construct at Owen Sound, where the harbor offers the easiest and safest ingress of any on the Great Lakes, a national elevator or elevators; and already representations have been made in connection with the matter to the proper departments at Ottawa.

Victoria, B.C.—It is expected that the steel bridge which has been in course of construction over the Little Qualicom River will be completed in a few days. This is on the Courtenay extension of the line, and, when finished, the laying of the steel will be proceeded with as far as Big Qualicom. While this work is under way the bridge gang will be transferred to Cowichan Lake to erect a steel bridge for which the foundations have been finished. This done the outfit will be removed again to Big Qualicom, which project will be carried forward as rapidly as circumstances permit. It is believed that the East Coast extension will be opened for passenger traffic by July 1 of next year.

Regina, Sask.—The development of the Saskatchewan Co-Operative Elevator Company during its short lifetime was reviewed at the recent annual meeting held at Regina. The first year the company operated 46 elevators, with 2,590 subscribers, and handled three and a quarter million bushels of grain. During the second season's business, which ended July 31, 1913, the company operated 137 elevators, with 8,962 shareholders supporting them, and thirteen million bushels of grain were handled. This year the company has 193 elevators, the total number of shareholders being 13,000; and up to September 20th, the company has handled considerably over 1,000,000 bushels of this year's crop.

Hull, Que.—The committees from Hull and Ottawa, appointed to arrive at the basis of an agreement between the two cities for the right-of-way of the Gatineau Lakes pipe line through Hull, have found only one difficulty in the way of a satisfactory agreement, e.g., the price which Hull shall pay for the privilege of taking water from the Gatineau system. In the proposed agreement Hull asks for a rate of one-quarter of a cent per 1,000 gallons, which is the rate that that city is paying at present. In return for this rate Hull will grant the right-of-way free of charge, and also an exemption of taxation until such time as the city of Hull decides to take its water from the new system.

Montreal, Que.—The City Council inspected recently the work on the filtration plant which is proceeding under the direction of Mr. Norman M. McLeod. The controllers found that a great deal of progress has been made. To obviate the damage by frost, which wrought such havoc with the plant last winter, the filtration plant is being put under four or five feet of water for the winter. The contractor has been helped forward on the work by the particularly favorable nature of the weather this autumn. The council was particularly satisfied with the enlargement of the aqueduct and the laying out of the twin boulevards on either side of the waterworks canal, the work on which is being done by the Cook Construction Company.

Montreal, Que.—Improvements upon the city's original sewage farm have been completed at a cost of about $120,000. These improvements were necessary before the farm could be used for the purification of the matter flowing from the sewers to the river. The new farm, purchased a year ago, is to be improved next year at a cost in excess of that of the work on the first farm. It is estimated that the total cost of the enire sewage farm when completed will be between $395,000 and $400,000. The work carried out during the past year on the old farm has been the adding of stone to the property so as to produce an effective filter for the sewage, the land having proven itself not sufficiently porous. The same method of treatment is to be given the new farm, and the final result will be that, in the course of twelve months, all the city sewage will pass through this farm and be purified before emptying into the river. Thus, contamination of the water supply will be obviated.

Toronto, Ont.—At the last meeting of York County Council, Mr. E. A. James presented an interim report on behalf of the Highways Commission of York county; and a complete report is to be forwarded to the council before the end of the year. Mr. James' report shows a total expenditure on construction of roads and bridges during the year of about $60,000; and on maintenance, of $14,000. Owing to the request of the Government that no extensive work be undertaken pending the report of the Provincial Highways Commission, construction work was restricted to completing

gaps between sections already built. Some of the most important work was one mile of macadam construction on Yonge Street at Thornhill; 1,500 feet of brick pavement on Weston Road west of Black Creek; and three-quarters of a mile of macadam roadway in Vaughan township. Other road construction was 8,470 feet on Kingston Road, 8,500 feet on Vaughan Road, and 6,700 feet on Markham Road. On bridges and culverts the total expenditure, including construction and maintenance, for the year was $16,342.

Vancouver, B.C.—The final consignment of steel pipe contracted for by the city at the beginning of the year has arrived from the Mannesmann Tube Company of Great Britain; and the city has now on hand between 80 and 90 miles of water pipe. Only about 5½ miles of mains have been laid from this year's pipe; and it is estimated that the city will have a supply on hand to last for several years. When contracts were let to the National Tube Company of Pittsburg for 320,000 feet and to the Mannesmann Tube Company for 110,000 feet, it was intended that the pipe should arrive at periods, considerably apart; and it was thought to thus obviate the difficulty met with in the past owing to non-arrival of the pipe in time. As the case now stands, and owing to the serious drop in the demand for mains, it is asserted that the pipe will rust long before the city can use it. Last year, the city engineer's report showed that 47.8 miles of pipe of all sizes had been laid; but this year only about 17 miles of water mains have been laid. This is due largely to the falling off in building operations this year in Vancouver.

Victoria, B.C.—According to Mr. D'Arcy Tate, vice-president and general manager of the P.G.E. railway, the company will complete its contracts within scheduled time in spite of unforeseen engineering difficulties encountered on the northern section of the line. The section between Point Atkinson and Newport promises to be one of the most costly pieces of construction on the entire line, and will involve an outlay of about $100,000 a mile. This will mean practically the laying of the road on a bed of solid rock. In the Upper Fraser country there will be big rock fills; but the nature of the sub-structure is such that this part of the line will be built for less than one-half the cost of the Newport section. A short section of the line between Newport and Cheakamus, about seventeen miles in length, will be completed this week, and it is probable that Sir Richard McBride will open this small length and at the same time take the opportunity of making a personal inspection of the progress made in construction. The North Shore section will be ready for traffic by January 1 of next year, and the next section by the end of the following July, in accordance with the terms of the contract.

Niagara Falls, Ont.—Mr. Frederick Walker of New York, has devised a plan to build a suspended raceway at a cost of about $2,500,000, to tap one-half of the waterfall from the Canadian Falls and one-half from the American Falls at Niagara, and to carry the water through the Niagara River to a point where a great power plant will be erected for the creation and distribution of electricity. The power plant, which is not included in the estimate of cost, would furnish unlimited power to factories in Eastern Canada, just as the Niagara Falls Power Company's plant furnishes power to factories in Western New York and Pennsylvania. The plans provide for the raceway to be suspended with one end upon the rocky ledges of the Niagara River and the other planted on the river bank, and to be arranged so that if the river rises or falls, the raceway will rise or fall automatically. The raceway will follow the Canadian shore for several hundred rods before reaching the place where the power will be harnessed; and its carrying capacity will be about 1,200 pounds to the foot. It will be constructed of steel and concrete. Already surveys for the work are being made, under Mr. Walker's supervision; and options on land on the Canadian side are being received by other men interested.

Montreal, Que.—Col. Greenwood, assistant chief engineer of construction on the C.N.R. east of Port Arthur, has inspected the bridges under construction for the company at Back River, and reports that Mr. J. P. Mullarky, the contractor, is rushing the laying of track on the section from the western portal of the tunnel to the crossing of the Back River so that the steel superstructure may be brought for the series of bridges across the Riviere des Prairies and Mille Isle. There are two channels at the Back River, each being crossed by 4-pier bridges. The middle pier of the first channel bridge alone remains to be finished; and for this the coffer dam is now being sunk. On the second channel bridge all the substructure has been placed in position. Where the C.N.R. crosses the Mille Isle, there is being built a bridge of 14 piers, all of which are completed. This is one of the most imposing structures on the main line of the railway; and the superstructure for it will be placed during the coming winter. All other bridges along the road as far as Carillon have been completed, while the sub-structure of the big bridge over the Ottawa River at Portage du Fort, a structure of 12 piers, has also been finished. The C.N.R. main line runs up on the Ontario side of the Ottawa River for a distance of 30 miles as far as Shaw Falls, and then crosses into Quebec. After continuing for 30 miles in Quebec territory, the line crosses the river into Ontario again by the Portage du Fort bridge.

Montreal, Que.—Much is planned to be effected at the Montreal harbor before it is opened again in the spring. Before that time the slope of mud and clay at the river edge of Victoria, the dingy old dredge, and the clamshell derrick will all have disappeared; and a smooth concrete wall, of a height uniform with the other high level wharves of the upper harbor, and another of the huge freight sheds which line the wharves all the way to Windmill Point, will have appeared. Half a mile down the shore, from sections 24 to 27, where new concrete piers lying parallel with the river have been constructed during the summer, two more big freight sheds will have appeared. The piles for these have already been driven—long, concrete stilts, thrust down to the rock to take the strain off the heavy structures with the thousands of tons of freight, which they contain when in use. New berths at Victoria pier will be ready to give every opportunity for loading grain. Above the roof of the new freight shed the conveyor gallery will be extended to the very edge of the river. This will be the last link in Montreal's wonderful elevator chain. It will make one continuous system from Victoria pier to the western end of the Allan Line shed at the foot of McGill street, which in all will then have close to 16 miles of belt conveyors to carry the grain from unloading tower to elevator, or from one elevator to another; or, finally from either elevator to any ship lying anywhere between those two extremes. Four miles lower still, a like transformation will have taken place at the site of the Canadian Vickers Company's shipbuilding and repair plant. Acres of mud and construction materials will have vanished and a concrete retaining wall, which will make the whole water frontage of this tract one big wharf, and a heretofore much-needed machine shop of immense proportions, will have been completed. Further improvements that will add materially to the rejuvenation of the harbor, will be the Armstrong steel plant directly across the river; and the river bed itself, which will have a newly dredged channel for the use of light craft in general, which will wind along on the north side of the deep channel, the passageway for large vessels.

PERSONAL.

A. K. GRIMMER, City Engineer of Medicine Hat, is at present on an extended trip through eastern Canada.

GEORGE T. CLARK, City Engineer of Saskatoon, Sask., has, it is announced, placed his resignation, to take effect February 1st, in the hands of the city council.

M. R. SHAW, B.A.Sc., is assistant superintendent for the Muskogee Refining Company, refiners of illuminating and lubricating oils and paraffine, Muskogee, Okla.

W. E. SKINNER, of Winnipeg, has been retained as consulting engineer for the town of Kenora, and will make a report upon the cost of producing power at the municipality's hydro-electric plant.

P. P. VON WEYMORN, civil engineer of the water power department of the Russian Government, is at present in Canada, to investigate the regulations of water power now in force in this country and the system of administration. For the past month Mr. Von Weymorn has been carrying on an investigation in the various cities of the United States, and is now visiting Canadian cities. He is very much impressed with the results of his investigations so far, and thinks that the regulations of water power of the Dominion Government are the best he has seen so far.

OBITUARY.

The death was recently announced in London, Eng., of Sir William H. Bailey, a prominent British engineer. Among his many accomplishments was the design and promotion of the Manchester Ship Canal.

The death occurred in Kingston last week of Mr. John Hazlett, well known in marine engineering, having been for years chief engineer of the Calvin and Hepburn Companies.

Mr. Oswald Gurney Carscallen, the Toronto representative of the Asphalt and Supply Company, Limited, died last Sunday at his home in Toronto after two months' illness. Mr. Carscallen was born in Hamilton and educated at the University School, Port Hope, and at Upper Canada College. Until three years ago he was vice-president and secretary-treasurer of the Gurney-Tilden Foundry Company at Hamilton. Mr. Carscallen had become very popular among the municipal and highway engineers and road contractors in Ontario during the three years that he was interested in paving work, and his death at the age of only forty-five years will be greatly regretted.

REVISION OF UNITED STATES ROAD LAWS.

A committee of the American Highway Association has been appointed to assist in the revision of the road laws of the various states in an endeavor to codify and simplify them and render them more uniform. The comprehensive plan which has been evolved will eventually result in a more uniform system of laws dealing with road matters. It is well recognized that most of the road legislation in various states is antiquated, and in many instances, obsolete. Many of the road laws are one hundred years old. There is little uniformity in the laws among the states. These facts appear as serious obstacles in the way of those who are seeking to give the entire country a network of improved highways.

It is probable that as a result of this movement the Governors of the various states will co-operate to urge upon the legislatures the appointment of commissioners, who will revise and simplify the laws.

THE FIFTH ANNUAL GOOD ROADS EXHIBITION.

The Public Roads and Highway Commission of Ontario will have an exhibit at the Good Roads Exhibition of the American Road Builders' Association, which is being held in Philadelphia, December 9th to 12th. In addition to some eighty-five commercial exhibits, which had been assigned before the end of November, and which figure will likely assume a materially larger dimension before opening day, there will also be extremely interesting and instructive exhibits from a large number of the state highway departments, leading cities, engineering schools and colleges. The United States Department of Agriculture will show the road models prepared by the Office of Public Roads.

The Ontario Highways Commissioners, Messrs. McGrath, McLean and Rankin, and Mr. Wagner, Secretary of the Commission, will be in attendance. Mr. A. T. Laing, Department of Highway Engineering, University of Toronto, and numerous road engineers throughout Ontario, Quebec as well as representatives from Western Provinces, have signified their intention of being present.

The officials in charge of the convention arrangements state that from present indications the forthcoming exhibition will be by all odds the largest and most complete that has ever been held. Every effort has been made, so far as possible, to include in this exhibition all the newest labor-saving machinery, methods and appliances, so that altogether, the exhibition will be an accurate and striking record of progress. Several important departures are promised by manufacturers in their respective lines, and the exhibition will afford those interested in the purchase and use of road machinery and materials an excellent opportunity for inspection and comparison.

A detailed programme of the technical features of the Convention appeared in *The Canadian Engineer* for November 20th.

COMING MEETINGS.

AMERICAN INSTITUTE OF ARCHITECTS.—Forty-seventh Annual Convention, to be held in New Orleans, La., December 2nd, 3rd and 4th. Secretary, Glenn Brown.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.—Annual Meeting will be held in New York, December 2nd to 5th. Secretary, W. H. Reed, 154 Nassau Street, New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The Annual Meeting will be held in New York, December 2nd to 5th, 1913.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—Annual Meeting to be held in New York, December 10th to 13th. Secretary, C. D. Odsen, Polytechnic Institute, Brooklyn, N.Y.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—Seventh Annual Convention will be held at Great Northern Hotel, Chicago, December 29th to 31st. Secretary, I. W. Dickerson, Urbana, Ill.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

SHORT COURSE IN HIGHWAY ENGINEERING.

The last Illinois legislature passed a law regarding roads and bridges which introduced new principles and methods concerning the construction and maintenance of roads and bridges; and the law also created the offices of county superintendent of highways, and provides for the possible appointment of township or district superintendents of highways. In view of the new principles of administration introduced by this law, and also in consideration of the entirely new duties devolving upon the county and township superintendents of highways, and further, on account of the recent radical changes in the methods and materials of hard road construction, due to the increasing use of automobiles, the Civil Engineering Department of the University of Illinois will offer a course in highway engineering from January 19th to January 31st, 1914.

There will be no charges of any kind by the University; and the course will be open to anyone, without examination or other condition, who aspires to be appointed to the position of either county or township superintendent of highways, and to any others interested in the maintenance or construction of roads.

The lectures will cover the various phases of highway engineering; and will be given by members of the staff of the Civil Engineering Department of the University of Illinois, and by Mr. A. N. Johnson, State Highway Engineer, and members of the staff of the Illinois Highway Commission. The laboratory exercises are to show the methods of testing and using the materials employed in ordinary road construction, such as hydraulic cement, concrete, tar, asphalt, road oil, etc. It is expected to have several pieces of road machinery on exhibition with experts in charge to explain the manipulation and method of using each. In the evenings there are to be semi-popular lectures, which will be instructive to highway engineers and others interested in road improvement.

AMERICAN MANUFACTURE OF DIESEL ENGINES

Most of the important European manufacturers of large steam and gas engines are largely concentrating their energies on building Diesel engines, and have such a large number of orders that to make prompt deliveries is practically impossible. It has for some time been a subject of much comment in view of the highly successful business being done in the Diesel engines by many European concerns, that no attempt has been made to build in America a full line of Diesel engines of a design which has proved to be a commercial success in actual use.

It should be remembered that notwithstanding the increase in the price of fuel oil, the actual cost of fuel oil and its relative cost, as compared with coal, is generally much lower on this side the Atlantic than in Europe. Also, that oil suitable for Diesel engines is a by-product which will always be available in ample quantities as long as the present large consumption of gasolene and kerosene exists. Many large new oil fields are also being developed in this country, in the United States and in Mexico.

Not only are Diesel engines said to offer many advantages for central station units, factory and other isolated power plants, and railway service, but are particularly desirable for marine work, where weight and space saved is of prime importance. The Diesel oil engine eliminates the boilers, with their necessary handling of coal and ashes; also pumps, and many other accessories characteristic of steam equipment. The space so saved, and the coal-bunker space, can be used for cargo, and the liquid fuel, handled by pumps, and requiring less than one-third of the room required for coal, can be stored in the ship's double bottom. In view of these facts, there seems to be no reason why there should not be a broad field for this type of engine.

An announcement has just been made that a corporation has been formed with a New York State charter to engage in the manufacture on an extensive scale of a full line of Diesel engines, both stationary and marine, for the American countries. In addition to American interests, the company has behind it a number of Swedish capitalists, who now control the Swedish Diesel Motor Company (Aktiebolaget Diesels Motorer), which company started building these engines in 1898, and many of their designs of the most important features peculiar to this type of engine, such as fuel pump, atomizer, details of pistons, etc., have been adopted by other European builders.

The new corporation will take over the plant and organization of the McIntosh & Seymour Company, of Auburn, N.Y., builders of steam engines, and the construction of both types will proceed under the one organization, the name of which has been changed to McIntosh & Seymour Corporation. Mr. Edwin S. Church, formerly superintendent of the Akron plant, International Harvester Company, will be president; Mr. J. A. Seymour, formerly president of the McIntosh & Seymour Company, will be vice-president, with charge of engineering.

AGRICULTURAL ENGINEERS.

The American Society of Agricultural Engineers is holding its Seventh annual convention in Chicago. Dec. 29th to 31st, 1913. From a lengthy program we select the following items as of special interest to municipal officials, irrigation engineers and those more closely connected with rural development:—

(1) Farm Sanitation, with Special Reference to Water Supply and Sewage Disposal.—Paul Hansen, Engineer, Illinois State Water Survey.

(2) The Design of Permanent Farm Buildings.—E. S. Fowler, Universal Portland Cement Co.

(3) Standardization of Wagon Wheels and Tires.—E. Parsonage, John Deere Wagon Co.

(4) Concrete in Drainage and Irrigation.—C. W. Boynton, Universal Portland Cement Co.

(5) Small Motor Applications for Farm Work.—C. J. Rohrer, General Electric Co.

(6) The Five Winnipeg Motor Contests, and Lessons to be Drawn from Them.

(7) Address.—C. R. Richards, University of Illinois.

(8) Extension Work in Agricultural Engineering.—F. M. White, University of Wisconsin.

The secretary, Mr. I. W. Dickerson, Urbana, Ill., states that immediately after the close of the convention a brief summary of the papers and discussions will be prepared and will be sent to any one interested.

The Toronto branch of the Canadian H. W. Johns-Manville Company, Limited, announces its removal to 19 Front Street East. This new store and warehouse has a floor area of approximately 35,000 sq. ft., and is situated in the heart of the wholesale district. In their new quarters this firm will be able to carry a larger stock and have ample space for the display of their complete line of specialties.

The Pedlar People, Limited, of Oshawa, have moved their Toronto branch from Bay Street to a new building at the corner of College and Markham Streets, where they have a greater floor space, and will be able to carry a more complete stock of sheet metal work of all kinds, including culverts, flumes, drains, roofing, fire-doors, metal buildings, etc.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20875—November 21—Authorizing C.N.R. to construct across Winnipeg Electric St. Ry. Co., near Helen Street and near Pembina Street, Winnipeg, Man., subject to certain conditions.

20876—November 22—Rescinding Order No. 19310, dated May 16th, 1913.

20877—November 24—Authorizing C.P.R. to construct siding for Quaker Oats Co. in City of Peterboro, Ont., mileage 24.3.

20878—November 1—Directing C.N.R. to furninsh a daily passenger service west of Alsask, Sask., satisfactory to an Engineer of the Board; said service to be put into effect not later than Nov. 10th, 1913.

20879—November 24—Directing G.T. Ry. to construct spur from its railway on south side of Kaministiquia River to factory and plant of Mount McKay Pressed Brick Co. ot Fort William, Ont., adjacent thereto, crossing two city roads and tracks of St. Ry. Co. in said City of Fort William, subject to and upon certain conditions.

20880—November 24—Authorizing G.T.P. Ry., subject to inspection by Dept. Public Works of B.C., after crossing is constructed, to construct main line across Government Road in S.W. ¼ Sec. 11-11-5, Coast Dist. B.C., at mileage 400 Prince Rupert East.

20881—November 24—Authorizing G.T.P. Branch Lines Co. and C.P.R. to operate their trains over crossing, in East Half of Sec. 23-17-20, W. 2 M., Sask., without their first being brought to a stop.

20882—November 24—Authorizing G.T.P.Ry. to construct Lake Superior Branch, at mileage 17.9 across highway between Cons. 3 and 4, Tp. Oliver, Ont.

20883—November 24—Establishing collection and delivery limits of Express Companies in Town of Leamington, Ont.

20884—November 24—Extending, for a period of one month, from date of this order, time within which C.P.R. complete extension of siding for Quinlan & Robertson in Lot 10, Con. 8, Tp. Huntingdon, Co. Hastings, Ont.

20885—November 24—Authorizing G.T.R. to construct siding into the premises of Pollard Manufacturing Co., Limited, north of Buttery St., Niagara Falls, Ont., subject to terms of consent of said city and certain conditions.

20886—November 25—Extending, for a period of thirty days from date of this Order, time within which C.P.R. complete work of fencing portion of right-of-way from mileage 6.8 to 7.6, on east side of track, and repairing fences on west side of track, on Kingston and Pembroke Branch.

20887—November 21—Approving plan showing two new abutments for replacing piers at C.P.R. bridge, at mileage 35.4 on Chalk River Subdivision.

20888—November 21—Authorizing C.N.C.R. to construct bridge to carry its line over Indian River, Tp. Richards, Co. Renfrew, Ont., at mileage 107.85 from Ottawa.

20889—November 25—Authorizing C.N.R. to construct across public road between Secs. 14 and 15, Tp. 26, R. 26, W. 3 M., Sask., Alsask Southeasterly Line.

20890—November 25—Authorizing G.T.R. to construct siding, from siding serving Queenston Quarry Co., Limited, north of road allowance between Twps. Stamford and Niagara, Co. Lincoln, Ont., into premises of S. W. Marchment on Lot 48, Tp. Niagara (near St. Davids).

20891—November 20—Directing that within 30 days from date of this Order, C.N.R. submit for approval of Engineer of Board detail plans showing proposed half-interlocking plants to be installed, as required under Orders Nos. 5598, 6751 and 7291; work of installing said half-interlocking be completed within three months after approval of plans. 2. Cost of putting in diamonds at said crossings be borne and paid by City of Edmonton; and cost of providing, maintaining and operating half-interlockers be paid half by city and half divided equally between railway companies. 3. Leave reserved to G.T.P. Ry. to appeal to Supreme Court upon question whether in view of agreement between it and city, dated Sept. 29th, 1908, it is competent for Board to apportion cost of such protection as provided in paragraph 2 of Order 4. 4. Order No. 14994, dated Sept. 11th, 1911, is rescinded; recission to take effect upon installation and completion of interlocking plants herein required.

20892—November 25—Authorizing T.H. and B. Ry. to construct spur for the Egg-O Baking Powder Co., Limited, Hamilton, Ont.

20893—November 25—Directing that C.P.R. erect fences along portions of right-of-way near Savona, B.C., work to be completed within three months from date of this Order. And rescinding Order No. 17358, dated Aug. 27th, 1912, in so far as it relieves railway company from erecting fences along said portions of railway between Savona and Pennys.

20894—November 24—Authorizing Rural Municipality ot Hillsburgh, No. 289, Sask., at its own expense, to construct highway across C.N.R. at a point 250 feet west of west switch, D'Arcy, Sask.; railway company plank said crossing, and municipality do necessary grading.

20895—November 25—Approving location and detail plans of Windsor, Essex and Lake Shore Rapid Ry. Co station on the Talbot Road, Town of Maidstone, Tp. Sandwich South, Ontario.

20896—Authorizing C.P.R. to open for traffic that portion of double track from mileage 121 to Broadview, at mileage 131.4, Sask.

20897—November 25—Authorizing C.P.R. to construct, at grade, its Snowflake Westerly Branch across nine (9) highways, mlieage 0 to 9.10, Manitoba.

20898—November 25—Authorizing C.P.R. to construct, at grade, proposed switching lead on Eastern Division, Smith's Falls Sub. Div., at mileage 123.0 from Montreal, across public road between Cons. 3 and 4, Tp. Montague, Co. Lanark, Ont.

20899—November 27—Approving revised location C.N. Montreal Tunnel and Terminal Co., Limited's, tunnel line from St. Antoine St., to junction with its main line, at Montreal, Que.

20900—November 26—Approving C.N.R. plan of freight shed proposed to be erected at St. Albert, Alta., as required under Order No. 20765, dated Oct. 31st, 1913.

20901—November 25—Authorizing G.T.R. to construct siding into premises of Harris Abattoir Co., Limited, in Lot 10, Con. 1, Tp. Barton, now City of Hamilton, Ont.

20902—November 25—Directing that G.N.R. construct an open ditch of adequate width and depth, with bottom ot uniform grade, on north side of its railway, from point marked "A," being at Hjorth Road, to point marked "B," about 2,000 feet therefrom; at Tynehead Station, B.C.; drainage of land south of track to be looked after by Municipality in connection with its road construction.

20903—November 25—Authorizing C.P.R. to construct spur for William Rutherford, at Stephen, B.C.

20904—November 25—Authorizing C.P.R. to construct siding for National Builders' Supply and Enamel Concrete Brick Co., Limited, Montreal, Que., from a point on existing siding in Lot Cadastral No. 323, Range St. Pierre, delaCabane Ronde, Parish of St. Henry de Mascouche, Co. L'Assomption, Que., mileage 14.81 from St. Martin Jct.

20905—November 25—Authorizing Government of Sask., at its own expense to construct highway over G.T.P. Ry. near N.E. corner of Sec. 17-38-26, W. 2 M., Sask.

20906—November 27—Authorizing Dept. Public Works, B.C., to construct, at its own expense, an overhead highway crossing over G.T.P. Ry. at a point about 127 miles (G.T.P mileage) from Prince Rupert and near Fiddler Creek, B.C.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer*.
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Brockville, Ont., water tube boilers		Nov. 20.	78
Burlington Channel, Ont., pier	Dec. 15.	Nov. 20.	82
Caldwell's Cove, N.S., breakwater	Dec. 15.	Nov. 27.	82
Calgary, Alta., machinery, etc.	Dec. 31	Nov. 13.	88
Gull Harbor, Man., extension to wharf	Dec. 4.	Nov. 13.	82
Halifax, N.S., and Esquimalt, B.C., stores for dockyards	Dec. 1, 3, 15.	Nov. 20.	82
Howick, Que., macadamized road	Dec. 10.	Nov. 27.	80
Little Sands, P.E.I., breakwater	Dec. 3.	Nov. 13	82
Montreal, Que., harbor transit sheds	Dec. 10.	Nov. 27.	82
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., coaling plants, etc.	Jan. 7.	Nov. 13.	86
Ottawa, Ont., ice-breaker	Jan. 8.	Nov. 27.	84
Pritchard, B.C., wharf	Dec. 15.	Nov. 27.	82
Richard's Landing, Ont., wharf and warehouse	Dec. 2.	Nov. 13.	86
South End P.O., Ont., pumping plant		Nov. 20.	88
St. Gabriel, Que., roofing of Shed No. I., Lachine Canal	Dec. 11.	Nov. 27.	88
Toronto, Ont., crushed limestone, etc.	Dec. 2.	Nov. 20.	88
Toronto, Ont., mechanical filtration plant	Jan. 20.	Nov. 27.	88
Vancouver, B.C., concrete sewer, etc.	Dec. 1.	Nov. 27.	88
Victoria Harbor, B.C., wharfs	Dec. 9.	Oct. 30.	84
Winnipeg, Man., motor hose-wagons, etc.	Dec. 15.	Nov. 20.	82
Winnipeg, Man., water supply		Oct. 16.	86
Winnipeg, Man., steam locomotive	Dec. 4.	Nov. 27.	78
Yorkton, Sask., electric machinery	Dec. 22.	Nov. 13.	86

RAILWAYS—STEAM AND ELECTRIC.

Hamilton, Ont.—The city council has decided not to sign any agreement with Mr. Webb providing a new east end incline until he has given the council proof that the present incline is in working order. An interested citizen of Hamilton has stated his willingness to build inclines on Wentworth Street and Sherman Avenue, leaving no grade crossings, providing the city will grant the necessary approaches, lands, and rights.

Hespeler, Ont.—The Hespeler board of trade has passed unanimously a resolution asking the town council to carry a resolution similar to those passed by other municipalities interested in the proposed Hydro-Electric Railway scheme.

London, Ont.—The directors of the London and Lake Erie Radial Railway Company have been petitioned to construct an extension through Elgin from Union to Sparta, and further, if possible, to Port Bruce.

Montreal, Que.—The board of control has submitted the whole matter of the offers of the Montreal Tramways Company and the Canadian Autobus Company for a subway service to the city engineers for a report. The board will also write several cities in the United States for information bearing upon the proposition.

New Westminster, B.C.—At the joint conference of representatives from Burnaby, Westminster, and Coquitlam, with the B.C.E.R., it was made known during the discussion of the proposed bridge over the Brunette River, that the B.C.E.R. has in view a cut-off into Westminster on the Burnaby Lake line. With regard to the extension of the B.C.E.R. over the proposed Brunette River Bridge, Mr. F. L. McPherson, the Burnaby municipal engineer, submitted a profile requiring a high-level bridge over the river, and a small bridge over the proposed cut-off. The suggestion was made, and will be considered by the B.C.E.R., however, that the two new car line grades—the cut-off and the Columbia Street East extension to the North Road—should be made to intersect.

+—Ottawa, Ont.—A contract has been let by the Intercolonial Railway Company to the HALL SWITCH AND SIGNAL COMPANY for the installation of a telephone train-despatching line between Moncton and St. John, N.B.

Port Arthur, Ont.—The Port Arthur council has demanded that provision must be made to have the main line of the street railway from Current River to Hodder Avenue some time in the future if it became necessary.

St. Thomas, Ont.—The finances of the London and Lake Erie Railway and Transportation Company at present do not warrant a $17,000 expenditure as half the expense of the construction of a new double track on Talbot Street. The matter will be brought to the attention of the board of directors at its next meeting. The committee dealing with the question were approached also by officials of the M.C.R. for the purpose of getting consent to construct a switch from the street railway tracks to the M.C. yards. Consent for such a switch has been secured from the Dominion Railway Commission, and the L.E. Railway and Transportation Company committee finally decided to recommend that council consent to the company entering M.C. property from the tracks on Wellington Street the company to pay the cost of keeping the road in order, and to pay the city $1 for every car hauled over the line. In this way the First Avenue subway will be avoided.

Toronto, Ont.—The Railway Commission Board has ruled in connection with the application made by the Canadian Pacific Railway Company for approval of its plan for new steel trestle required for a double track at the Don viaduct in Toronto, is that the work is necessary and must be undertaken, but that a street opening must be provided, the extra cost of $3,000 to be paid by the city.

GARBAGE, SEWAGE AND WATER.

East Angus, Que.—A by-law to provide for the issuing of debentures to the amount of thirty thousand dollars at six per cent., to provide for the completion of the water and sewer system, was brought before a public meeting of the ratepayers and approved.

Hamilton, Ont.—After the presentation of a financial statement to the city council by Mayor Allan, that body decided on a majority vote not to submit the sewer bylaw to the ratepayers. Two weeks ago, the council decided unanimously in favor of submitting this by-law asking for $650,000 for a storm overflow sewer.

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Hull, Que.—A delegation representing the city of Hull has visited Quebec to interview the Premier and the private bills committee concerning the Ottawa bill now before the Legislature with regard to the Gatineau Lakes water scheme. They asked that certain amendments be embodied in the measure before the bill will be allowed to pass. One amendment confines Ottawa to certain townships and objects to the granting of exclusive rights to all the lakes in the Gatineau district as asked by Ottawa. Another will make it compulsory for Ottawa to supply Hull with water, if desired, and not optional as in the original clause of the bill. Also the bill has been amended so as to exempt Hull from inclusion in the clause regarding Ottawa's powers of expropriation of lands, etc. And finally another clause has been added to the bill whereby the powers and rights of the act shall not have priority over any powers and rights given Hull by its charters and amendments.

Ingersoll, Ont.—The report of Consulting Engineer Weston of Boston, who was engaged in connection with the proposed sewerage system for Ingersoll, has been prepared and received by the Sewerage Committee. After receiving consideration from this body, it will be forwarded to the town council.

London, Ont.—Engineer E. S. Smyth of Winnipeg, one of the western engineers of the Chipman firm, is at present in London assisting on the plan work for the new storm sewerage system. Mr. W. A. MacGregor, also an expert of the Chipman firm, will be transferred to this work on January 1st, and construction on three sections is to be commenced simultaneously in the spring—Carling's Creek, Egerton and South London.

Medicine Hat, Alta.—By-laws have been passed at Medicine Hat, which total an expenditure of $500,000 for next year's work. Two of these by-laws provide for extensions to the city's water and sewer systems.

Ottawa, Ont.—It has been announced at Ottawa that a special meeting of the International Waterways Commission, to be held at Washington in January, will deal with the application of Winnipeg to convey water from Shoal Lake to the city, and also with the joint application of the Michigan Power Company and the Lake Superior Corporation for power to dam the St. Mary River at the Soo and develop the power for distribution.

▲—**Toronto, Ont.**—Tenders will be received up till December 16th for one overhead hand-operated crane, having a working load of 40,000 pounds, for the main pumping station. Plans and specifications may be obtained from the Purchasing and Accounting Dept., City Hall, Toronto. Signed, H. C. Hocken (Mayor), Chairman Board of Control.

▲—**Toronto, Ont.**—Tenders will be received up till December 16th, 1913, for the laying and jointing of a 36-inch water main from the high level pumping station to West Toronto. Plans and specifications may be obtained from the Waterworks Section, Department of Works, City Hall, Toronto. Signed, H. C. Hocken (Mayor), Chairman, Board of Control.

+—**Toronto, Ont.**—The city council has awarded contracts for sewers to J. F. CONNOLLY on Benlamond Avenue at $1,942; to J. H. McKNIGHT CONSTRUCTION COMPANY on Dufferin Street at $14,445, and on the Midway Drainage system at $4,445.

Vancouver, B.C.—Alderman Black, chairman of the water committee, has been informed by Mr. H. H. Stevens that the public works department at Ottawa will not sanction any scheme for the laying of Point Grey partnership main across False Creek at Granville bridge, that does not specify that the pipe shall be 40 feet below tide. Since it will doubtless take years before the Dominion Government carry out their extensive plans, the committee favor the laying of the pipe at any reasonable depth, so long as it would not in the meantime interfere with any work that might be undertaken by the Government, and also, so that it could be removed when the occasion required.

+—**Victoria, B.C.**—The contract for the construction of the reinforced concrete flow line for the Sooke Lake waterworks system has been awarded to the PACIFIC LOCK JOINT PIPE COMPANY. The company's bid was for $329,760 for a 40-inch pipe line; but the size of the pipe has since been increased to 42 inches. The question of the manner in which the pipe, when fabricated, will be distributed and laid along the pipe line grade, whether by the contractors or by the city, will be decided when the contract is before the Council for signature.

Victoria, B.C.—Alderman McNeil has given notice of a motion to request the finance committee of the city council to make the necessary arrangements with the Pacific Lock Joint Company in order that the work on the concrete flow line pipe may be begun immediately, instead of waiting till a further sale of waterworks debentures has been made.

Victoria, B.C.—Two tenders for the riveted steel pipe have been received, one from the Macdonald Godson Company of Vancouver, at $485,203, which is over $40,000 in advance of the July tender, and the other from David A. Chesney of Craigdarroch Castle, at $426,080. They have been referred to the water commissioner and consulting engineer for a report.

LIGHT, HEAT AND POWER.

Medicine Hat, Alta.—Two of the by-laws passed by the Medicine Hat burgesses recently provide for the necessary expenditure to make installations and extensions to the city's gas and electric light systems.

Niagara Falls, Ont.—At the last meeting of the Niagara township council, a motion was carried to request the clerk to notify all parties holding Hydro-electric petitions to return the same to the council at once, in order that they may be forwarded to the Hydro-Electric Commission without delay.

+—**Peterborough, Ont.**—A large contract has been received by the WILLIAM HAMILTON COMPANY from the Charlton-Englehart Power Company, of Ontario, for the water-wheels and other machinery required for a generating station to supply power to the towns of Charlton and Englehart.

St. Thomas, Ont.—Mr. J. T. Lynn of Detroit, natural gas expert, whose advice the city engaged, has reported to the city council, strongly recommending the city to contract for a supply of natural gas, if an agreement can be made whereby the supplying company will be paid on a percentage basis at a rate permitting the city to sell to consumers at 45 cents net in summer and 30 cents net in winter. Mr. Lynn points out that whether the city retains an artificial plant or takes natural gas, $20,000 must be spent on new mains. If the artificial plant is continued, over $60,000 additional will be needed to put it in condition to handle existing business in a proper manner. The city expects to conclude negotiations with the Southern Ontario Gas Company for a supply from Tilbury field next week.

BRIDGES, ROADS AND PAVEMENTS.

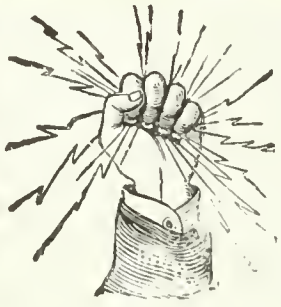
Fredericton, N.B.—Mr. P. M. Monserrat of Montreal, one of the designing engineers for the Quebec bridge, has had a conference with Premier Flemming, and it is understood will make an independent report to the Provincial Government on the question of the construction of the proposed bridges across the St. John and Kennebeccasis River for the St. John Valley Railway.

Montreal, Que.—The City Council has adopted the following motion, which will be presented at Quebec as a proposed charter amendment: "that the City Attorney be requested to insert in the city's bill now before the Provincial Legislature a clause compelling the city to set aside each year for the laying of permanent pavings a sum of not less than $1,500,000, to be taken out of the funds raised in virtue of Article 343 of the charter."

Ottawa, Ont.—The Government has approved of the subsidy contract for the Second Narrows bridge at Vancouver, amounting to three hundred and fifty thousand dollars. The money now being available, the work can proceed forthwith.

Ottawa, Ont.—Representative citizens, who have appeared before the Board of Control in connection with a temporary structure at the Billing's bridge site, have been assured that the board will seriously take into consideration the suggestion to build a pontoon bridge to keep open communication. The city engineer will report on it and the

PHILLIPS



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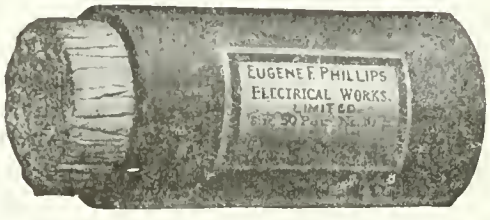

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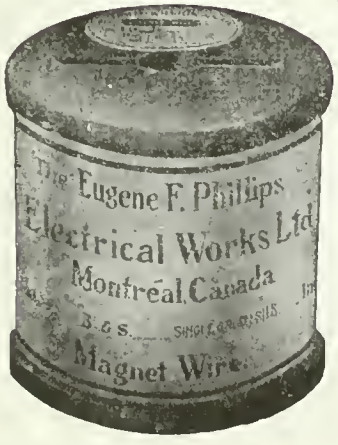

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county will again be approached in the matter. The estimated cost of the pontoon bridge is $3,500.

Perth, Ont.—The county of Lanark recently sold $40,000 good roads debentures to a Toronto house at 97.

Peterborough, Ont.—The city of Peterborough has accepted, with the approval of the Government, the offer of the C.P.R. to place a swing bridge with a 37-foot opening on each side of a pivot pier in the new bridge being erected by the railway company over the Otonabee River on the line of the Trent Canal at Peterborough.

+—South Vancouver, B.C.—The municipal council has awarded a contract totalling $438,494.93 for the paving of Main Street from Sixteenth Avenue to River Road. The firm to secure the contract is the DOMINION CREOSOTING COMPANY, and the material stipulated is creosoted wood blocks.

▲—Toronto, Ont.—Tenders will be received up till December 16th, 1913, for asphalt, paving block, granite or stone setts, etc. Plans and specifications may be obtained from the Accounting and Purchasing section of the Department of public works, City Hall, Toronto. Signed, H. C. Hocken (Mayor), Chairman of the Board of Control.

+—Toronto, Ont.—The city council has awarded the contract for asphalt pavement on Grange Avenue to the CONSTRUCTING AND PAVING COMPANY, price $6,210; for asphalt concrete pavement on two sections of Givens Street to the CONSTRUCTING AND PAVING COMPANY for $3,980 and $3,023, respectively; for concrete pavement on Danvers Avenue to the RIVERDALE CONCRETE PAVING COMPANY, price $241; for brick block pavement on Derby Lane to the GRANT CONTRACTING COMPANY at $2,595; for asphalt pavements on Alma Avenue to the COMMISSIONERS OF WORKS; on Arlington Avenue to the GODSON CONTRACTING COMPANY, at $8,400; on Carus Avenue, to the CONSTRUCTING AND PAVING COMPANY, at $1,822; on Johnson's Lane, Rushton Road, and Wells Hill Avenue, to the COMMISSIONER OF WORKS; for bitulithic pavement on Bain Avenue, to FRED. REID, at $1,275; on Springmount Avenue, to the BRITNELL CONTRACTING COMPANY, at $10,350; on Spears Avenue, to the RAMSAY CONTRACTING COMPANY, at $1,000.

Toronto, Ont.—Mr. Frank Barber, York township engineer, has submitted his report to the township council regarding the proposed high level bridge across the West Don on Eglinton Avenue. He claims that the bridge at this location is not only necessary to traffic, but could be available also for radial lines, such as the Toronto Eastern and the Hydro Radial from Port Perry, should the commission select the north-east route. The bridge would be 1,000 feet long, 100 feet high and would cost $150,000 to $200,000. The council passed a resolution requesting the commission to select the northerly route and bring the radial into the city via Eglinton Avenue.

Vancouver, B.C.—The civic board of works has recommended that tenders for $325,000 worth of new pavements be called for at once; and it is expected that these will be advertised before the end of the month.

Winnipeg, Man.—Salter Street subway supporters are holding meetings for the purpose of taking action to have the city council build the proposed subway.

Winnipeg, Man.—The board of control has practically decided to employ an expert on subway planning and construction to advise on the plans and specifications for subways at Salter Street and Talbot Avenue, Elmwood. It is not at all likely that work will be begun on these until the end of next year.

INDUSTRIAL WORKS.

Coderich, Ont.—In connection with the wreck enquiry, important improvements needed for the proper equipment of Goderich harbor were emphasized, e.g., a modern foghorn suitably placed, a well-manned lifeboat station and adequate lights, and the dredging of the harbor basin to a greater area.

+—Ottawa, Ont.—The contract has been awarded by the Cabinet Council for the ocean section of the Halifax terminal scheme. The successful tenderers are FOLEY BROS., WELCH, STEWART, AND FAUQUIER; and the contract price is $5,208,743. The works involved are docks, wharves, and subsidiary equipment; and operations are to be rushed. Two sections of the water front improvement scheme remain to be put under contract.

+—Ottawa, Ont.—The contract has been awarded by the Dominion Cabinet Council to ANDREW McCONNELL for the construction of a wharf at Summerland, B.C., costing $12,365.

+—Ottawa, Ont.—The Dominion Government has awarded to the COASTAL DREDGING AND CONSTRUCTION COMPANY the contract for dredging to the extent of $5,945 at Glace Bay, N.S.

+—Ottawa, Ont.—The Cabinet Council has awarded to ELZEAR CARON the contract for the construction of a wharf at St. Jean Port Joli, Quebec, at a cost of $7,855.

+—Ottawa, Ont.—The Dominion Legislature has awarded the contract for dredging at Oak Point, N.B., to the MARITIME DREDGING AND CONSTRUCTION COMPANY at 19 cents per cubic yard, or a total of $6,337.

+—Ottawa, Ont.—The contract for dredging 300,000 cubic yards of sand at Sand Hearts, at the mouth of the Fraser River, B.C., has been awarded by the government to the NAVIGATION DREDGING COMPANY, the contract price being $70,500.

Ottawa, Ont.—Tenders will be received up till December 22nd for the construction of an extension to the wharf at Grands Mechins, County of Rimouski, Que. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—Tenders will be received up till December 22nd for the construction of a line of wharves and dredging Tidal Basin at Rimouski, County of Rimouski, Que. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—Tenders will be received up till December 10th for the construction of a breakwater at Blandford, Lunenburg Co., N.S. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Ottawa, Ont.—Ulric Valequette, supervising engineer of the Public Works Department, has left for Esquimalt, B.C., to choose a location for the new dry dock in that city. It will be an almost complete duplicate of the dock now being constructed at Quebec.

Port Moody, B.C.—A committee has been appointed by the local Conservative Association to draw up a memorial to Colonel J. D. Taylor, M.P., asking the Government to extend the Port Moody wharf fifty feet further into the Inlet or to dredge the channel off the wharf to permit large vessels to come alongside.

St. John, N.B.—Following the promise of the Hon. Robert Rogers to have an expert look over the St. John harbor situation, Mr. A. D. Swan of Montreal, is in St. John going over the ground already developed, inspecting the facilities now in course of construction, and ascertaining as far as possible in what direction and upon what lines future harbor development must be laid out. Mr. Swan may also report upon the new eastern harbor at Courtnay Bay, and also upon the suggested extension of the new west side wharves to the length of 1,000 feet.

+—Toronto, Ont.—The city council awarded a contract for stop valves to DRUMMOND, McCALL & COMPANY in connection with the tender called for brass and bronze castings, cast-iron pipes, hydrants, etc.

Vancouver, B.C.—Colonel Sam Hughes, of the Ottawa Government, has approved of the ground plan for the improvement by the park board of Vancouver of the property at the head of Coal Harbor, Vancouver.

MISCELLANEOUS.

Brandon, Man.—Dr. Pickard, who is engaged upon the matter of securing for Brandon an incinerator, is waiting for a definite price from the Decarrie Company, of Minneapolis

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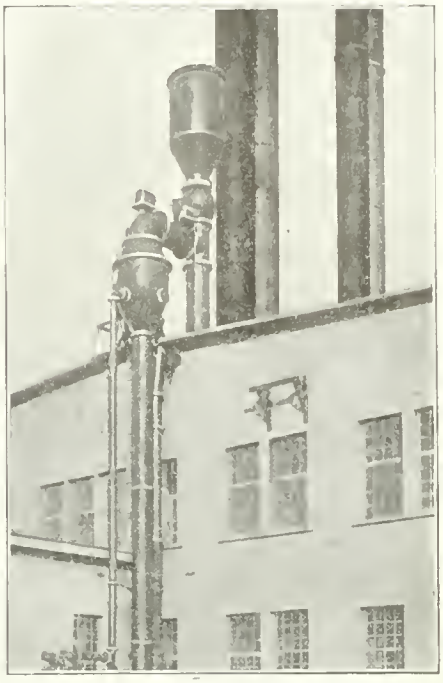

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for a destructor suitable for the growing needs of the city before placing the whole matter before the city council for its consideration.

Calgary, Alta.—The Lake of the Woods Milling Company intend to build an elevator, mills and a warehouse in Calgary, and at the present time the company is taking the matter up with the Government.

Fort William, Ont.—Construction work on the Stanley Avenue sewer, which has been retarded owing to a controversy between the city and contractors and the Canadian Car and Foundry Company, will probably be resumed within a few days. The sewer has been completed on both sides of the plant, and it is thought that it will be run under the huge plant of the car company within a month's time.

London, Eng.—Sir Percy Girouard has refuted the notice that the new Canadian company of Armstrong and Whitworth will concern itself with armaments or shipbuilding. The company intends to manufacture high-grade steel for commercial purposes.

+—Ottawa, Ont.—The contract has been awarded by the Ottawa Cabinet to the WALLACE SHIPYARDS, LIMITED, North Vancouver, B.C., for the installation of oil-burning apparatus and construction of oil-tight flat in the tug "Point Ellice," at a cost of $4,386.

+—Ottawa, Ont.—A contract for the construction of a dump scow with a capacity of 260 cubic yards, was awarded by the Dominion Government to the WALLACE SHIPYARDS, LIMITED, at $8,475. The big scow is for use in connection with the extensive harbor improvements at Victoria, B.C.

Port Arthur, Ont.—Two steamers are to be put in drydock at Port Arthur this winter to undergo extensive repairs—the Athabasca of the C.P.R. upper lake passenger service, and the Alberta. The estimated cost of improvements to the two steamers is about $70,000. No confirmation of the report made some time ago that the Keewatin and Assiniboia would undergo repairs also in the Port Arthur dock has been given, though they will be overhauled either here or at the Collingwood plant.

St. Catharines, Ont.—The citizens of St. Catharines will vote upon the incorporation of a branch of the firm, Lord and Burnham, recommended as one of the best industrial concerns in the United States.

+—Toronto, Ont.—The city council awarded a contract to MR. R. D. WOOD for special castings in connection with the tender called for sundry orders of castings, valves, pipes, etc.

Vancouver, B.C.—Mr. Yarrow, shipbuilder, of Glasgow, Scotland, is examining possible building sites, charges for wharfage and harbor depths, etc., in connection with the possible construction of a shipbuilding plant at Vancouver.

+—Victoria, B.C.—The city council has awarded the contract for telephone wire to the lowest bidder, THOMAS WATSON, ESQ., at $426 a mile, or $10,650.

CURRENT NEWS.

Brandon, Man.—According to the report presented by Superintendent Antonisen to the city council committees on Friday, November 28th, the street railway receipts for November are in excess of those for the previous month to the extent of nearly $5 per day.

Brantford, Ont.—In connection with the construction of Lorne Bridge, the main retaining wall is completed; and Mr. Wright of the contracting firm, Wright, Hazzard and Cohen, states that, as he understands the situation concerning the second retaining wall, the railway has not submitted plans to City Engineer Jones for his approval, and instructions have not been given his firm to proceed with the work. Men are being laid off work, awaiting further developments.

Galt, Ont.—Difficulty of a financial nature, according to Mr. John Muir, president of the L.E. and N. Railway, has caused a temporary lay-off in the construction work on that railway. Much work must still be done between Brantford and Galt, before the line is completed, but it is expected that construction will commence again within a short time.

Lindsay, Ont.—The special Mud Lake Narrows bridge committee of the county council has met and discussed the bridge recently completed. Tenders were received for the bridge ranging from $1,786 to $6,467, while the final cost of the structure was $6,481.63.

Montreal, Que.—The council of the Montreal Board of Trade has passed a resolution earnestly protesting against any amendment to the city charter whereby the cost of paving the streets shall be made a charge upon the civic revenue. Copies of the resolution are being sent to Sir Lomer Gouin, the Montreal member of the Legislature, and Mayor Lavallee.

Moose Jaw, Sask.—Another street car service was opened recently at Moose Jaw, when Mrs. J. Darley Colley, in the presence of the Mayor and influential citizens formally opened the car line built to Boulevard Heights, about two miles from the centre of the city.

Ottawa, Ont.—The Dominion Dredging plant has had brought to Port Weller new dump cars of 1913 patent. They have the latest improvements in air brake and all dumping attachments. In addition there are expected at the plant this week three new 50-ton locomotives, a new drag line and a new steam shovel. The shovel is one of the largest made and has a bucket with a four-yard capacity. The Dominion Dredging Company has not made much progress as yet, but they expect soon to be ready for rapid operations with modern machinery.

Ottawa, Ont.—The Hydro-Electric and Ottawa Power commissions have completed a new contract between the city and Provincial Commission which will receive further consideration at Ottawa. It has been provided for a larger consumption of power upon a sliding scale giving much better terms to the city.

Ottawa, Ont.—When in the capital recently, Sir Donald Mann, vice-president of the C.N.R., said that the Canadian Northern would be "letting the daylight through Mount Royal" about December 10; and that already a mile of the tunnel had been widened to the regular size for the double track.

Redcliff, Alta.—The International Supply Company, will have in operation within the next month a drill on its oil leases northwest of Redcliff. The Medicine Hat firm will also set in operation here well drilling apparatus, and will use a double casing to bore through the gas down to oil.

St. Catharines, Ont.—The new extension of the Niagara, St. Catharines and Toronto Railway, between St. Catharines and Niagara-on-the-Lake, has been completed within a few miles of Niagara, and a regular passenger service has been commenced.

St. John, N.B.—Surveys have been completed for the western extension of the Aroostook Valley Railroad, which has been incorporated under the name of the St. John and Quebec Railroad, and work of construction will be commenced early in the spring. The rails will connect with the St. John Valley and other Canadian roads, forming a link in a transcontinental route.

Sydney, N.S.—According to the report furnished by President Gillies to the Board of Trade concerning the services of an ice-breaker for Sydney Harbor, the Government has provided for the services of an ice-breaker on the south coast of Nova Scotia. Sydney Harbor will in all likelihood receive the attention the Board of Trade has been endeavoring to obtain

Sydney, N.B.—Work on the extension of Sydney's "White Way" is progressing favorably, and there is a probability that a further extension may be requested.

Vancouver, B.C.—Agreements between the city, Esquimalt and Saanich in connection with the construction cost of the proposed north-west sewer system, have been presented to the city council. In view of the fact that Saanich may not be in a position to sign should the by-law to be submitted be defeated, Alderman Cuthbert urged separate agreements between all parties, instead of one including all.

Vancouver, B.C.—Work has been started on the new Provincial Government bridge over the Kootenay River near Nelson, known as the Taghun Bridge. The contract for this structure was recently awarded by the Provincial Government Public Works Department to Hodgson, King and McPhalen of Vancouver. The contractors now have materials on hand for

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the work, and Engineer Clyde Campbell of the Public Works Department is on hand to superintend the construction for the Government.

Vancouver, B.C.—Construction work on the drill scow to be used by Messrs. Henry, McFee and Macdonald, the contractors for the submarine work in connection with the new Dominion Government dock to be built on Burrard Inlet, has nearly been completed, and the boat is expected to be ready for launching next week. Dredging of the surface material that covers the rock bed of the dock site has been proceeding since October 17, and several thousand yards of dirt have been already taken out.

Vancouver, B.C.—The city engineer has announced that out of the $150,000 set aside some time ago by the board of sewers, about $100,000 has been spent, and the balance will be expended before the end of the year on the work in hand.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received:—1886.—A South African importer asks to be put in touch with Canadian exporters of calcium carbide. 1900.—Samples and prices are asked by a South African importer. 1913.—A South African importer asks for catalogues and prices on Canadian-made agricultural machinery. 1915.—Samples and prices are asked for by a Port Elizabeth firm on Canadian wire. 1960.—A South African importer asks to be put in touch with Canadian exporters of shovels. 1961.—A South African importer asks to be placed in communication with Canadian exporters of axes. 2064.—A Durban firm of machinery importers asks to be placed in touch with Canadian exporters of calcium carbide. 2077.—A long-established British firm at Bordeaux, France, desires to correspond with Canadian exporters of rare minerals, especially wolfram, molybdenite, etc. 2081.—A Glasgow firm would like to hear from manufacturers of mica.

The names of the firms making these inquiries, with their addresses, can be obtained upon application to:—"The Inquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary and Chambre de Commerce du District du Montreal.

MONTREAL MARKET LETTER

It would seem that there are now only three merchant furnaces operating in Canada, these being at Hamilton, Deseronto and Port Colborne. There were formerly two others, being located at Midland, but they are now the property of the Canada Iron Corporation. The Port Colborne furnace is a new one, and is being operated by the Canadian branch of an American company. It is stated in Montreal that this furnace, as well as the furnaces at Deseronto and Hamilton, are all keeping busy, and that at Port Colborne has orders on hand for months ahead. It is also understood that the Dominion Iron and Steel Company has been selling some of its output to foundries and other users. At the same time, the great bulk of its output is used right in its own works, and thus contributes to the industrial activity of the corporation.

It is stated here that Canadian foundries have plenty of work on hand at the moment. Unfortunately, future activity is very doubtful, few large contracts for delivery during the coming winter being reported. It is felt, however, that there is no use borrowing trouble, inasmuch as when the time comes matters will probably straighten themselves out again. It is encouraging to hear that stocks of consumers are low; since this will probably mean that before long they will have to be replenished. It is generally felt that buyers are holding off in the hope of getting lower prices, and it must be admitted that up to the present the situation seems to be mostly in their favor.

The pig iron situation is figured out something as follows: The competition is mostly from Buffalo iron, which, at a cost of $13.75 in Buffalo, $2.80 duty, and the same freight, would make $19.35 Montreal. Iron in Montreal is now quoted in store instead of on dock, the season of navigation being over. Altogether, prices show little change.

Bar Iron and Steel.—Trade is reported active. Bar iron, $2.05 per 100 lbs.; best refined horseshoe, $2.30; forged iron, $2.20; mild steel, $2.05; sleigh shoe steel, $2.05 for 1 x ⅜ base; tire steel, $2.15 for 1 x ¾ base; toe caulk steel, $2.95; machine steel, iron finish, $2.10.

Pig Iron.—Canadian iron is quoted at $17 to $17.50 at the furnace, equal to about $19 to $19.50 Montreal. Summerlee, No. 1, ex-store, $22.50; No. 2 selected Summerlee, $22; and No. 3 soft, $21.50; while No. 3 Clarence is $20.50, all ex-store.

NEW INCORPORATIONS.

Georgetown, Ont.—The Century Pressed Brick and Tile Company, Limited, $250,000. J. W. Ramshaw, J. R. Peacock, D. Menzies.

Kelowna, B.C.—Kelowna Implement Company, Limited, $25,000.

Levis, Que.—The National Drop Forge Company, Limited, $49,000. J. B. Doris, E. Belleau, N. Belleau.

Montreal, Que.—Economical Gas, Light and Power Company, $1,000,000. A. Carrillo, L. Hoz, B. Bassi. Lachine Rapids Power Company, Limited, $500,000. W. K. McKeown, L. Choquette, J. R. Law.

Ottawa, Ont.—Canadian Contracting Company, Limited, $1,000,000. E. Belleau, N. Belleau, J. E. Labadie.

Thorold, Ont.—Inland Pulp and Paper Company, Limited, $200,000. G. H. Levy, A. H. Gibson, S. W. C. Scott.

Vancouver, B.C.—The Canadian Steel Studding and Manufacturing Company, Limited, $30,000.

Winnipeg, Man.—Linton-Hay-Lush Electric Company, Limited, $20,000. E. N. Linton, J. R. C. Hay, H. S. Lush, J. H. Brooke. The Rice Lake Gold Mines, Limited, $2,000,000. F. E. Evans, A. L. Anderson, C. Andrews.

It is understood that the report of the government cruisers, who recently completed cruising the timber on the limits in the Seymour Creek watershed offered to Vancouver by Mr. D. A. Robinson as a site for the proposed Seymour Creek reservoir, will state that the estimated value of the marketable timber thereon is $56,916.55. They estimate the amount of timber of all kinds at 124,000,000 feet, of this amount but 98,340,000 feet being accessible, and assume that the timber would be removed in five years, the cost per thousand feet being based on the estimate of accessible timber on the area in question, namely, 98,340,000 feet board measure. As the timber could not be taken out in a satisfactory manner by driving Seymour Creek or by a flume, it would be necessary to construct a railway from salt water, fourteen miles in length, and the cost of this, including right-of-way and terminal facilities, is placed at $125,000. It is also estimated that $90,000 would be necessary for equipment.

There are at present twelve sea-going vessels classed with Lloyd's which are propelled by Diesel engines and 25 others are being built. There has been a remarkable increase in the amount of tonnage classed in respect of vessels intended for carrying oil in bulk. Forty-five of these vessels of 202,005 tons were classed during the year, and there are at the present time 83 of 381,410 tons preparing and in course of construction under the supervision of Lloyd's surveyors. The use of wireless telegraphy and submarine signalling increases year by year. There are now recorded 1,932 vessels fitted with wireless installations, as compared with 1,392 at a corresponding date last year, and 806 fitted with submarine signalling apparatus, as compared with 630 last year. The return for the quarter ended September 30 shows that, excluding warships, there are 508 vessels of 1,987,254 tons gross under construction in the United Kingdom, as compared with 505 vessels of 1,846,829 gross tonnage in the corresponding quarter of last year.

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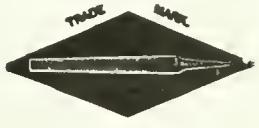

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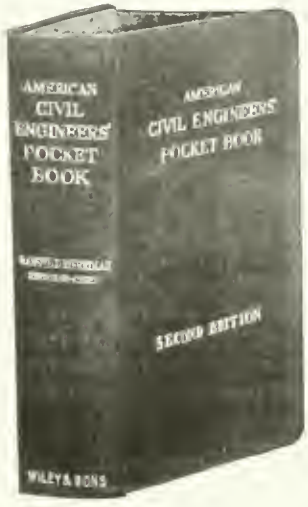

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COAST TO COAST.

Guelph, Ont.—Guelph comes third on the list of municipalities contributing to Hydro-Electric profits. It returns a surplus of 35 per cent. above the total operations, and is the equal of Berlin in this respect.

Hamilton, Ont.—Hamilton is expecting very favorable consideration from the Hydro-Electric Commission, when it announces next reductions in the cost of power purchased by municipalities.

Calgary, Alta.—In public utilities construction work, Calgary has expended almost seven million dollars, according to the statistics furnished in the report of the city controller. The sum of $2,921,160.05 has been laid out on city's water system, $1,915.078.96 on the street railway, and $1,781,136.68 on electric light.

Vancouver, B.C.—Double tracking of sections of the line west of Kamloops and east and west of Revelstoke will be completed early next spring, according to the statement of vice-president Bury of the Canadian Pacific Railway, when in Vancouver after conducting inspection on his way through from Winnipeg.

Vancouver, B.C.—Preparatory work is being carried on in Vancouver for the laying of pavement next year, to commence as early in the spring as possible. The city will lay between 4 and 5 miles of pavement next season, which has had to stand over owing to the prevalent financial stringency, and also other work that may be decided upon as urgent.

Montreal, Que.—In the month of April, work was started on the new buildings connected with the Angus shops operated by the C.P.R. at Montreal; and in five months all was completed, and the first steel freight car had been built. The addition to the shops has a capacity for manufacturing 10 steel freight cars a day, and from 8 to 10 steel passenger cars per month.

Winnipeg, Man.—A comparison between the collections and earnings of the civic light and power plant for October, 1912, and October, 1913, shows an appreciable growth in that department's business. For the former month, the collections were $25,552.57, and the apparent earnings $41,189.56; for the latter, the net collections $61,389.78 and the earnings $72,032.06. The amount of cash collections for 1913 is not complete, all the bills not yet having been paid.

Ottawa, Ont.—It has been announced that up to date a total expenditure of $4,372,000 has been made on the Hudson Bay Railway, of which almost one million has been used on the harbor at Port Nelson. This harbor construction has proven very difficult, owing to the tides and tremendous current. On the railway, 75 miles of steel have been laid, and another 135 miles have been graded for steel. Some 30 miles are in a stage close to completion; but construction has not yet been begun on 178 miles of the road. So far, work has proceeded from Le Pas toward Hudson Bay, but next year construction will be commenced from Port Nelson. The railway was to have been ready for operation by December 1st, 1914; but, owing to the scarcity of ties, it is now expected that completion will not be attained before December 1st, 1915—two years hence. At that date, upwards of $12,000,000 will have been spent, the harbor and terminal expenditure aggregating some millions of this.

Montreal, Que.—The C.P.R. has its programme all ready for next year. This includes the continuation of the programme for this year carried forward into the new year—the double tracking between Sudbury and Port Arthur; between Port Arthur and Calgary, which calls for 1,095 miles of trackage; between Calgary and Vancouver; between Brandon and Calgary; the double-track tunnel through the Selkirks; the double-tracking between Revelstoke and Vancouver; a line between Sedgewick and Edmonton—290 miles; two new lines from Bassano to a connection with Swift Current. Then there is the Weyburn branch, running south of and parallel to the main line in Saskatchewan and Alberta to a connection with the Alberta railway south of Lethbridge—a distance of 436 miles. There are several other smaller lines, ranging from 20 to 100 miles in trackage, which are included in the programme, which is to be steadily pursued next year as part of the policy undertaken two years ago, and which, when all is complete, will more than absorb the $100,000,000 which Sir Thomas Shaughnessy announced the company intended to spend on betterments and extensions.

Ottawa, Ont.—Optimistic reports on the present year of railway construction up to the present are being circulated from Ottawa. During the twelve months ending June 30th, 1912, the addition to operating railway mileage was 1,330 miles, which was a record; and it is understood that the year ending June 30th, 1913, will show an addition exceeding that of 1911-12 by some 500 or 600 miles. That is to say, from June 30th, 1912, to June 30th, 1913, some 1,900 miles were added to the operating mileage of the railways of Canada. Since June 30th last there has been intense activity in construction. During the year the Canadian Pacific has added several hundred miles to its lines, some of it being double-trackage in the West, but the greater part of it consisting of branches perfecting the service in the West. The work done by the other systems is largely of a nature which when completed will open up large areas to development, such as Northern British Columbia and Northern Ontario and Quebec. The coming session of the House will provide the means for pushing forward the gigantic task of laying down for Canada a national equipment, or development plant, in railways, canals and terminal ports adequate to the enormous growth which is to be expected in the course of the next few years. The year 1914 will be a period of great activity in public works and railway construction.

PATENTS.

Below will be found an up-to-date list of Canadian patents recently granted. It is furnished by Messrs. Fetherstonhaugh & Co., Patent Barristers, Solicitors, etc. Head office, Toronto. Offices in Montreal, Ottawa, Winnipeg, Vancouver and Washington, D.C., from whom all information may be readily obtained:—

S. Curran, poppet valves for internal combustion engines; H. A. Desparois, self-measuring pumps; G. Ashwood, showcases; C. H. Vessot and A. G. Mather, flax-pulling machines; A. Camirand, windmills; F. Dutcher, railway signal torpedoes; E. L. Knight, pilot-house propeller indicators; H. B. McElhinney, nail magazines.

Power generation and hydraulicking are accomplished with the same water at the Pioneer tin mine in Tasmania. The power-house is situated 300 feet above the mine, and generates electric current by the means of impulse turbines operating under a head of 189 pounds per square inch. During the six months ended December 31st, 1912, the mean power load was 482 kilowatts. The power is transmitted at 6,500 volts to the mine, and the water after leaving the turbines is conveyed 4¼ miles to a point 240 feet above the mine, where it is available for use in the pipe lines to the hydraulicking giants.—Power.

MEXICAN EAGLE ASPHALT

TRADE MARK

Delivered to meet the specifications of the American Society for Municipal Improvements, the Association for Standardizing Paving Specifications or any other standard specifications

Purchase MEXICAN EAGLE ASPHALT because:

1—It is more cementitious than other asphalts.

2—Water will not readily injure it.

3—Exposure to sun and air will not cause its deterioration.

4—It has great cohesive strength.

5—It is more ductile and flexible than other asphalts.

6—Shocks will not crack it. It is very malleable.

7—We will supply asphalt having the proper penetration for your needs.

8—It is best adapted to Canada's climate—will not mark in hot weather—nor are snow or ice likely to crack it.

9—It has over 99 per cent. bitumen. Purest on the market—therefore free from deleterious matter.

10—It is so constituted that it will not be injured by the heat necessarily applied to melt it for paving operations.

Samples, prices, analyses, etc., on request.

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

TENDERS CALLED FOR

TENDERS FOR A COMPLETE MECHANICAL FILTRATION PLANT.

BOILERS, STEAM TURBO-GENERATOR PLANT AND ALL APPURTENANCES.

Tenders will be received by registered post only addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on

Tuesday, January 20th, 1914,

for the installation of a complete Mechanical Filtration Plant, Boilers, Steam Turbo-generator Plant and all appurtenances at Toronto Island.

Specifications and Tender forms may be obtained upon application at the office of Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City by-law must be strictly complied with, or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or, in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, November 25th, 1913.

DEPARTMENT OF RAILWAYS AND CANALS.

LACHINE CANAL.

NOTICE TO CONTRACTORS.

ROOFING ST. GABRIEL SHED No. 1.

Sealed tenders, addressed to the undersigned and endorsed "Tender for Roofing of St. Gabriel Shed No. 1, Ottawa Street, Lachine Canal," will be received at this office till **12 o'clock noon, Thursday, December 11th, 1913.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer of the Quebec Canals, New Birks Building, Montreal, Que.

An accepted bank cheque on a chartered bank of Canada for the sum of $500.00 made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

L. K. JONES,
Asst. Deputy Minister and Secretary.

Department of Railways and Canals,
Ottawa, 22nd November, 1913.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—51421.

TENDERS FOR ONE OVERHEAD HAND-OPERATED TRAVELLING CRANE.

DEPARTMENT OF WORKS.

Tender will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on **Tuesday, December 16th, 1913:—**

One Overhead Hand-operated Travelling Crane, having a working load of 40,000 pounds, for Main Pumping Station, foot of John Street.

Specification and Tender Form for the foregoing may be obtained upon application at Room 12, Pur. and Accounting Section of the Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering, as prescribed by City by-law, must be strictly complied with, or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties, approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman Board of Control.

City Hall, Toronto,
Nov. 26th, 1913.

TENDERS FOR ANNUAL SUPPLIES.

DEPARTMENT OF WORKS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, December 16th, 1913.

1. Asphalt (refined).
2. Paving Blocks (vitrified).
3. Granite or Stone Setts.
4. Treated Wood Blocks.
5. House Numbers.
6. Iron and Steel.
7. Special Castings.

Specifications and tender form for any of the foregoing may be obtained upon application at the Accounting and Purchasing Section of the Department of Works, Room 12, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering, as prescribed by city by-law, must be strictly complied with, or the tenders may be declared informal. Tenderers shall submit with their tenders the names of two personal sureties, approved by the City Treasurer, or in lieu thereof the bond of a guarantee company approved as aforesaid.

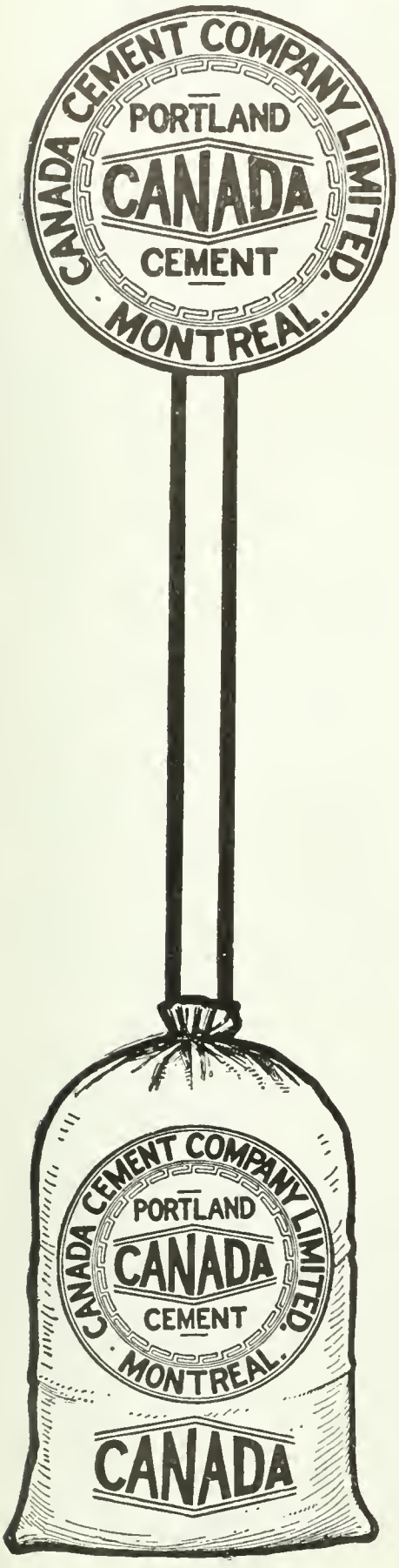
The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, December 1st, 1913.

(For further Tenders see page 90.)

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Second-Hand Machinery

Advertisements under this heading three cents per word per insertion, if not "displayed." Minimum 50 cents per insertion.

New and Second-hand

Contractors' Machinery For Sale

IMMEDIATE DELIVERY.

1—8"x12", double cylinder, double drum hoist with boiler (new).
1—7"x12", double cylinder, double drum hoist with boiler (new).
1—7"x10", double cylinder, double drum hoist with boiler (used).
1—6"x12", double cylinder, double drum hoist with boiler (new).
1—6½"x8", double cylinder, double drum hoist without boiler (new).
1—6½"x8", double cylinder, single drum hoist with boiler (used).
1—5"x7", double cylinder, single drum hoist without boiler (new).
1—10"x10"x10", Steam Driven Air Compressor (new).
1—8"x10"x8", Steam Driven Air Compressor (used).
1—No. 3, Ransome Concrete Mixer on skids (used).
1—No. 2, Ransome Concrete Mixer on wheels (used).
4", 5" and 6", Centrifugal Pumps, d.-c. to Vertical Engines (new).
1½", 3" and 4" Centrifugal Pumps, d.-c. to Gasoline Engines (new).
5" and 6", Belt Driven Centrifugal Pumps (used).

H. W. PETRIE, Limited

Front Street West TORONTO, ONT.

Tenders Called For

TENDERS FOR LAYING 36-INCH AND 20-INCH WATER MAINS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, up to noon on Tuesday, December 16th, 1913, for the laying and jointing of a 36-inch water main from the High Level Pumping Station to West Toronto, in three separate contracts, and for the laying and jointing of a 20-inch water main in another contract.

Specifications and tender forms for the foregoing may be obtained upon application at the office of the Water Works Section, Department of Works, Room No. 9, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering as prescribed by City by-law, must be strictly complied with, or the tenders may be declared informal. Tenderers shall submit with their tenders the name of two personal sureties, approved by the City Treasurer, or in lieu thereof, the bond of a Guarantee Company, approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, November 26th, 1913.

(For further Tenders see page 88.)

It is stated that construction trains will be operated this winter on practically the whole line of the National Transcontinental Railway from Cochrane to Moncton. Contractors' trains have been serving the mills and colonists east and west of Cochrane for some little time. When the service is established eastward to Quebec, which is not far distant, now that the steel is practically all laid, it will be very advantageous to the public to use these construction trains, and at the same time their use over the new line will be an improvement to the track.

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED—Experienced electrical and mechanical draftsman. Address: Algoma Steel Corporation, Limited, Water Power Department, Sault Ste. Marie, Ont.

ASSISTANT ENGINEER—Good opportunity is offered a graduate, Mechanical or Electrical Engineer, to become connected as Assistant Engineer with an established Consulting, Engineering and Construction Corporation, based on co-operative plan. Main offices in Cleveland. Highest references and financial interest required. Contract with salary, commission and interest in business guaranteed. Answer Box 190, *Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

GRADUATE SWISS CIVIL ENGINEER, with experience, wants appointment in Reinforced Concrete firm. Also seeks work for spare time. Preferred difficult calculations for reinforced concrete work, statically indeterminate systems. Please address Box 182, *Canadian Engineer*, Montreal.

STENOGRAPHER—Experienced in engineering correspondence, estimating and accounting, desires position, preferably as secretary. Gilt-edged references. Please address, Box 168, *The Canadian Engineer*, Toronto.

CIVIL ENGINEER in Riverdale wants to be initiated in Structural Steel design and detail by good Structural Steel draftsman living in Toronto. State fees and all particulars in first letter. Box 186, *Canadian Engineer*, Toronto.

MECHANICAL CONSTRUCTION engineer and draftsman, experienced designer and erector of mining plants, Marcus screens, coal-washing plants, and buildings, cost estimator and supervision, all kinds of steam engines, boilers, air machinery, etc., seeks position. References. Box 188, *Canadian Engineer*, Montreal.

WANTED.—Construction Foreman or Inspector wants position. First-class man on reinforced concrete structures, buildings, bridges, steel construction, mines, railways, etc. Good draughtsman and instrument man. Strictly sober. Box 192, *The Canadian Engineer*, Toronto.

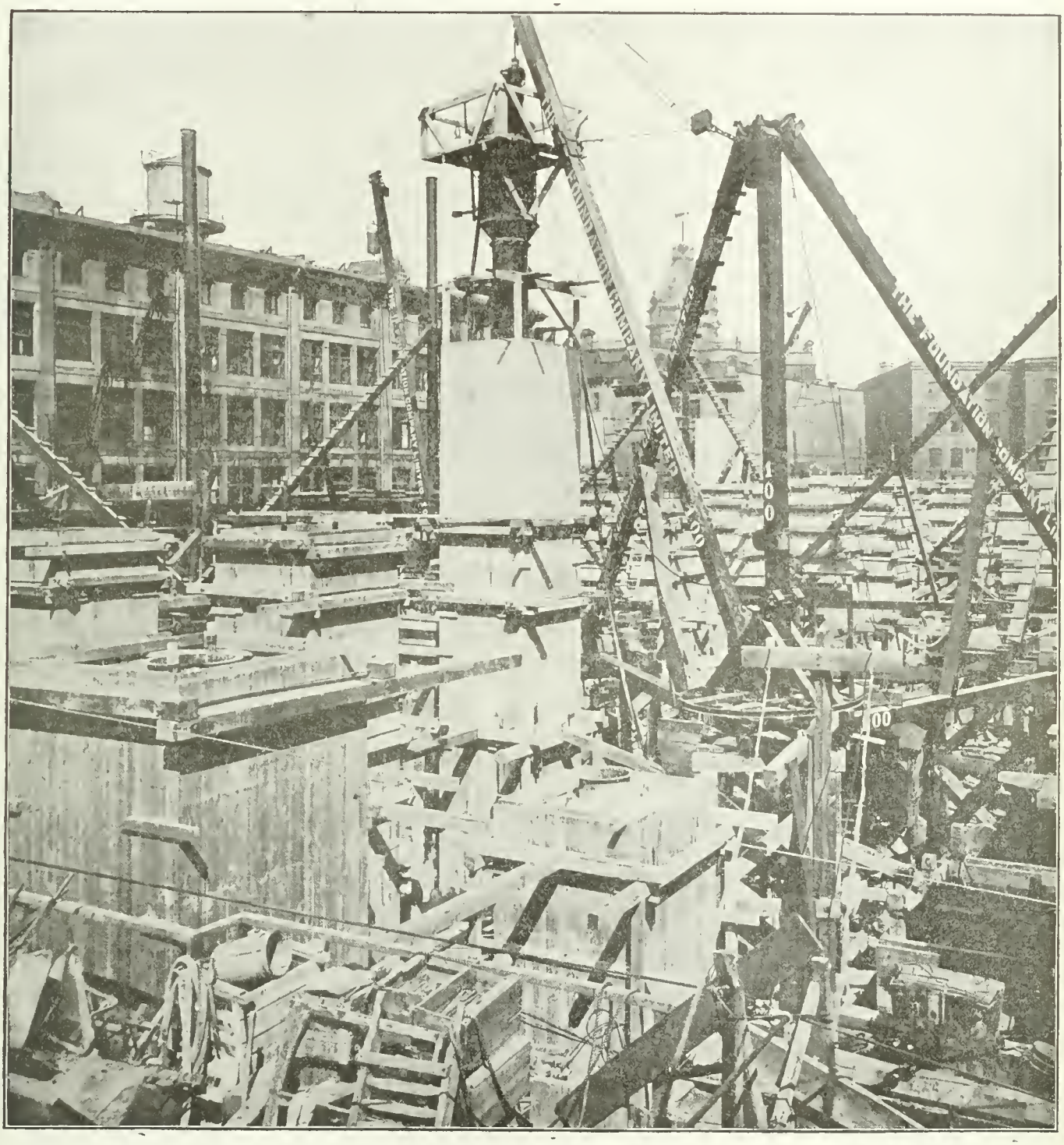
Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE—Anyone desiring to obtain the invention covered by Canadian patents No. 133,388, granted May 30th, 1911, for Surveying Instrument, and Patent No. 133,673, granted June 13th, 1911, for apparatus for Locating Forest Fires, to Daniel W. Adams, of Glendale Springs, North Carolina, U.S.A., may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh, & Smart, 53 Queen Street, Ottawa, Canada. Russel S. Smart, resident.

THE FOUNDATION COMPANY

MONTREAL LIMITED VANCOUVER



COMPRESSED AIR

Has helped to engineer some of the world's most famous Tunnels, Bridges and Skyscrapers. Under modern methods and organization it has become a speciality. The above shows the foundations for a new building in Montreal with caissons in various stages.

MARKET CONDITIONS

Montreal, December 1st, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25-lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21.25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine, 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady:—¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, December 3rd, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $13 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 5c. per hundred for each 2 in. wire additional. Single strength, $3 per hundred, advance 5c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price, 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c, "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, December 2nd, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41.50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3 16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜ $5; 7-16, $4.75; ½, $4.50, 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.80 22, $4.20; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, Black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7.50; 1½-inch, $9.35, 2-inch, $12.50; galvanized—¼-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in., $3.35 base; machinery, $3 base; share: $4.50 base; share crucible, $5.50; cast share steel, $7.50; tee caulk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

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Contents of this issue on page 839

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

THE DESIGN OF MEDIUM SIZED COAL GAS PLANTS

THE CONDITIONS GOVERNING THE SELECTION OF GAS PLANT—DESCRIPTION OF DESIGN AND OPERATION OF THE COAL GAS PLANT AT NORTH YAKIMA, WASH.

By GORDON KRIBS,
Assistant Chief Engineer, Texas Power and Light Co., Dallas, Texas.

GAS plants for supplying towns and cities with illuminating gas may be divided into three classes according to the type of gas they are designed to manufacture. (1) Coal gas plants; (2) water gas plants, and (3) oil gas plants. In deciding on the type of gas plant to be used in any particular locality, several points should be considered, the main ones being as follows:—

1. Location as to source of fuel and gas-making materials.
2. Cost to manufacture.
3. Physical and chemical properties of gas desired.
4. Market for residuals.
5. Likelihood of competition with natural gas.

Let us examine these points in the order in which they come.

Raw Materials.—The location of the source of fuel supply and other raw material and the cost of getting same to the point where they are to be used has an important bearing on the type of gas plant to be used, as it is of prime importance in figuring the cost of manufacture.

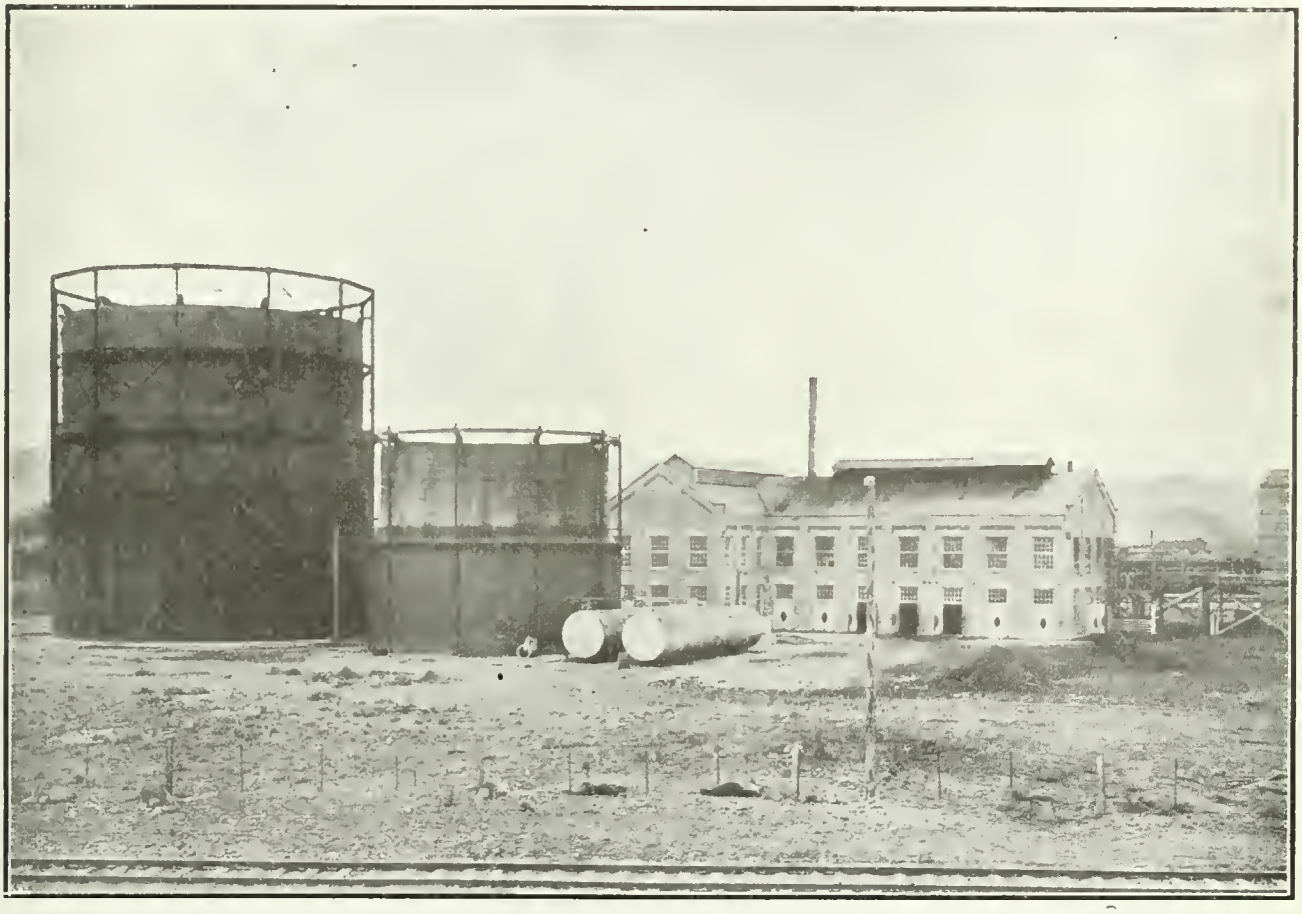

Fig. 1.—Gas Plant of Pacific Power and Light Company at North Yakima, Wash.

For example, at North Yakima, Wash., it was decided to install a coal gas plant for the reason that good gas coal can be procured in the mountains at Rosslyn, about sixty miles away. The haul is short and down

grade, and the freight rate low, making the price of raw material correspondingly low. Oil can be had, but as it must come from the California oil fields, the freight rates are high; it has to be transhipped from steamer to cars and the source of supply could not be guaranteed as constant without installing immense storage tanks. Hence, the cost of both oil and water gas would be excessive.

At Portland, Oregon, however, the gas plant installed is of the oil gas type. Oil can be brought from California to the plant in tank steamers and unloaded directly from the steamer into the storage tanks at the plant. Hence oil is comparatively cheap and under the conditions the oil gas type of plant resulted in the lowest cost of manufacture.

At Paris, Texas, however, coke can be procured at a reasonable cost, while oil is also procured at a fair price, and it has been found least expensive to use water gas in the plants in this district than any other. Hence most of the plants in Northern Texas are either water gas or a combination of water and coal gas.

Cost to Manufacture.—The cost to manufacture the various kinds of gas varies in different localities. The following table gives the cost to manufacture coal and oil gas in various localities on the Pacific Coast for October, 1910. These are all medium and small sized plants and, of course, this cost can be somewhat reduced in plants of larger capacity.

Cost of Gas Manufacture per M. Feet, October, 1910.

Town.	Walla Walla.	Pendleton.	Lewiston.	North Yakima.	*Astoria.	Salem.
Production cost	.62	.38	.70	.54	.54	.70
Transmission and distribution	.09	.08	.05	.12	.06	.35
Commercial expenses	.09	.14	.11	.07	.01	.06
New business expenses	.16	.11	.32	.13	.08	.03
General expenses	.15	.50	.36	.25	.18	.20
Total	1.11	1.21	1.54	1.11	.87	1.34
Average daily output, in cubic feet	82,000	12,500	38,300	24,800	80,000	41,400
Population of town	22,500	5,000	7,000	16,000	10,000	.....
Rate per M.	$1.75	$2.00	$2.00	$1.50	$1.75	$1.70
Cost of coal per ton at plant	$5.10	$5.25	$5.10	$3.60	....	$5.89
Oil per bbl.	....	....	....	....	$1.05	.....

*Oil gas plants.

Physical and Chemical Properties of Gas Desired.—The principal characteristics of a gas, which are of interest to the consumer, are as follows:—

1. Candle-power.
2. Heat units or B.t.u.'s per cu. ft.
3. Amount of injurious or objectionable constituents in the gas.

The lighting customer is interested, of course, in getting as much light from his burner as possible, and hence in some franchises granted gas companies by the municipality a certain candle-power is stipulated, and to meet this requires care in the manufacture and it may also be a deciding point in the choice of the type of gas plant to be used. The standard for measuring candle-power is a flame burning at the rate of 5 c.f. per hour, the gas being measured at 60 degrees Fahr. and 30″ barometer, or corrected to this. This flame is compared with a standard sperm candle which weighs six to the pound and burns at the rate of from 114 to 126 grains per hour.

The heating customer is much more interested in the number of B.t.u.'s per 1,000 cu. ft. than he is in the candle-power of his gas, and hence franchises are sometimes drawn up stating the limiting heat value of the gas in B.t.u.'s, below which the gas company must not allow it to fall. This also is of very great importance in deciding what type of gas plant will be used. The average heating quality per cu. ft. of various gases is given in the following table:

Pennsylvania natural gas	1,145
Ohio and Indiana natural gas	1,095
Kansas natural gas	1,100
Average coal gas	755
Texas (Petrolia Field) natural gas	630
Average water gas	350
Average bituminous producer gas	155

The presence of injurious and objectionable constituents in the gas is usually entirely the fault of the gas company, as by means of the proper condensing, purifying or reheating apparatus, all objectionable impurities may be removed. Among the more important impurities in crude gas may be mentioned, ammonia, hydrogen-sulphide, carbon-dioxide, carbon-bisulphide, cyanogen, tar, carbon, and naphthalene. The market for residuals has considerable influence on the net cost of manufacture of the gas. Coal gas produces:—

1. Ammonia liquor—and if the plant is large enough to warrant the installation of a still to concentrate the liquor it is a source of considerable revenue.

2. Coal tar—a coal gas plant produces a considerable amount of heavy, dense tar which is in great demand for roofing and as an ingredient in preservative paints and a gas plant can usually dispose of their entire output very readily.

3. Coke—a coal gas plant produces a large amount of coke, the quality, of course, depending on the time that the coal has been in the retorts. The kind of coal used also influences the quality of the coke to a large extent. While some coke can be used in the benches and boilers as fuel, yet only a small proportion can be used up in that way, and the remainder has to be sold or it will accumulate very fast. Usually the breeze and smaller pieces can be used as plant fuel, leaving the best of the coke for sale, and the market is generally very good. It sometimes happens that a company operating several coal gas plants can erect a water gas plant at some convenient point in order to utilize the coke from the coal gas plants.

Water gas produces a very light and watery tar, which is not in such demand as coal tar. It is, however, usually possible to find a market for same, and failing in that it can be sprayed under the boilers and used as fuel, although even then it makes a very indifferent fuel.

Oil gas produces large quantities of lamp black, a finely divided and almost pure carbon. In small plants

this may be separated from the plant liquor and dried and used under the boilers. In large plants the carbon may be pressed into briquettes which may be sold as a substitute for coal. The Portland Gas and Coke Company, of Portland, Oregon, handle it this way and find ready sale for all they make. Unless the plant is large, however, it does not pay to do this, as the machinery for handling same is expensive.

All these points regarding residuals should be carefully gone into before deciding on the type of plant to be installed, as they have a marked influence on the net cost of manufacture.

It is the purpose of this paper to consider only the first-mentioned type of plant, namely, the coal gas plant, and in order to facilitate the description of the design and operation of a coal gas plant, it is well to select an example, and hence the description which follows applies to the North Yakima plant of the Pacific Power and Light Company, situated in North Yakima, Washington.

In connection with the following description, reference may be had to Figs. 1, 2 and 3. Fig. 1 is a general plan of the coal gas plant, the building in dotted lines being the old plant which was displaced by the new one. Fig. 2 is a detailed layout of the main building, consisting of the retort room, exhauster room and condenser room. Fig. 3 shows elevations and sections of the main building showing type of building used. The buildings are two in number, built of red brick. The larger is the retort house and the smaller the meter house.

The main building is divided into four rooms, namely, the bench or retort house containing the benches and boiler; the condenser room containing the condenser; tar extractor, etc.; the exhauster room containing the exhausters and compressor, and above the exhauster room is arranged a wash room for the employees, containing toilet, shower baths, bath tub and lockers. The meter house contains the station meter and valves for controlling the operation of the holders. The roof of the retort house consists of steel trusses of the Fink type supporting the roofing material which is of asbestos protected metal. The meter house has a concrete roof. The storage holders are two in number, one being a single lift holding 43,000 cu. ft. capacity and the larger one a double lift of 150,000 cu. ft.

Coal for the plant is brought in by rail and stored in an elevated coal storage bin. From this bin the coal is handled by means of a one-ton car fitted with roller bearings and run on an industrial track of 26-lb. rails, supported on pressed steel ties. The track is so arranged that the car may be run over a track scales and an accurate account is kept of the amount of coal used in the plant. It is then run in front of the benches and the stoker shovels the coal directly from the car into the retorts. There are three benches of 6's manufactured by the La Clede-Christy Company installed at the present time with provision for a fourth. They are of the half depth, rear clinkering, through retort, semi-regenerative type, each bench having 6 retorts 26" x 15" inside by 11 feet long. The coal is shoveled in the front end, and when carbonized, is removed by a special hand-operated coke pusher supplied by Isbell Porter Company, Newark, N.J., and which removes the coke in a few seconds, being

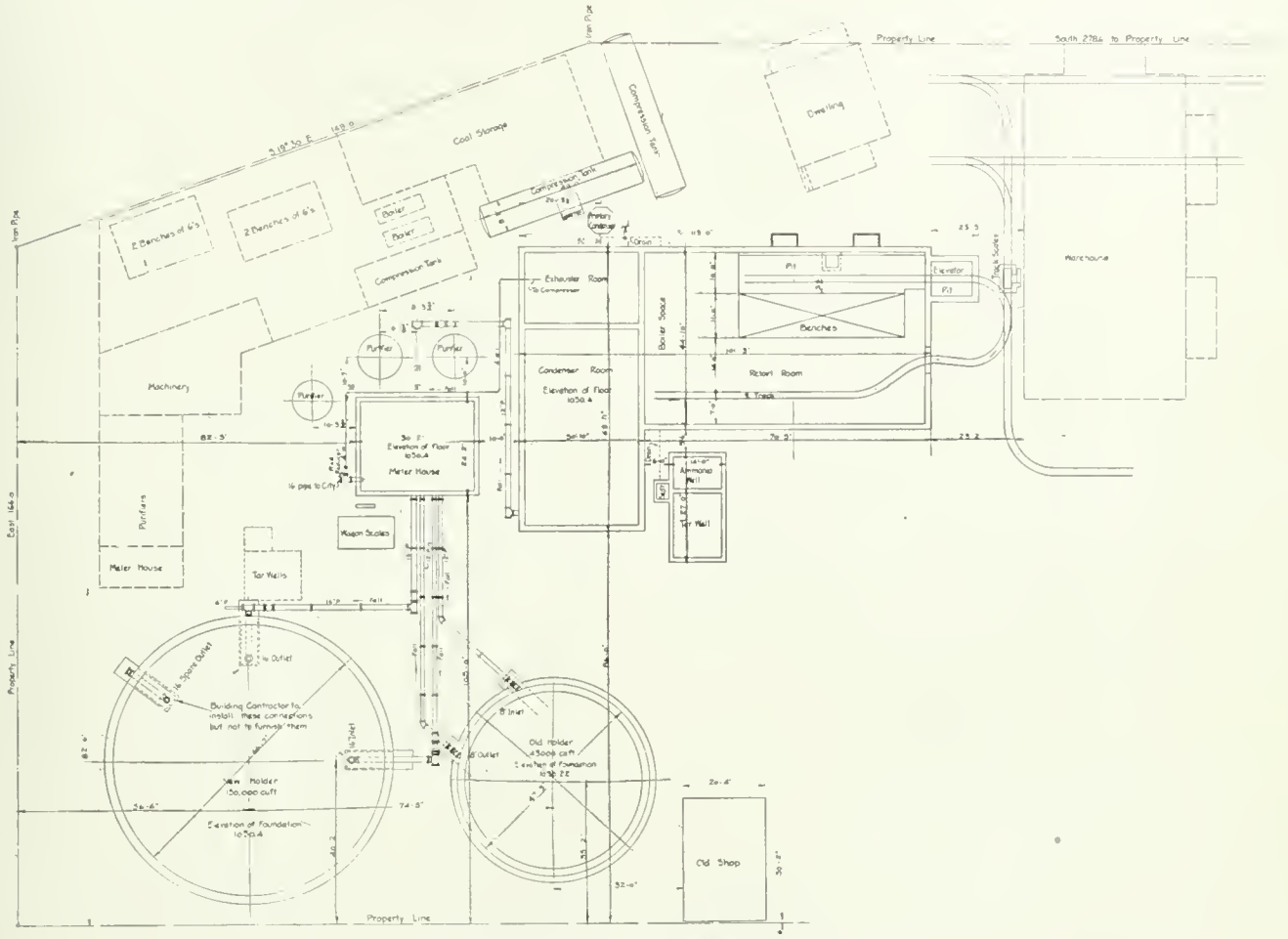

Fig. 2.—General Plan, North Yakima Coal Gas Plant.

much ahead of the old method of hand-raking. The coke is removed by pushing it out the rear end of the retort and falls into steel hoppers in the rear of the benches, where it is quenched with water and dropped into a small industrial car in the pit. This car is similar to coal car, with the exception that it is lined with asbestos. It is elevated to the level of the coke runway by means of a 2-ton platform sidewalk elevator which is motor-driven.

Coke is used in the benches for fuel. About three hundred pounds of coal is charged per retort and is carbonized from twelve to eighteen hours. The capacity of each bench is from 50,000 to 75,000 cu. ft. of gas per day according to the quality of coal used and heats run. The capacity can even be run above this by increasing the heat, but it is detrimental to the life of the retort.

When coal is roasted in an airtight retort at about 1,200 degrees Fahr., crude coal gas is given off mixed with tar and ammonia and other impurities, and if the heats are not proper, considerable naphthalene and carbon will also be formed. One ton (2,000 lbs.) of average coal will give 9,800 cu. ft. of 14 to 15 c.p. gas, 1,300 lbs. of coke, 12.5 gallons of tar, 27 gallons of 6 oz. ammonia liquor and 1 lb. of retort carbon. Naphthalene is a very troublesome substance in that it is normally a solid but is capable of being transported long distances in the form of vapor by coal gas. When, however, the temperature of the gas is reduced to such an extent that it becomes saturated with the vapor the naphthalene crystallizes out in the form of flakey white crystals which occupy a large volume and if deposited in large quantities will stop up mains and services. Carbon formed in the retorts is deposited in the stand-pipes, causing stoppages and other operating worries. After forming in the retort the gas is conveyed through the stand-pipes to the hydraulic main which acts as a seal to the retorts when they are open and prevents the return of the gas. It collects the heavier tars which should be drained off periodically and the water dissolves a portion of the ammonia but, being hot, the percentage is small.

Nearly all the ammonia present in crude coal gas is in the "free" state, i.e., it can be driven off by merely heating; only from 5 to 15% being fixed. Coal gas contains approximately 350 grains of ammonia per 100 cu. ft. At the outlet of the condensers, this is reduced to 250 grains and at the outlet of the washers and scrubbers this amount has been reduced to 1½ grains.

The gas leaves the hydraulic main varying in temperature from 140 degrees to 130 Fahr., and is conveyed by means of the 12" foul main to the primary or air condenser, which is situated just outside the exhauster room. The gas should be approximately 110 degrees Fahr., in order to be able to extract the tar from it satisfactorily and it is the duty of the primary condenser to reduce the gas to this temperature before it reaches the tar extractor. The primary condenser is 6' in diameter by 20' high, made of ¼" steel shell, has 61 tubes 3" x 17' and if fitted with a stack 24" diameter. by 14' high, which induces a natural draught through the apparatus, the draft being controlled by means of a stack damper. A portion of the tar and ammonia are deposited in the primary condenser and are drained by means of a suitable drain to the tar and ammonia separator and tar well.

The next piece of apparatus is the exhausters, which are two in number. They are of the P. H. & F. M. Roots type, known as a No. 4, and each have a capacity of 17,700 cu. ft. per hour per 100 revolutions. One exhauster is driven by a 5" x 7" vertical engine direct connected while the other is motor-driven, being belted to a 5-h.p. variable speed A.C. motor. The speed of the engine-driven unit is kept proportional to the amount of gas being made by means of an automatic governor. The speed of the motor-driven exhauster is hand-governed. The function of the exhauster is to take the gas from the hydraulic main on top of the benches and force it through the various purifying devices and into the holders against the holder pressure. The only pressure which the gas in the retorts is under is due to the amount of seal of the dip pipes which varies from 1" to 2" of water, preferably 1". By the use of the exhauster the amount of carbon deposit in the retort is lessened; the loss due to leakage is very much less, and the amount of gas obtained from a given quantity of coal greater.

From the exhauster the gas is forced through the tar extractor, and in this case a 12" P. & A. tar extractor was used. This piece of apparatus is most efficient and extracts practically all the tar from the gas. The principle of operation of a P. & A. tar extractor is as follows: The gas to be purified is forced through a series of small holes forming jets which impinge against a flat surface opposite. Tar is conveyed by the cool gas in the shape of small bubbles, and when the gas strikes the flat surface these bubbles attach themselves to it and drip down to a reservoir from which a pipe leads to the tar drain and then to tar well. The reason for locating the tar extractor in this order is due to the fact that the heavier tars have when cold, the property of absorbing the lighter hydrocarbons which are very efficient as light givers, thus destroying to some extent the value of the gas as an illuminant.

The next piece of apparatus is the secondary or water condenser, which consists of a steel shell 5" diameter by 19' high, made of ¼" steel boiler plate and contains 61 tubes 3" x 16' long. The gas circulates around the tubes and the cooling water through them, the gas entering at a temperature of 90 to 100 degrees Fahr., and being cooled to a temperature of 60 to 70 degrees Fahr., at which temperature it is ready for the scrubber. When the gas reaches the secondary condenser it has been relieved of all but a small percentage of the tar it contained. It, however, still contains many other impurities, a considerable amount of water vapor, and ammonia compounds. The water vapor and some of the ammonia is condensed and collects in the bottom of the condenser, from which the solution is taken by means of a special syphon drain 3" in diameter. The condensers in the North Yakima plant were installed in duplicate and the piping so arranged that either of the condensers could be used at a time or both in parallel. It should be noted that cooling the gas too quickly is very detrimental, as it reduces the candle-power by condensing some of the most effective light-giving hydrocarbons.

The gas next passes on to the scrubbers which, in the case of the plant described, consisted of two units arranged so as to be used singly or in parallel, each 6' diameter by 19' high with 10" inlet and outlet nozzles and five 13" x 18" manholes. The inside of the shell is filled with wooden trays composed of small slats of wood, over which a small stream of water is kept flowing, just enough water being admitted to keep the slats wet. The gas is admitted at the bottom of the shell and in passing up between the slats is broken up into small streams coming into intimate contact with the water passing down. The cold water meeting the gas previously cooled in the secondary condenser readily absorbs the ammonia remain-

ing in the gas. It also absorbs and combines with a portion of the CO_2, which is very desirable, as one volume of this gas in 100 of illuminating gas will reduce the candle-power 5%. The liquor is collected in the bottom of the scrubber and is drained off by means of a special syphon connection which seals the apparatus and prevents the escape of the gas, at the same time allowing the liquor to escape. The liquor flowing from the condenser and scrubber is conveyed by means of a 3" main to the tar and liquor separator. The gas then passes out of the condenser by means of a 12" main and on to the purifiers, which are located just outside the condenser room.

It will be noted that the exhausters are in a room by themselves as are also the condensers and scrubbers, and these can only be reached from the retort room by going outside, there being no inner passageway. This arrangement reduces the risk of explosion due to leaking gas making an explosive mixture.

The purifiers are situated outside and consist of three steel boiler-plate boxes 11" in diameter and 12' high, the sides and bottom plates being ¼" and the top plates 3/16". Each box is equipped with two layers of oxide trays and a ½-ton duplex chain hoist for lifting cover. They are interconnected by means of valves and piping so that as flexible arrangement as possible was secured. The boxes were arranged so that the direction of the flow could be reversed in all the boxes and any two could be placed in series or any two in parallel with the third in series. The advantage of reversing the flow lies in the fact that when one side of the bed of oxide becomes clogged the other side may be used, thus extending the periods between revivifying. The oxide used in this particular case was made up by the following formula, and gave good satisfaction: 6 bbls. pine shavings, ½ bbl. lime, ½ bbl. copperas.

The principal impurities in the gas when it leaves the scrubbers are hydrogen sulphide, carbon dioxide and carbon bisulphide. Lime is very active in the removal of CO_2 and H_2S and after absorbing the H_2S it also requires the property of absorbing carbon bisulphide. It is the office of the purifiers to eliminate these objectionable compounds from the gas and the efficiency depends altogether

Summary of Costs—North Yakima Coal Gas Plant.

No.	Article.	Quantity.	—Unit— Used.	Cost.	Total.	Remarks.
I.	Buildings	204,755	C.F.	.10¼	$21,023.75	$21,959.72 Grand total
II.	Wrecking old buildings.				935.97	On contract
						Total, $23,306.23
III.	Miscellaneous structures:					
	(a) Tar well				746.11	3,300 C.F. capacity.
	(b) Industrial track (installed)				923.59	860 ft. 20-lb. track and pressed steel ties.
	(c) Gas holder			.14		
	(installed)	150,000	C.F.	7.00	21,636.53	150,000 C.F. 305,166 lbs.
						Total, $37,600.86
IV.	Machinery & equipment:					
	(a) Benches (erected)	4 benches	2787.12		11,148.50	3 benches of 6's filled and one empty,
	(b) Gas machinery ...				20,145.77	capacity 60,000 C.F. each per 24 hours.
	1. Gas treating apparatus					Includes 2 condensers, 2 exhausters, 2 scrubbers, tar and ammonia separator. Works piping, yard piping, station meter, 2 purifiers, all erected on purchasers foundations (by contract).
	2. Compressors				344.17	Moving and changing to motor-drive.
	3. Boiler, 75 h.p.....				1,314.16	
	4. Boiler piping—exhaust head, etc.				101.35	4" Burt exhaust head and piping.
	5. Coke pusker				1,083.40	Hand-operated discharge machine, including runway.
	6. Coke quenching chutes				1,264.08	8 McDonald & Mann coke-quenching chutes and motor-operated sump pump.
	7. Coke elevator				1,371.19	Two-ton motor-operated sidewalk elevator.
	8. Coke and coal cars	4	cars	$143.60	574.40	
	9. Miscellaneous ...				341.74	Includes labor moving compression tanks, cost of 3 ton track scales, etc.
V.	Overhead charges	14.5%			11,997.03	Includes 10% engineering fee, interest during construction, storeroom expense, superintendence, timekeeping, etc.
	Total.....				$94,951.74	Daily capacity 180,000 C.F. or 52c. per C.F. daily generating Capacity.

on the size of the purifiers, and the condition of the oxide. After the oxide has been used for some time, it loses its efficiency as an oxidizer and is revivified by being removed and spread out in a thin layer on a flat surface and exposed to the air, being turned over repeatedly so as to expose every part of it. When thoroughly revivified it is ready for use again. A large concrete slab is usually provided for treating the oxide. A small shed is also provided for an oxide storage.

From the purifiers the gas passes into the storage holders, which in this case are two in number, the old holder of 43,000 cu. ft. and one new one of 150,000 cu. ft. capacity, having a total weight of 305,166 pounds. The small holder is a single lift type with a steel containing tank, while the new holder is of the double lift type. Each holder is supplied with drip pots to collect tar and gas liquor, the C.I. mains being laid so as to drain towards the holders. All gas house piping is of cast iron, mostly bell and spigot leaded. All fittings are standard gas fittings, reducers being eccentric and all mains being laid so as to convey gas liquor and tar to some point where it can be readily removed to a drip pot or seal. All elbows are provided with hand holes in order that the pipes may be rodded in case they become clogged. Tees are used in the piping instead of ells for the same reason and the tar drains are made as straight and short as possible, allowing as much fall as convenient under the conditions. In passing from the holder on its way to the distributing system the gas is made to flow through the station meter. This meter is of the wet type, 72″ x 72″, and is supplied with a Hinnman drum. The capacity of the meter is 500,000 cu. ft. per day with a loss of 1″ pressure. The inlet and outlet pipes are 10″ and the meter is furnished with a by-pass in order that it may be taken out of commission without seriously interfering with the delivery of gas.

The system of distribution used in North Yakima is known as the high pressure system. The gas is drawn from the holders through the station meter and compressed into two compression tanks 8′ 2″ x 10′ to 40 lbs. pressure by means of an Ingersoll Rand 9″ x 11″ steam-driven compressor running at 160 r.p.m. A 2″ high-pressure main conveys the gas to the centres of distribution in the city where district regulators reduce it to the standard 3″ pressure for commercial use.

A 75-h.p. boiler supplies this compressor as well as the gas exhauster with steam. The boiler also supplies hot water to the holder cup in winter, so as to prevent freezing, and is also used to heat the building during the cold weather and supply hot water to the men's wash-room.

A table showing the cost of the above plant is shown on the previous page.

It is announced from Zanzibar, East Africa, that the building of the railway through German East Africa is going ahead successfully, and if the hopes of the promoters are realized, will be opened for public traffic early in 1914. The line has been completed to within 210 miles west of Tabota, whilst the earthworks has been carried to within 30 miles of Ujiji. No native is allowed to leave the Belgian Congo or German East Africa without special permission, and the regulations which govern them are strictly enforced. Even the Governor is not allowed to grant this permission without a contract from the recruiters of native labor that the men shall be returned to their own country at the expiration of the contract.

SOME TESTS OF CAKED CEMENT.

The following tests of eight samples of caked cement were made at the Kansas City Testing Laboratory, Kansas City, Mo. The object of the tests was to determine the effect of caking on the tensile strength of cement. The tests were made on neat cement and on 1:3 briquettes. The results of the tests are given in Table I.

Table I.—Results of Tests of Briquettes Made From Caked Cement.

	Neat cement			1 cem.: 3 sand.	
Ref No.	24 hrs.	7 days.	28 days.	7 days.	28 days.
1	259	691	811	250	317
2	304	778	861	242	391
3	215	646	807	318	404
4	185	545	708	165	265
5	203	510	703	255	325
6	135	643	865	335	443
7	115	505	698	190	304
8	190	650	822	230	390

The breaking strengths in pounds per square inch at various ages are given in the table. Some of the cement used was badly caked. This is especially true of specimen No. 4, as this cement had been stored in an old basement against a porous sandstone wall.

Although these tests show a wide variation, most of them developed sufficient strength to pass standard specifications. They do not show as definite an increase of strength as should be given by fresh cement, but this may in part be due to the lumps not being uniformly pulverized. In reporting these tests it was stated that "while it is safe to use caked cement, it must be observed that unless the cement is again perfectly powdered, any remaining lumps of cement will not have any bonding effect, and more cement in sufficient quantities must be used to compensate for any undisintegrated lumps that may remain."

When practically all of the cement was imported from Europe, it was not uncommon to find that the cement in some of the barrels was sufficiently hardened to remain in position after the staves were knocked off. In such cases the cement was not rejected, but was powdered and used with satisfactory results. It is known by testers of cement that Portland cement which has caked and has then been powdered and used does not set so rapidly nor does it acquire its maximum strength so quickly as does cement which has never caked; yet testers have found that the strength of such material is practically unimpaired and that it will pass the requirements of specifications. Of course, the safe thing to do is to use only fresh cement, but to reject all cement which contains lumps may result in a very considerable loss. If cement which contains some lumps is used, care should be taken to thoroughly pulverize the lumps before using it.

Mr. H. C. Cooke, of the Geological Survey of Canada, has completed researches on Vancouver Island, and asserts that as a result of his investigations, which have been carried on since May of this year, he is able to state authoritatively that there are great prospects of copper development in certain sections, notably in the vicinity of Sooke and also of Ladysmith. It is anticipated that his report, while pregnant with valuable geological data, will attach particular significance to the copper-bearing regions of the Island he has come in contact with.

PAINTING STRUCTURAL STEEL.

A PAPER to be presented to the American Society of Civil Engineers on January 7th next by A. H. Sabin, A. M. Am. Soc. C.E., outlines the situation as it obtains at present in the painting of structural steel. The corrosion of structural metal by atmospheric and other natural causes is a subject which has long been of importance to the engineer. A few years ago, the greatly increased use of concrete structures aroused the hope that danger from such corrosion would be much reduced; but unarmored steel seems to be used as much as ever. Concrete has not taken its place, but has made an entirely distinct place for itself. Much has been written, and much has been done, relative to the protection of steel; but improvement has been slow, progress being made step by step.

Some years ago, Mr. G. W. Thompson attempted to classify pigments, as to their relation with iron, by suspending them in water and immersing pieces of iron or steel in these mixtures. The results were somewhat surprising; some of the pigments which common experience approved, seemed to increase corrosion in this condition, and others, known to be useless in protective paints, seemed to be much better for preventing it. Lampblack, for instance, was the worst in provoking corrosion, and white zinc or pulverized chalk prevented it. This was probably due to the fact that lampblack contains, condensed on the surface of its particles, considerable carbonic acid, which is the most generally active agent in the corrosion of iron, and white zinc and chalk are basic substances by which iron is not rusted; however, the carbonic acid in lampblack is displaced by grinding in oil, and the well-known lack of durability in paints made of white zinc and chalk prevents their good qualities from coming into action.

So great is the need of more knowledge as to the value of pigments in paints, and their mode of action, that nothing promising new information is neglected. A committee of five chemists from different parts of the United States, with the approval of the Society for Testing Materials, made a series of tests of the principal pigments, and of some other substances, on steel immersed in water; and, as was to be expected, arrived at substantially concordant results. These results, as has been stated, were of no value from the standpoint of the paint-maker, being inconsistent with the known value of the pigments when ground in oil or varnish. When the report was published, however, the pigments were classified, according to their water value, into three groups, namely, inhibitors, indeterminates, and stimulators. This was the origin of the use of these now well-known words in paint terminology. It was expressly stated in the report that this was a classification as regards water only; but the names were so convenient and so tempting that those not familiar with the subject and also many who saw their value for advertising purposes (two quite distinct classes), put them into common use to classify pigments in oil. It is obvious that any classification of pigments in oil should be based on their behavior in oil, and if, as must be conceded, this is radically different from water tests, the latter should not be regarded. All this investigation began some years ago; meanwhile numerous young men, mostly students working under the supervision of their teachers, have made brief and generally inconclusive studies of paints, and almost without exception have used these indefinite terms, inhibitors and stimulators. Patents have even been taken out—which, in the writer's opinion, are not only worthless but invalid—covering the use of old and well-known pigments. What is worse, every maker of a paint nostrum assures his hearers or readers that his particular paint absolutely inhibits rust, and that everything else stimulates it. This is the whole history of this jargon about inhibition and stimulation; it never had any particular value to the consumer, and it is generally used to mislead him.

It is obvious that in a good paint the pigment particles are enveloped in a film of oil; they do not come in contact with the iron; if they did, the paint would peel off, for no dry pigment adheres well to metal. It is as true to-day as it has been in the past that steel rusts because air and moisture act on it; and paints are used to keep air and moisture from it. They do not inhibit rusting, except as they inhibit the cause of it.

The important practical question is whether paints have been or can be improved as to being non-porous and durable. This is essentially dependent on the relation between the pigment and the oil. As to the true nature of this relation, very little is known; but something is known about its visible manifestations. It is known, for instance, that 1 lb. of dry red lead mixed with ¼ lb. of oil makes a paint of ordinary consistency, and 1 lb. of dry lampblack requires at least 6 or 8 lbs. of oil, say, thirty times as much, or making allowance for difference in density, six times as much, as the red lead. Similarly, 1 lb. of white zinc takes twice as much oil to make a paint as 1 lb. of white lead; and white lead takes nearly twice as much as red lead. These are things we know; but we have no idea why they are so. Again, red lead, which is an oxide of lead, makes an excellent paint for iron; oxide of iron is neither very good nor very bad; oxide of manganese is bad. Our knowledge of paints is as yet largely empirical; chemists dislike to admit this, for like everybody else, they hate to confess that there is anything they do not know, and thus when a new theory is offered some of them make a great rejoicing over it without first finding out whether or not it agrees with the facts. Where we are gaining is in more general appreciation of the value of the proper application of paint, better preparation of surface, more confidence in good paint rightly used, and in the better preparation of paint materials. For instance, in the older books, and until about twenty years ago, we find analyses of red lead showing as low as 55 per cent. of true red lead, with 45 per cent. of litharge. Red lead is made from litharge, and the presence of the latter is not a sign of adulteration, but of incomplete conversion. At the same time other samples showed as high as 80 per cent. of true red lead. As is well known, there was much difference of opinion in those days as to the value of red lead as a paint for iron; though most users liked it, some thought it poor stuff. It is now known that its value depends on the quantity of red lead it contains. Coarse red lead always contains litharge, because the litharge in the middle of a large particle is never oxidized. It was observed that the finer the red lead, the better it was, and so a demand arose which forced the manufacturers to make higher grades; now they are grinding their litharge to an impalpable powder before roasting it, with the result that 94 per cent. of true red lead has been on the market for some years. Then an unexpected fact was developed. The old red lead when mixed with oil would set in a day or so—often in a few hours—into a cement; just like plaster of Paris and water; this tendency made it work with difficulty and unevenly in application and its coarseness gave it a tendency to run; but the new, or high-grade, article is inactive to oil, and brushes out smoothly like a house-paint. This enables the painter to cover 50 per cent. more surface with the

same quantity and still get a coating having a uniform thickness which gives more protection than the thin portions of the paint formerly used. This secures greater economy, even at a slightly greater cost per gallon; and this is an economy not only in the cost of the paint, but in the labor, because the paint works more easily, and a man can cover more surface in a day; it also requires less skill, and, therefore, a less highly paid man, to do good work. For the last year or two, red lead ground in pure linseed oil has been offered to the trade as a paste ready to be thinned with more oil; such a paste keeps for a year or more, or indefinitely as far as known, like white lead paste. Its use saves time and waste in mixing, and, being ground through a mill, the mixture is perfect, which is not the case with hand-mixing; and, as it avoids the presence of a dusty pigment, it is more sanitary.

The only serious objection to the use of such red lead is that it dries more slowly than the older kinds. This can be obviated, however, by the use of a little japan drier. There is a well-founded prejudice against the use of excessive quantities of drier in any paint; but it should be remembered that red lead paint mixed in the (standard) proportion of 28 lbs. of pigment to gal. of oil, contains 20¼ lbs. of pigment per gallon of mixed paint. If this pigment contains 15 per cent. of litharge, it has 3 lbs. of litharge per gallon. Now, ordinary, good lead japan driers, or lead and manganese driers of approved quality, contain the equivalent of 1 lb. of litharge in about 3 gals. of drier; and 3 lbs. of litharge will make 8 or 10 gals. of drier. To make 1 gal. of mixed 94 per cent. red lead paint dry requires only 1 pint of drier; the rest is excess. It is much safer to add the desired quantity of drier. It may be asked why the litharge in the 94 per cent. red lead is not more active; it is probably because, when the peroxidation of the lead has been carried so nearly to completion, the particles of litharge are enveloped so completely by a dense coating of true red lead that the oil does not reach them. This is obviously not the case with the commoner and less thoroughly oxidized pigment.

It has sometimes been suggested, by those not very familiar with the chemical questions involved, that the litharge is the essentially valuable part of the paint, and that the red lead is only an inert extender. This is not so. The whole history of the subject shows that the improvement in red lead for paint during the last twenty-five years has been made by reducing the litharge contained in it; litharge alone, or used with other pigments, has not been satisfactory, though orange mineral, which is red lead free from litharge, is most excellent, and would be used if its cost were not so great. Further progress will undoubtedly produce red lead with a lower percentage of the protoxide; in fact, the 94 per cent. red lead now in the market usually contains much more than 94 per cent. of true red lead.

Progress has also been made in our knowledge of linseed oil. Within a few months, the American Society for Testing Materials has adopted specifications for North American raw linseed oil, which is of better quality than that made from South American seed. These specifications are the result of a great deal of work by many of the best oil chemists, and it is now possible for any good analyst to tell whether or not an oil is pure and good. Methods of paint analysis are in general being standardized; and a vast amount of work is going on in Germany and England, as well as in the United States, on the chemistry and nature of drying oils. At present, linseed oil has adulterants, but no substitute; China wood oil is a valuable drying oil, more valuable for some purposes than any other, but, as an oil for ordinary paints, it is used, as far as the writer knows, only to cover up the use of non-drying oils, which must be regarded as adulterants. At present prices, it is not likely to be used even in this way. Fish oil is used to some extent, as it always has been, in paint for roofs and smokestacks; but one should not be disturbed by talk about the "newer paint oils," for, except China wood oil, there are none.

In closing, Mr. Sabin mentions that the committee appointed by the American Society for Testing Materials has made a final report on the condition of the paints on the Havre de Grace Bridge; as is well known, this bridge was painted six years ago by a committee of that Society, which committee included several members of the American Society of Civil Engineers. This report describes three of the paints as excellent; two of these were straight red lead in oil, and the third was red lead, with about 15 per cent. of a pulverized silicate added, in oil, the red lead being about 98 per cent. true red lead. Nine other paints, of varying composition are reported as affording generally effective protection to the structure. As all these paints were carefully applied, it is fair to conclude that the durability of any good paint may be increased one-half, and probably doubled, by proper care in its use as compared with average practice. It is only by continually reiterating this fact that we shall ever secure the most elementary and fundamental requirement for the economical treatment of structural steel.

PRESERVATION OF WOODEN WATER PIPE.

Since the durability of wooden pipe depends entirely upon its continuous and perfect saturation with water, it follows that the pipe should be thin enough to insure penetration of the water through its pores at a more rapid rate than the loss of water by evaporation from its surface.

The porosity of timber differs to such an extent that a proper thickness of shell of a red cedar pipe, for example, is too great a thickness for Washington fir. Obviously a thickness that is proper for a pressure of 40 pounds per square inch is too great for a pressure of 10 pounds per square inch.

This curious condition of fairly well-recognized facts is pointed out by Engineering and Contracting, which says further that these are fairly well recognized facts, but not until comparatively recently have engineers begun to consider the external conditions that affect the life of the wooden pipe. Enough instances of long life of wooden pipe buried in clay are on record to establish the fact that clay is an admirable preservative.

The reasons for this are probably twofold:—Clay holds moisture and thus insure continuous and thorough saturation of the wood at the surface of the pipe; and moist clay is not a good culture bed for the growth of fungus that causes rot.

In view of the preservative quality of clay, it is asked would it not be good engineering to encase wooden pipe with clay several inches thick? Where the clay is within comparatively easy reach, and particularly where the trench is in soil that is either very porous or contains much vegetable humus, it would seem that a clay jacket around wooden pipe would prove economic. A concrete jacket might serve a similar purpose, but ordinarily at a greater cost than clay.

The lock-gates and sills of the Panama Canal are all made from "Greenheart," a large tree found in the dense jungles of northern South America, especially British Guiana. The wood will bear, without crushing a weight of six tons to the square inch, and will remain sound 100 years under water, being immune to the attacks of the salt water teredo.

TRANSMISSION LINE WORK.

By Ernest V. Pannell, A.M.E.E.,
Chief Engineer, The British Aluminium Company, Limited, Toronto.

DEVELOPMENTS in transmission line practice during recent years have insistently sounded the keynote of reliability. With increase in operating pressures from 40 and 60 up to 130 and 150 kilovolts it has been realized that the weakest part of any power system is the transmission line and practice has shown the weakest link in the transmission line to be the insulators. Notwithstanding the relative perfection to which insulator design and construction have been brought it has still to be accepted as an axiom that the fewer the insulators the less will be the risk of breakdown. This has been the chief factor urging the adoption of long spans in transmission line work and the long span has called forth the very best properties of conductor material in general; moreover, it has brought into the field the reinforced conductor by which is understood a wire or cable in which the tension is carried mainly by a core of high tenacity steel wire.

When aluminium was first used for transmission purposes the opponents of this material asserted that a metal of such relatively poor physical properties would be useful on the very shortest pole-spacings only. Improved manufacturing methods and better understanding of the laws of sag and tension have assisted to make the long-span aluminium line an every-day engineering proposition. It is granted that the sag will be greater with aluminium than copper and that the towers will, as a rule, be more costly. Aluminium is, however, in most countries and under usual market conditions, so much cheaper than copper that the credit balance more than pays for the extra high structures. The relative economy effected by the use of aluminium is, however, powerfully influenced by the conditions under which the line is put up. Under what may be called northern conditions, figuring with ½" ice and a wind velocity of 65 miles per hour, the sags will be much greater and towers more costly than where the line is being laid out in California or Mexico where no ice or snow have to be allowed for. It is proposed in this article to discuss only northern conditions, so that any conclusions which tend to be unfavorable to the light metal may be reversed with a change in latitude. The maximum vertical summer sags on equivalent sizes of copper and aluminium conductors are shown by the curves in Fig. 1. The constants on which these curves were calculated are as follows:—

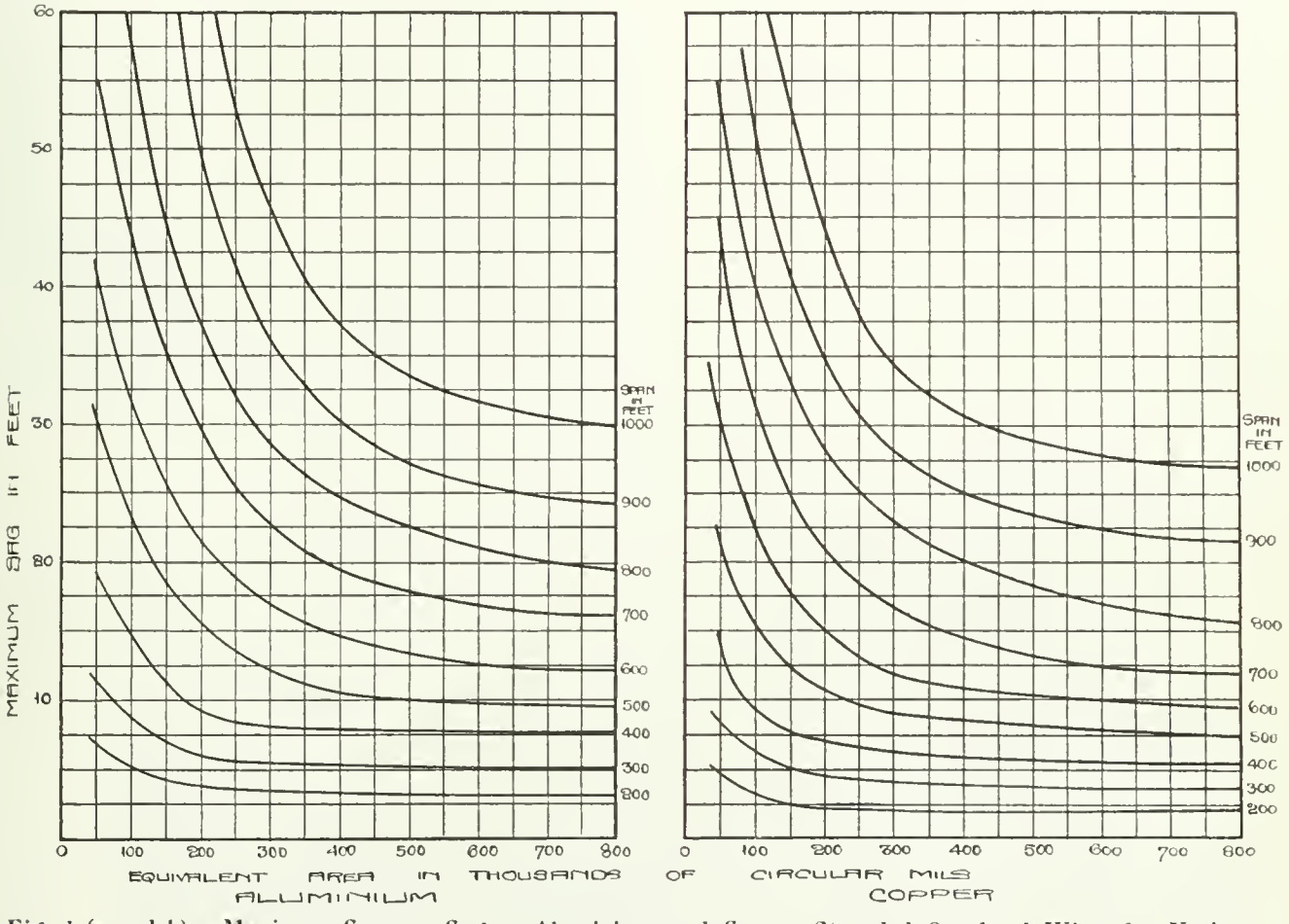

Fig. 1 (a and b).—Maximum Summer Sag on Aluminium and Copper Stranded Overhead Wires for Various Lengths of Span.

	Aluminium.	Copper.
Tensile strength, lbs. per sq. in.	28,000	60,000
Yield-point, per cent.	75	60
Working stress	14,000	30,000
Per cent. extension per deg. F.	.00130	.00093
Modulus of elasticity	9,000,000	12,000,000

The design of transmission line towers is at the present stage of development a somewhat complex subject, as there is no recognized standard for the type to be em-

ployed, tests to be fulfilled, weight of sections, etc. The weights and cost of towers of different types for precisely the same class of service vary enormously. It is possible, however, given a properly worked out design, to deter-

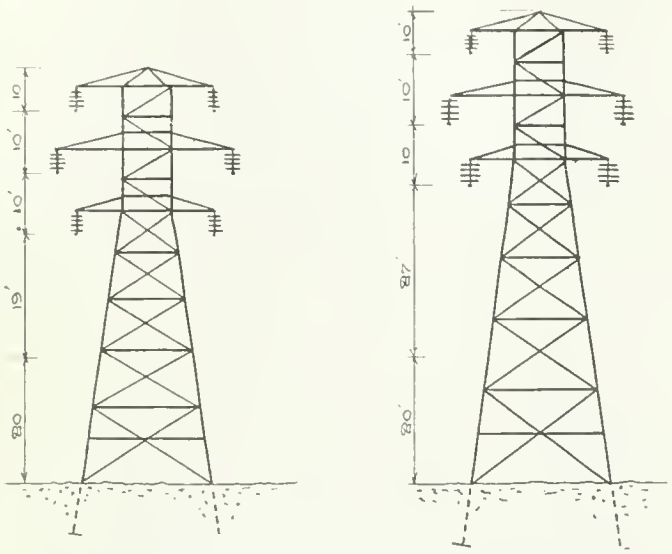

Fig. 2.—Towers for 2/0 Equivalent Copper and Aluminium Conductors on 600-Foot Spans.

mine how the cost and weight of the structure will be influenced by changes in the sag or span. Taking a practical instance: suppose it is desired to run a double-circuit three-phase 100,000-volt line across level country with 600-foot spans and copper conductors, size 2/0, B. & S. The type of tower assumed is shown in Fig. 2(*a*) and its height is determined by allowing the usual clearances and adding the amount of the maximum sag, found from Fig. 1 to be 19 feet. As is seen, the total height of the tower from the ground up will be 69 feet and its weight, including the extension angle footings, will be 5,000 lbs. This would function as a dead-end or corner tower, as it would be capable of carrying tests of greater severity than those usually specified for suspension towers. Now, any change in the height of the tower will increase the moments and stresses coming upon the main members, so that the weight will be increased once due to the greater height and once again because all the sections will have to be thicker to give them the necessary stiffness. In short, the tower weight will vary as the square of the height. Expressed in symbols, $W = mH^2$ where W is the weight in lbs., H, the height in feet and m is a constant depending upon the number and size of the wires and whether a suspension or dead-end tower, for the present instance m has the value of 1.05. Considering now the aluminium equivalent of the above copper cable, its maximum sag is found from Fig. 1 to be 27 feet; the tower, to give the same clearances as before, will, therefore, be 77 feet high. The extra size of the conductors will not be sufficient to call for any increase in the value of m so the weight of the tower in this case is $W = 1.05\ (77)^2 = 6{,}200$ lbs. Allowing a base price of 4 cents per lb. for the tower sections drilled, galvanized, bundled and delivered on site, the extra cost on the towers for the aluminium line will be $420 per mile. This need not be so high as the structures are unnecessarily heavy, and lighter towers might quite well be interspersed along the run of the line. Allowing this item to stand, however, and taking present-day average bases of 18 cents for copper wire and 25 cents for aluminium, however, the use of the latter will save $730 per mile, so that on this particular size of conductor there is a broad margin in favor of aluminum after allowing for the more costly tower line.

Fig. 3.

A point which has to be considered where a tower or pole line has to support conductors of very large area is that the tension along the line is likely to be very much more than the wind pressure acting laterally on the wires. In other words, the severest strain which may be put upon the tower is not that of a gale of wind blowing sideways on to the line, but the effect of two or more conductors breaking in the same span. Under these conditions the towers for an aluminium line frequently figure out lighter and cheaper than those for use with copper, owing to the fact that the maximum tension in the former case is about 25% lower than in the latter.

Fig. 4.

The most difficult problems in connection with long-span work are those associated with river crossings. Here not only has a long distance between supports to be negotiated, but the clearance has usually to be extra high so as not to impede navigation and frequently restrictions are laid upon the maximum stress in the wires which greatly increase the complexity of the problem. In most cases matters are considerably simplified by the adoption of a larger size of conductor than that used on the run of the line. For instance, take a 1,000-foot span across a river which is to be crossed by 6 aluminium cables, the size employed along the line being 200,000 cir. mils. The maximum sag on this size will be 65 feet and, allowing 50-foot clearance above the navigation channel with banks 10 feet high, the height of the towers will not be much less than 120 feet. If, however, the cables be increased to 300,000 c.m., the sag will be reduced to 45 feet and the towers consequently to 100 feet. Needless to say, this diminution would be well worth while. Considerably larger sizes of aluminium cable are in use on long spans, the Southern Pacific Railroad having four 2,000,000 c.m. stranded aluminium cables spanning 1,300 feet across a branch of Oakland Harbor. In this case, as in the original spans across the Niagara Gorge, the cables are dead-ended at one end and run over pulleys and weighted at the other so that the tension is constant whatever the weather conditions. On the Southern Power Company's lines in North Carolina 2/0 aluminium conductors are run with 1,500-foot spans with sags very little greater than on the parallel copper wires. Of course, in this latitude no ice or snow are encountered and sags may be correspondingly short.

The illustration (Fig. 3) shows a view on a very remarkable transmission line in Norway. Twenty 3-phase circuits of 600,000 circular mil aluminium cables convey 170,000 kva. along a steep mountain-side. The spans average 700 feet in length and the district is a stormy one, considerable sleet and severe winds having to be reckoned with. Before installing the line the then chief engineer, Dr. F. W. Marguerre, made a number of experiments in order to try out thoroughly the rival merits of copper and aluminium line wires. All things considered, it was found that the light metal offered the most important advantages in this instance. Aluminium wire having the relatively low tenacity of 24,000 lbs. is used and is strung to give its maximum tension at minimum temperature with a ¾-inch ice-coating and a wind-pressure of 14 lbs. per square foot on the projected surface of the cable. A flexible tower line is employed with heavy strain towers at intervals. Among other experiments, tests were made to determine the minimum spacing which would be safe to adopt between conductors on a 700-foot span with the results that 48 inches was adopted.

In Fig. 4 is shown a standard tower on another recently constructed transmission line in Norway. These towers are designed to carry four 3-phase circuits of 260,000 c.m. aluminium conductors. In this case, again, the average tower-spacing is about 700 feet. This appears to be becoming a European standard for tower lines. At several places where rivers and marshy ground have to be crossed spans up to 2,000 feet are encountered. At these places special towers are used and extra high tenacity aluminium wire is strung. Very great care is

Fig. 5.

taken in the manufacture of this cable with the result that its tensile strength is about 38,000 lbs. per sq. in. It is, however, only stressed up to 13,000 lbs., so as to allow an ample safety factor. So far, this would appear to be the longest span upon which aluminium has yet been tried, and although the line has been in operation for nearly two years the engineers report having had no trouble. There seems, indeed, no reason to doubt that, with careful design and stringing, aluminium will prove a thoroughly satisfactory material for even the longest spans. The two principal troubles likely to be experienced are due to improper methods of tying on to the

insulator or to insufficient spacing. In the present instance the insulators (which are duplicated on the long-span towers) are fitted with lead-lined clamps. Any abrasion is, therefore, taken by the soft metal. The spacing between conductors was, after careful tests, fixed at 69 inches.

In this country less attention has been paid to the possibility of improving the physical properties of aluminium *per se* than has been done in Europe; engineers have in general been more attracted by the possibility of reinforcing the aluminium cable by means of a steel core. The view in Fig. 5 shows a 1,000-foot ravine span which is crossed by three steel-reinforced aluminium conductors. (This transmission line was described in the "Electrical News," Vol. XXII., p. 34). The arrangement of a typical steel-core cable size 3/0 is shown in Fig. 6. It has to be remembered in dealing with this class of cable that when the maximum wind and ice stresses come upon

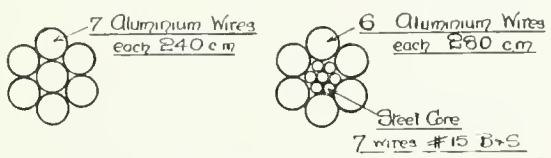

Fig. 6.—3/0 Aluminium Cable and 3/0 Steel-Core Aluminium Cable.

it all the tension will of necessity come upon the steel due to the fact that the aluminium will elongate about three times as much. The core must, therefore, be at least as strong as the rest of the conductor. As, however, the section of the steel is only one-sixth of the aluminium, it must have a tenacity not less than six times as great. A typical specification will be as follows:—

	Aluminium.	Aluminium-Steel.
Size B & S.	3/0	3/0 equiv.
Circular mils (aluminium) ...	167,805	167,805 equiv.
No. Aluminium wires	7	6
Diameter each, inches	.155	.166
No. of steel wires	—	7
Diameter each, inches	—	.057
Diameter of cable, inches..	.465	.498
Diam. of cable with ½" ice.	1.465	1.498
Weight per foot, lbs.	.155	.216
Weight per ft. with ½" ice.	.755	.819
Total loading per foot.....	1.234	1.290

From the above it will be seen that the extra weight and diameter of the steel does not increase the loading to any great extent. The tensile strength of the aluminium may be taken as 28,000 lbs. per sq. in. and that of the steel as 220,000 lbs., the working unit stresses will be safely assumed at one-half these figures respectively. Now, as the area of the steel is one-sixth that of the aluminium, the tensions in the two classes of cable will have the following ratio:

$$\frac{\text{Steel}}{\text{Aluminium}} = \frac{220{,}000}{28{,}000} \times \frac{1}{6} = 1.31$$

It is, therefore, possible for the same safety factor to put approximately 31% greater tension on the aluminium-steel cable. This will, in most cases, reduce the sag by 25%, and under certain circumstances would be well worth the extra expense. In most situations, however, the writer is inclined to favor the European principle of manufacturing aluminium cable of the very highest grade and tenacity, so that reinforcing would be unnecessary.

PROPER INSPECTION OF TRACK PAVING.

THE following instructions to inspectors have been developed by Messrs. D. H. Roszel and H. H. George, and adopted by the Public Service Railway Company, of Newark, N.J., upon the recommendation of Mr. Martin Schreiber, Maintenance-of-Way Engineer. The object of these instructions is to secure full compliance with the contract and specifications and the performance of first-class work by the contractors in such minor details as are not generally specifically mentioned, but are implied by the contract and specifications. Those relating to paving inspection are published herewith as outlined in a recent issue of the journal of the American Electric Railway Association.

General Instructions.—The inspector is to make out daily reports on forms provided for the purpose, and also to keep in a field book a detailed record of each day's work, which must contain the following:—

(a) The date of his assignment to the contract and the date of its actual commencement and completion.

(b) Detailed force account for each working day and the amount of material used.

(c) Condition of weather each day.

(d) Delays, reasons for, and the period of duration.

(e) Conditions of sidewalks along the line of paving, previous to commencement of work, to forestall any future claim for damages.

(f) Accidents: date of accident, names of persons concerned and witnesses, cause of accident.

(g) Any neglect or refusal on the part of the contractor to comply with the contract specifications.

(h) Damages to persons or property by reason of any act or omission on the part of the contractor.

(i) Oral instructions or orders received from his superior officer, and all other matters appertaining to the contract that might be worthy of record.

(j) A record of the various types of paving used (such as new, clipped or unclipped block and their kind, sand, cement or tar and gravel joints, etc.) and the exact terminating points of each type.

The inspector must be present on the work at all times when any work is in progress, unless excused by his superior officer.

It is the duty of the inspector to familiarize himself with the local conditions affecting the contract to which he is assigned, in order that the work at all stages may be so carried on as to cause the least possible inconvenience to the operation of the cars, and to the public generally. The street must not be unnecessarily obstructed, and the contractor must provide temporary passageways at crossings, and wherever else necessary.

The inspector must not permit the contractor to interrupt the trolley traffic during the course of the work, and must see that no materials are permitted on or near the track, that will interfere with the operation of cars or the safety of passengers.

All materials, as they are brought on the street, must be piled compactly and neatly at such points as the inspector shall designate, and in such a way as shall comply with the regulations of the municipal authorities. All loose material, excavated matter, and rejected materials must be removed from the site as soon as possible.

Special care must be taken that no material is piled around city fire hydrants, and that the space in front of same is kept clear at all times, and accessible to the fire apparatus.

The inspector shall see that all necessary signals and warning signs are placed on the work to protect the public, and that red lights are properly placed at the close of each day's work.

The inspector must see that the city monuments and bench marks are preserved from injury by the contractor. In case it becomes necessary to move or lower any monument, the inspector shall notify the Division Engineer, and the contractor shall not move same unless so instructed by the Division Engineer.

The inspector is to examine the material as it is brought on the work and see that it conforms to the specifications before permitting it to be used. Should the inspector at any time suspect that the material used is not in accordance with the specifications, samples must be taken by him, with a record of the location, and the office of the Engineer of M. of W. or the Division Engineer notified immediately.

The inspector shall not permit any portion of the paving to be laid at a higher elevation than the top of the head of the rail.

The inspector shall see that the void between the head and the base of the rail is filled either with the paving, or a suitable rail plaster, and shall not permit the contractor to pave against the rail unless this void has been filled.

Where block paving is to have tar and gravel, or cement joints, the inspector shall see that such tar or cement is omitted for a sufficient space around each joint, until the joints are electrically welded, provided such joints are to be so welded.

The inspector shall report to the Division Engineer any variation from the ordinary paving that will require special measurements, and shall keep sufficient records to be able to designate such places until same shall be measured by the engineers.

The inspector shall notify his superior officer at once of any accident, no matter how slight. If the accident is serious the inspector shall immediately notify the claim department by telephone.

In addition to the above general instructions, the inspector shall watch out particularly for the following points: (This is not to be construed by the inspector to mean that they are the only items to be checked; but he is to keep a close supervision over the entire job.)

Concrete.—Cement must be effectually protected from water or dampness. Packages of cement, which when turned out contain hard lumps, should be rejected.

Where the contractor is to place the concrete foundation for the paving, the inspector shall see that the specified proportions are strictly adhered to. Where the sand and stone is supplied to the mixing board by wheelbarrows and the cement in bags, the inspector shall measure same, to see that the contractor is using the right proportions of cement, sand and stone. One standard bag of cement will be considered as one (1) cubic foot, and a barrel of cement as four (4) cubic feet.

In mixing the concrete, the inspector must see that the directions of the specifications are followed. The method of ganging the proportions must be accurate, and the operation of mixing it by hand must be done on suitable mixing boards. The ingredients must be thoroughly mixed. The inspector must see that the concrete is deposited as quickly as it is mixed.

When a concrete mixer is used the inspector must acquaint himself with the theory and principle of operation of that particular type of mixer, and be able to detect at any time any change in the proportion or uniformity of the mixture.

When the mixer is of the automatic-feed type, the inspector must test it at least once during each day's work, at times unexpected by the foreman, by feeding measured quantities of cement, sand and stone, in the proportion specified, into the respective hoppers. If the mixer is gauged properly and feeding freely, the measured quantities of materials will be exhausted simultaneously. Should some cement be retained in the cement hopper after the sand and stone are exhausted, it is sufficient indication that the mixer is either improperly gauged or that the cement feed is clogged. Whatever the trouble is, it must be corrected before the mixing is allowed to continue.

When the contractor employs a concrete mixer into which the materials are not loaded in batches, the inspector is not to depend for the securing of proper proportions on the accuracy of the machine gauging or the proportion of the shovelers used. The material must be placed in properly proportioned piles, not containing more than 10 cubic yards in the case of sand, broken stone or gravel, and the inspector must see that the machine exhausts all material simultaneously. Should it be impossible to obtain these results, due to improper piling of material, the inspector must require the use of measuring boxes for proportioning the charges for the mixer.

Use sufficient water to make what is called a wet mixture, but not so much that free water will drain from the mixed batch before ramming.

The test for the degree of mixing or turning will be that all fragments of stone are fully covered with mortar.

Grouting of concrete after it has been laid, or the application of neat mortar to the surface, and the sweeping of the surface with street brooms to make it smooth or to cover up defects, must not be permitted. Concrete made of fine stone in the stated proportions of mixture may be used for the leveling up of depressions.

The inspector shall see that the concrete is protected from injury while setting, and that no hauling or trucking over it is done, except on planks, and only after a proper hardness has been reached.

Sheet-Asphalt Pavement.—The principal care of the inspector will be to see that the asphalt is not laid at too low a temperature. The minimum temperature permitted by the specifications is 250° F. While the main or interior mass of a wagon-load may be well above that temperature, the top and outer part of the load may be, particularly in cold weather, too cold to be safely used. Some of this colder portion may be sufficiently reheated by mixing it with the hotter material, if properly handling in unloading; but any material that is so cold as to be lumpy when unloaded, or, more particularly, when being raked out, should be discarded. This applies to both surface and binder mixtures. The best practical guide is the manner in which the mixtures behaves in raking. It should always be so hot that it will, under the rake, break up into a uniform crumbling or powdery mass. If it does not do this it is too cold, whatever its temperature may be.

Preparation of Street Surfaces.—Before the binder is laid, all loose material, rubbish, street dirt and other matter foreign to the concrete surface, shall be removed and the concrete surface swept, with street brooms if necessary, to properly clean it.

Neither binder nor surface mixture shall be laid upon wet surfaces. Before the spreading of the surface mixture on the binder, the latter must be cleaned of all foreign matter and swept if necessary. If the binder course already laid has become covered with mud from wagons or other travel, it must be swept clean. No loose fragments of binder material must remain on the surface. Any part of the binder course

that may have become broken or loosened must be taken up and new material laid in its place with the same care as the original.

Laying Binder Course.—Nearly the same care in raking and equally as careful rolling should be required as for the surface course. If the binder is not thoroughly compressed and becomes cold before the surface course is laid, it is likely, in the future hot weather, to soften and yield under heavy travel, and thus start small depressions in the pavement.

Laying the Surface Course.—The joints against a cold edge of previously laid surface must be cut back until solid, fully compressed material of full thickness is reached, and the raw edge completely but thinly painted with liquid bitumen. No masses or fragments of cold mixture must be allowed to remain on the surface of the binder, in advance of the placing of the surface course, to be covered up by the latter. Such cold masses will not be compressed by the roller, but will later, under the hot sun and heavy travel, yield and start depressions in the pavement. The raking requires to be properly and skilfully done. The tines of the rake must penetrate to the binder, so that the raked material will be a uniform mass from top to bottom.

Rolling.—The inspector must insist upon the roller being placed upon the freshly raked surface just as soon as the material will bear it without being squeezed out or displaced laterally. The tendency is to keep the roller off too long, thus permitting the chilling of the surface and preventing its proper compression. The inspector must not take the contractor's word as to how soon the rolling may be begnn, but should have trials made until he is able to judge for himself.

The rolling of the heavy roller should be very thorough; the roller should be kept at work constantly until the surface is too cold to be impressed. In operating the roller lengtnwise of the street the rolling should begin at the gutters and work toward the centre of the street whenever practicable. Cross rolling and diagonal rolling must be insisted upon wherever the width of the street will permit.

Asphalt surface must not be laid when rain or snow is falling or so long as the surfaces are wet. Surface mixture raked out and caught in a shower before it is well enough rolled to exclude water must be taken up and discarded.

Block Paving.—The more important things for the inspector to look after are:—

(a) The quality and shape of the blocks.
(b) The sand cushion.
(c) The setting of the blocks.
(d) The ramming of the surface.
(e) The filling of the joints.

The Blocks.—Assuming that the general quality of the stone has been approved, the inspector will need only to observe and reject blocks made from soft, weathered or otherwise defective stone. Any material divergence from the correct form, or from the sizes specified as permissible, will be readily caught by the eye as the blocks are brought to the street, and such defective blocks thrown out.

The proper dressing of the blocks is important, and should be watched carefnlly. While the inspector is not expected to examine each individual block, close observation of the blocks as they are handled and laid will enable him to detect and reject those that are materially defective in shape or dressing; or excessively wide joints will call attention to them as they are set.

Sand Cushion.—Screened sand must be used for the cushion bed. It should be moderately coarse and must be fairly clean and pure. The tendency with contractors is to use any dirty sand or sandy loam available on the street. Such material, especially if it becomes filled with water, will yield under the blocks and will not support them properly. The sand bed should not vary materially in thickness. It should be laid and graded not more than 50 nor less than 20 feet in advance of the setting of the blocks.

Setting the Blocks.—Blocks of uniform width and depth must be selected for each course, and each block must be laid upon a full bed of sand and "struck in" at the base, so as to bring the stone in close contact with its neighbor in the preceding course, and thus insure the closest possible joint.

The inspector must see that the joints in the line of traffic are close, and that the alignment of the course is true. This is most important, as a crooked or wavy course lessens the chances of getting close joints, not only along that particular course, but along the courses that are to follow. The inspector must see that all longitudinal joints are broken by a lap of at least 3 inches.

The operation of ramming is not to be permitted to approach within 20 feet of the end of the paving. After ramming, the surface of the pavement may look somewhat wavy and uneven. The inspector must then see that it is back-rammed. All blocks below the general plane of the surface must be raised and more sand placed thereunder, and the blocks rammed again to an even bearing.

Whether sand or grit is used for partly filling the joints before paving cement or pitch is poured, care must be exercised in placing the sand or grit in the joints. Dumping a wheelbarrow load on the surface and then sweeping the joints full is not to be permitted under any circumstances.

Sand and grit or gravel should be dried before being used and put into the joints as nearly as possible to a uniform height, as called for in the particular class of granite pavement.

For pitch joints, the contractor shall remove the gravel for the depth of about 1 inch below the surface before applying the pitch. The latter should be poured into the joint while at such a temperature as to be perfectly fluid.

Clipping Old Block.—In clipping, care should be taken that all blocks are of as nearly uniform size as possible, and that the sides are even and square, in order to insure uniform width of joints.

Any block that falls below the minimum specified size after clipping shall be rejected.

Wood, Asphalt Block, Brick Paving.—The inspector must use special care in the inspection of brick, asphalt or other artificial block, and reject and prevent the use in the pavement of any broken, chipped or otherwise defective blocks. A contractor will often use such brick and lay them with the defective side or face next to the sand cushion. This should not be permitted. The contractor should not be allowed to fill the joints of any stretch or section of paving with cement, pitch or other filler, until such paving has been thoroughly examined by the inspector for defective blocks, and such blocks replaced by perfect ones.

However carefully lumber may have been inspected before its manufacture into blocks, the subsequent seasoning, treating and handling will develop many defects, and yon will need to observe the delivered blocks closely and reject those that do not comply with the specifications.

Under certain conditions, wood blocks will develop a great many "season cracks" which should not condemn them unless the cracks open for the full depth and to more than one-third of the thickness of the block. What are called "shakes" result from the separation of the wood along the growth rings, and if well defined or open should condemn the block, though in many cases the blocks, after the defective part has been trimmed off, may be used.

The inspector shall see that the required crown is given to the concrete before the same is set, as on account of the even size of blocks, any inequality of foundation more easily affects the surface.

When these blocks are to be placed under the head of the rail (as in Tee Rail), the inspector shall see that they are placed tight against the web of the rail, and that all voids are completely filled, to avoid any loosening by the action of the cars on the adjoining rail.

Macadam Paving.—The inspector must see that the stone is spread in a uniform layer to the specified depth before rolling, and that the rolling is continued until the stones are thoroughly settled into place, and show no movement under the roller.

The inspector shall see that the binder is applied in thin layers, and that it is not rolled until dry. The application of binder with intermittent rolling must be continued until all the voids in the stone shall have been filled. He shall then require water to be applied in such quantities that a wave of mud forms in front of the roller. The rolling must continue until the pavement is thoroughly consolidated.

The inspector shall see that the road is again rolled after the final coat of screenings is spread over the surface. He shall not accept the same until the surface becomes thoroughly consolidated, hard and smooth.

Before the application of a bituminous dressing, the inspector shall see that the surface is so swept that the ends of the one and one-half inch stones are exposed. Such dressing must not be applied except when the temperature is above 50° F., and the weather is clear.

The inspector will bear in mind that the foregoing instructions are general and intended as a guide to be used in conjunction with, and as a supplement to, the contract form and specifications. He must not conclude that, because no mention is made of some specification provision in these instructions, they are of minor importance and may be neglected or violated. He must remember that the contract specifications govern in every case, and will be held to strict accountability for the enforcement of every and all provisions contained therein.

TORONTO ASPHALT SPECIFICATIONS.

SPECIFICATIONS for the supply of asphalt for the city of Toronto for the year 1914 were issued last week by City Engineer George C. Powell. The following portions will be of interest to municipal and highway engineers and road contractors:—

All asphalt herein shall be obtained by heating crude natural asphalt or crude asphaltic petroleum without the admixture of any other material to a temperature of 400 degrees F. until all the water and light oils have been driven off, and the refined asphalt thus obtained must meet the following requirements, viz.:—

(1)—It shall contain not less than 90 per cent. of "Bitumen."

(2)—Not less than 98.5 per cent. of its "Bitumen" shall be soluble in carbon tetrachloride at air temperature.

(3)—Not less than 65 per cent. of its "Bitumen" shall be soluble in standard petroleum naphtha at air temperature, and the word "Bitumen," as used in these specifications, shall signify and shall be taken to mean "any hydrocarbon, or hydrocarbons, soluble in carbon bisulphide at air temperature.

(4)—It shall not contain more than 15 per cent. of fixed carbon on ignition.

(5)—Fifty grams of refined asphalt, when heated in an open flat-bottom cylindrical dish, 2⅞ inches in diameter and 1¼ inches high, shall not lose more than 5 per cent. of matter by volatilization at 325 degrees F. in twenty-four hours.

(6)—It shall not be softer than sixty penetration at 77 degrees F. (Dow Machine).

(7)—It shall not be harder than that which will require more than 15 per cent. of flux, calculated on the percentage of "Bitumen," to produce an asphaltic cement of forty-five penetration at 77 degrees F.

(8) The flux used in the preparation of the asphaltic cement above mentioned, will be any suitable standard flux having a specific gravity at 6 degrees F. between 0.9395 and 0.9722.

(9)—All asphalt herein shall be subject to the approval of the Commissioner of Works and be tested at destination.

An affidavit must be submitted with each tender, showing where the material was mixed or the source of supply, and also stating where it is refined and the method of refining, and further stating that nothing whatever has been added to the crude natural material.

The asphalt must be shipped in strong, light packages, capable of being handled in all temperatures, and the gross weight must be marked on each barrel or container. In addition, a list must be forwarded prior to each shipment showing these weights, and upon arrival the weight of each barrel or container, will be checked on the city scales. Should any discrepancies in the weights appear, then the weights as shown on the railway manifest shall govern, for establishing gross weights.

Tenderers must submit a sample lot of not less than two pounds of refined asphalt, together with an analysis of the same, made and certified by a properly qualified chemist, of each class tendered upon at least forty-eight hours before date set for reception of tenders, samples to be addressed to the Commissioner of Works, City Hall, Toronto, plainly marked as to grade and class and by whom submitted. These samples will be subject to the approval of the Commissioner of Works, and will be taken as a guide in considering any asphalt required or delivered under this contract.

The percentage of "Bitumen" found by analysis of the samples submitted with the tender, shall be taken to be the "minimum percentage" of "Bitumen" which the proposed grade of asphalt shall contain, and the award shall be made on the price per ton of "Bitumen" calculated from the percentage of "Bitumen" thus found.

The following is a list of municipally-owned electric railways in Canada: Berlin and Waterloo Street Railway, Calgary Municipal Railway, Edmonton Radial Railway, Guelph Radial Railway, Lethbridge Municipal Railway, Regina Municipal Railway, St. Thomas Street Railway, Saskatoon Municipal Railway, Brandon Municipal Railway, Port Arthur and Fort William Electric Railway and Toronto Civic Car Lines.

PARAFFINE SCALE AND DUCTILITY.

By Leroy M. Law,
Chemist, United States Asphalt Refining Company.

THERE are other tests, besides the Fixed Carbon Test, appearing in some specifications for asphalt supply, which should be omitted until their status is better estabilshed. Among these are the tests for "paraffine scale" and "ductility."

The so-called paraffine determination is supposed to show the amount of hard or "scale" paraffine present in refined asphalt, and is, therefore, considered to be an index as to its liability to crack in cold weather or to granulate with age.

The general procedure employed in this determination is doubtless familiar, consisting of distilling the material rapidly down to dry coke and collecting the distillate. The latter is then weighed, an aliquot portion removed, dissolved in alcohol-ether, chilled, and the crystallized scale filtered off, dried and weighed. Many specifications prescribe that the scale shall not exceed a certain figure, yet few of them prescribe their modifications in detail.

The result is that each customer performs the test in a manner most agreeable or convenient to himself, and the manufacturer must stand for the whims and modifications that the customer may see fit to introduce. Usually the test is conducted in a glass retort, yet some operators substitute in its stead an iron one. That this may influence results matters little, so the manufacturing chemist must visit all these laboratories to become familiar with each chemist's details, then return home and endeavor to duplicate conditions.

Dow and Smith, using an iron vessel, have shown the effects of different rates of heating, type of condenser, etc., and they express the belief that at certain heats soft paraffines may be converted into the scale form. In the face of these experiments and opinions, we have chemists who insist that the higher the paraffine scale obtained the more accurate the method, their claim being that "you cannot get out more than there is in it."

In an effort to learn something as to the paraffine test as generally applied, the six laboratories who replied to the fixed carbon inquiry (see *Canadian Engineer* for Nov. 20th, 1913), were also asked to determine paraffine scale in the same samples. They did so with the exception of one laboratory, which, for reasons not stated, declined to make the determinations. I trust that laboratory E realizes the unscientific status of the paraffine scale test, and it was this realization that prompted them to decline to report on the subject.

Results on Paraffine Scale.

	Sample No. 213. Per cent.	Sample No. 215. Per cent.
Laboratory A.	3.6	2.8
" B.*	0.10	1.58
" C.	2.7	1.49
" D.	1.21	1.25
" F.	4.13	3.04

The above results tend to make a laughing stock of the profession, and are only printed with the hope that asphalt chemists may soon get together and study or eliminate these embarrassing subjects. Our company is furnishing a certain material to one customer, who limits paraffine to one per cent. From him we have had no complaint whatever, yet the same material is ineligible under another specification, having been reported to contain paraffine in excess of four per cent. Which chemist is right, and what is the manufacturer to do under such conflicting evidence?

Turning now to another requirement of questionable scientific value, and non-indicative of either quality or service results, I call attention to a requirement in many road oil and binder specifications which states that the material at, say, 50 penetration shall have a specified minimum ductility. The idea is that the bitumen shall possess adhesiveness, a quality best shown by the ductility test. By concentrating to 50 penetration, the standard consistency for this ductility test, all materials are brought to a uniform basis of comparison. Thus far the idea is sound, but the method of concentration—the all-important feature—is sadly neglected.

Some chemists, in a blind attempt at conserving ductility, stipulate that during concentration the temperature shall not exceed, say, 400° or 500° F. Others provide for "occasional" stirring, but generally they neglect the essential feature in asphalt treatment, namely, the agitation. In hardening the softer asphalts, agitation plays, if anything, a far more important role toward conserving ductility than does the mere restriction of temperatures.

My interviews with inspecting chemists relative to this test show that they are uniform only in following "no regular procedure." Some of them use heat-test residues which, by accident, have just reached 50 penetration, or again, this residue treated to a further heating on a hot plate or in an oven to obtain the desired consistency. Others concentrate the material from an oily state to asphaltic consistency in a single operation, either on a hot plate or in an oven, with or without agitation, as suits their fancy, and the manufacturer must ascertain, and duplicate in his laboratory, all of these eccentricities to find out the chance his material has of passing a so-called scientific specification.

On one occasion the writer submitted to a prospective customer a series of asphalt products varying in consistency from a maltha down to an asphalt cement. These were tested by the inspecting chemist, who passed the harder materials but rejected the softer ones as absolutely lacking in ductility when reduced to 50 penetration.

The chemist allowed me to look over his results, and I observed that with the material requiring the least concentrations he had secured the highest ductility, and in case of the fluid material requiring the greatest concentration to reduce it to 50 penetration, practically no ductility was obtained. All of the products were from the same primary material, the maltha, the harder ones being produced by refinery operations, which he or no one else could duplicate in the evaporation tins of an asphalt laboratory.

In the instance cited the chemist's process was undoubtedly one destructive to ductility, for the longer the heating required to reach 50 penetration, the lower the ductility of the product. The chemist avoided the issue by deciding that to his mind the test represented service conditions where no agitation of the material took place.

The two requirements above dealt with, together with the fixed carbon test previously dealt with, are examples of requirements without theoretical or practical significance.

*Material foamed considerably. Analyst is of opinion that there is no accurate method and results are only approximate.

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CONTENTS OF THIS ISSUE.

Editorial: PAGE

In Honor of the Dean 839
A Commission Without an Engineer 839

Leading Articles:

The Design of Medium Sized Coal Gas Plants 823
Painting Structural Steel 829
Transmission Line Work 831
Proper Inspection of Track Paving 835
Toronto Asphalt Specifications 837
Paraffine Scale and Ductility 838
Letters to the Editor 839
Storm Sewers for London, Ont. 842
Field Examination and Testing of Clays 844
A Dinner in Honor of Dean Galbraith 847
Resistance of Steel to Wear 849

Coast to Coast 851
Personals 853
Coming Meetings 854
Railway Orders 76
Construction News 78
Technical and Municipal Societies 94

"IN HONOR OF THE DEAN."

The twenty-fifth annual dinner of the University of Toronto Engineering Society constituted a re-union in honor of a man who, fifty years ago, came to the University of Toronto in search of an engineering training and who, finding none and foreseeing a profound necessity for such, proceeded to establish a foundation and build one; and whose labors, extending over thirty-five years of unceasing devotion to the cause, have produced an institution, still in the building, but now regarded as one of the important factors in the development of the Dominion.

It was a re-union in one of the drafting rooms of the old edifice through whose halls have passed generations of engineering students—familiarly known as the School, but which appellation has enlarged during recent years to include buildings of more modern and special design.

There are many things that might be said about Dr. Galbraith and his institution now known as the Faculty of Applied Science and Engineering of the University of Toronto. Pages might deservedly be devoted to his prominence in any one of many phases of the evolution of applied science and the development of engineering. As a criterion, as convincing as it is genuine, the expressions of student and graduate gratitude and of professional admiration that were in evidence upon the occasion mentioned, are sufficiently indicative of the indebtedness of a nation to the man for so diligently devoting his life and energy to the furtherance of technical and scientific education.

The remarkable assembly comprised prominent engineers from the chief centres of Canada, joined by leaders of the profession in United States, including graduates of years covering a full third of a century, and representative of the forces upon which the development of Canada has so materially depended—a strong phalanx of men of indomitable spirit assembled to do honor to John Galbraith, one of the builders of a Dominion.

A COMMISSION WITHOUT AN ENGINEER.

The following letter from the American Institute of Consulting Engineers, to the President of the United States, is largely self-explanatory. It is reproduced in these pages to exemplify the clear-cut purpose of the Institute to be of what assistance it may in the country's advance. It shows the altruistic motives behind the movement in the interests of a better equipped Interstate Commerce Commission, to rule the transportation forces of the United States, at the same time exposing the remarkable fact that the Commission, with so many duties that are pure engineering or closely allied to it, has worried along with no engineer on its membership, to be of service in the investigation of problems with which he might well be most familiar:—

Sir,—The American Institute of Consulting Engineers recently sought an appointment for its committee to present to you, orally, a request for the appointment of some able and experienced engineer to fill one of the vacancies on the Interstate Commerce Commission, with reasons therefor. A hearing having been found impracticable, the Institute has the honor to present its views through the medium of this communication. It is hoped that the argument that must be so briefly expressed here may so appeal to you that you will grant the hearing desired for the committee representing the Institute.

Membership in the Institute is limited to engineers in independent private practice of such experience and professional standing as enables them to serve their clients in an advisory or executive capacity; therefore, the membership consists only of the older or more experienced engineers Among its members are several of the past presidents of the national societies of Civil, Electrical and Mechanical Engineers.

The Institute has no candidates to present for office, and is, therefore, enabled to address you from an impartial standpoint, free from personal ambitions, and solely in behalf of the public interests.

The Interstate Commerce Commission is charged not only with the regulation of transportation rates, but also with the regulation and inspection of safety appliances used in our railways, with the investigation of accidents, and with the stupendous and expensive task of making a physical valuation of the railways of the country (United States); consequently many of the duties of the Commission are highly technical.

The leading part taken by the engineer in surveys, location, construction and operation of the railroads, gives him special training, skill and acquaintance with their details which would be of the greatest value in the study and decision of the cases that come before the Commission, and particularly in the executive work of physical valuation. Heretofore, with but few exceptions, the Interstate Commerce Commission has included no member having previous training or experience in the peculiar and complex problems that have come before it, and the knowledge and training had to be acquired after appointment.

We submit that while several years are required for a lawyer, politician or other layman to become familiar with the technical details of rail transportation, the engineer, on the other hand, is already acquainted with them. He can examine the details and special facts presented for adjudication without loss of time or unnecessary expense to the public through lack of preparation. With one or more engineers as members of the Interstate Commerce Commission we believe that the duties and responsibilities of the other Commissioners would be greatly lightened.

While the regulation of rates is not wholly an engineering question, the knowledge of the experienced railroad engineer would be helpful and valuable in its consideration. The economic and commercial factors underlying the rate structure are more familiar to him than to any other except the traffic expert.

Safety appliances and the investigation of accidents on the railways are matters wholly technical, and an engineer commissioner would, therefore, render inestimable service in reviewing the reports of inspectors and giving them proper value. The decisions and recommendations upon the subject of safety appliances, such as block signals and steel equipment, promulgated by the Interstate Commerce Commission, would be authoritative and command the respect and confidence of the general public and of the carriers if participated in by well-known engineers.

The physical valuation of railways is, perhaps, the most important engineering work now being done in this country. Its cost will be great, it has little useful precedent, and the whole responsibility for the task rests with the Commission. While the Commission will be aided, of course, by engineering boards and experts, the work will be dominated and directed by the Commission.

The results of this great work will be of vital import to all classes of society, and the well-being of the investor, shipper and laborer is bound up in the outcome. Moreover, the scrutiny that the valuation must undergo before the courts, the railroads and the general public makes it important that the decision of the many elements entering into the valuation should not be left by the Executive entirely in the hands of a Commission upon which the engineering profession is unrepresented. We respectfully suggest that an Interstate Commerce Commission, including in its membership one or more engineers, would arrive at an authoritative and equitable valuation, in which all concerned would have confidence.

While urging the appointment of an engineer on the Interstate Commerce Commission, we do not maintain that technical knowledge constitutes by itself a sufficient qualification: a judicial temperament, executive ability and tact are as necessary for a useful engineer member of the Commission as for any other; if therefore you decide to appoint an engineer, we ask that you select one having these essential qualifications as well as the highest professional attainments.

An engineer of the type we ask you to consider will not serve in a subordinate capacity under laymen, but would probably make personal sacrifice for the honor of serving under your administration as a member of the Commission and with the thought of performing a duty as a citizen.

We repeat that we have no candidate to offer and no motive except to serve your administration.

Respectfully submitted,

American Institute of Consulting Engineers.
Alfred Noble, President.
Eugene W. Stern, Secretary.

New York, Nov. 26th, 1913.

LETTER TO THE EDITOR.

Some Points for Consideration in Discussing the Reasons Why Some of the Upper Lake Freighters Failed to Weather the Storm on the Great Lakes on November 9th.

Sir,—Now that the first shock caused by the terrible marine disaster upon the Great Lakes of the 9th of November has passed, one can begin calmly to try to think out some reasons for the how and the why. Unfortunately, in all the most important cases not a living soul is left to tell the tale, to lift ever so slightly a corner of the curtain which hides the tragedy, nor to indicate why a number of large steel steamers of modern construction and equipment could not withstand with reasonable safety the force of even such an exceptionally heavy gale as that which sent them to destruction.

It seems almost inconceivable that the "James Carruthers,"* for instance, a brand new ship, which was the product of twenty-five years' experience in steel shipbuilding upon the lakes, beginning with 255-footer and progressing successively through the 300-ft., 400-ft. and 500-ft. classes, until it has reached the modern 10,000-tonner, should disappear utterly, and leave no sign behind to indicate what happened when she took her final plunge into the watery depths of Lake Huron.

A good many possibilities have already been brought forward in the daily papers, and chiefly by practical men, suggesting collision, capsizing through shifting of cargo, want of stability, inefficiency of hatchways, carelessness with regard to hatch fastenings, overloading, deficiency in size, weight and length of ground tackle, stowage of cargo, and want of power, etc., but until an exhaustive enquiry has shown the exact condition of each vessel separately with regard to construction, loading, power,

*For detailed description see *The Canadian Engineer* June 5th, 1913, page 310-11.

nature and quantity of cargo, equipment, draft of water, etc., it is impossible to come to any satisfactory conclusion as to the immediately contributing cause of the catastrophe.

With all available information at hand, it may be possible, by eliminating those conditions which are self-evident, to narrow the enquiry down to such a point as to enable something like a fair and reasonable explanation to be offered in each case as to the cause of the wreck—which is probably as near to the actual result as will ever be attained.

For the sake of humanity, of the shipbuilders, of the owners, of the shippers, and of the insurers, it is imperative that a competent commission be appointed, representing all interests, with power to get at the facts and with ability to draft such regulations as will, as far as it is humanly possible, prevent a recurrence of such a deplorable event.

The loss of life and treasure has been terrible. It would be a still greater calamity if the lessons to be learned by such an enquiry were neglected in any particular whatever.

Whilst it would be premature to discuss matters upon which we have no definite information, there are some phases of the case that can be investigated with propriety from data already made public; such, for instance, as the type of the modern 10,000-ton lake freighter. It would be interesting to compare her with a modern 10,000 gross ton ocean cargo boat, built up to the requirements of Lloyd's Register of British and foreign shipping, and of the British Board of Trade. The leading particulars of the two boats are as follows:

	Ocean boat.	Lake boat.
Length, feet	460	530
Beam, feet	58.5	56
Depth, feet	41.0	31
Draft, feet	27.0	19
Depths to length	11.2	17.1
Drafts to length	17.0	28 nearly
Watertight bulkheads	6	3
Displacement, tons	16,000	15,000
Indicated horse-power	4,000	2,000
Block coefficient	.79	.850
Freeboard, feet	14	12

There are some screen bulkheads in the main hold of the lake freighter, but they are not watertight, and the hold is about 390 feet long, so that if a collision caused any serious damage below water at any point within that cargo space, the vessel's pumps could not keep her free and she would inevitably sink.

These two boats are constructed within a small margin of precisely the same weight of metal, and for a rough-and-ready comparison they may be looked upon as two girders of different dimensions and of equal weight, thus:—

The ocean boat contains 4,750 tons of steel, is 460 feet long, 41 feet deep, and the lake boat with the same weight of material is 530.0 feet long and 31 feet deep. It is evident from this that there is a vast preponderance of longitudinal strength in favor of the ocean boat, which is a point worth considering. This does not prove that the lake freighter is too weak for her work, but if the waves are so much worse for the ships on the lakes than they are on the ocean, as Captain Inkster intimates in his letter to the press upon this subject, one would naturally suppose the preponderance should be the other way. Fortunately, this point can be readily settled, after the plans and specifications have been examined and strength curves made showing the stress upon the materials. These possibly have already been worked out. Lloyd's Rules provide only for normal ships having a maximum length of sixteen depths measured from the keel to the middle deck, or 13 depths measured from keel to gunwale, and even in the latter case, a substantial deck house must, in all cases, be erected extending over half the vessel's midship length. When classification is required for vessels outside or beyond these proportions, special designs have to be prepared and submitted to the committee for their approval, showing how the additional longitudinal strength required is to be provided for.

It is clear that the lake freighter does not begin to measure up to the standard set by Lloyds' for a first-class cargo steamer in this respect, and it cannot be an unreasonable question to ask whether her abnormal proportions of 18 depths to length, with 31 hatchways, each 36 feet wide and 9 feet long, have been adequately provided for so as to enable her to efficiently perform the work she has to do.

Then, as to power. Captain Bassett, in his evidence in the "Wexford" case, stated (according to the press) that "most steamships have sufficient power in relation to their size, although the longest boats would sometimes fail to get headed into the seas if they got in the trough of the seas, because of the tremendous leverage of the boats."

This is a significant statement, coming from such an authority as Captain Bassett, especially in view of the fact that the ocean steamer carries 4,000 i.h.p. and the lake boat only 2,000 i.h.p. The position of the machinery indicating this power is amidships, or nearly so, in the ocean boat, and as far aft as it can be placed in the lake boat. The latter arrangement, of course, leaves all the room forward available for cargo, but it militates against the vessel's seaworthiness—when light, in consequence of her excessive trim by the stern, and at all times owing to the absence of the watertight bulkheads which would have to enclose the machinery space if the latter were amidships.

As regards stability, the ocean boat has a metacentric height of 1 ft. 6 in. at 27 ft. draft with a full load and homogeneous cargo, which would indicate an easy, slow-rolling boat very comfortable in a sea way. The lake boat probably has a metacentric height of something like four feet when full loaded with homogeneous cargo to 19 ft. draft, which indicates ample, if not excessive, stability, but a hard, fast-rolling boat very uncomfortable in a sea way.

When loaded with 10,000 tons of wheat, coal or ore the boat would not be near full, consequently her centre of gravity would be lower and the distance between her metacentre and centre of gravity would be increased proportionately. If, in this condition the cargo should shift heavily, of course it is possible that at a large angle of heel the stability would vanish and the ship capsize, but this is another point that can be cleared up by stability curves made from the drawings of the ship.

It may be asked: Have not the steamboat inspectors power to prevent such vessels proceeding to sea without the proper means for preventing the cargo from shifting, the same as they have for preventing the overloading of passenger steamers? The answer is: There are no de-

tailed regulations in Canada, as yet, for the guidance of inspectors giving them authority over the design, construction or operation of steamers, nor does any competent central body exist, having similar functions to the British Board of Trade, to control marine matters, and to which they could refer in case of necessity. The present inspectors have a very large territory to cover, have an arduous duty to perform, especially during their busy season, and could not possibly be looking after ships on Lake Erie or Lake Ontario, when similarly engaged on the Georgian Bay. They are painstaking and strict in the performance of their existing duties, which they are well qualified to perform, but in the interests of the community at large, the system should be extended. The Canadian merchant marine has become of sufficient importance within a generation to demand a classification of its own, endorsed and supported by government authority.

The pending enquiry will probably result in a coroner's verdict, and it is to be hoped that a trial will be held under competent legal and technical auspices as already indicated.

W. E. REDWAY,
Naval Architect.

Toronto, Nov. 29th, 1913.

STORM SEWERS FOR LONDON, ONT.

A REPORT has recently been submitted to the mayor and council of the city of London by Willis Chipman, C.E., civil and sanitary engineer, of Toronto, upon a system of storm sewers. The city, with a present population of 49,000, has felt for some time the necessity of such a system for the prompt removal of rainfall from its streets. The improvement of roadways and the paving of streets are examples of municipal work that have been seriously held up, pending action in the matter of storm sewers, while the menace to public health through the only existing alternative of connecting into the sanitary sewers to relieve surface flooding has become grievous, owing to cellar and basement flooding by the forcing back of sewage by storm water.

The following information respecting the conditions that have developed during the past twenty years are from Mr. Chipman's latest report upon the situation, and his recommendations and estimates for the improvement of these conditions are appended.

The central business section of the city is now served by a system of combined sewers constructed prior to 1892. At various times drains have been laid in the outlying sections for the removal of cellar and street water, without regard, however, to any system; and, at the present time, fully half of the city is unprovided with storm sewers.

Separate System.—For some years prior to 1891, numerous damage suits had been entered against the city by riparian owners for pollution of the river by sewage which was then discharged into the south branch of the Thames River. Wastes from factories, canneries, and other drains discharged into both branches of the river, and aggravated pollution was the result.

In 1891, Mr. Chipman investigated the problem of disposing of the city's sewage, and presented a report in February, 1892, advising the city to adopt a separate system of sewerage, the domestic sewage to be conveyed by gravity into lands situated west of the city; the sewage from the north area to be collected by an intercepting sewer laid in the valley of Carling's Creek; that from the south area by a similar sewer parallel to the south branch of the river, both interceptors to pass beneath all the existing sewers and to collect from them the normal dry weather flow only. During rains, the interceptors would flow full, the excess passing into the original outlets.

Several tile sewers had been constructed in London South prior to its annexation to the city in 1890. The report referred to recommended a third interceptor for this section.

After lengthy consideration, during which the report was endorsed by Mr. F. X. Goodnough, engineer of the State Board of Health of Massachusetts, and Mr. C. H. Rust, then city engineer of Toronto, the project was eventually adopted by the city council in October, 1896. Construction began that fall and the main sewers were completed in two years' time. In 1901-2, two filter beds were constructed and one sedimentation tank added in 1908-9.

From 1890 to 1913, with the exception of eight streets, storm sewers were not laid with the sanitary sewers, and in the majority of instances the street water was discharged into the small sewers designed for domestic sewage only, notwithstanding the fact that in 1906 it was pointed out by the consulting engineers that the storm water should be rigidly excluded from the latter. The city engineer's department evidently intended to design a comprehensive system of storm sewers, similar to the system of sanitary sewers projected in 1890, but the matter was postponed from year to year, the troubles from storm water constantly increasing.

Catch Basins.—In 1896-97 attention was called to the inadequacy of the "gullies" through which the street water entered the sewers. Each gully comprised a vertical 18-inch sewer pipe or concrete pipe set vertically, with a cast iron grating at the upper end. The earlier form of "gullies" were only 30 inches in depth and 16 inches in diameter, with connections to sewer 8 inches in diameter. About thirty proper brick catch basins, with pits to collect the sand and mud, were built in 1896-99, but since that date the cheap vertical pipe gully that permits the sand, gravel, mud and debris to enter the sewer, has been all but universally constructed. There are now about fifteen hundred of these gullies, as many as twelve being built on one street intersection. The combined capacity of the pipe connections from these gullies would equal the capacity of a main sewer 20 feet in diameter, laid on the same grade as the existing trunk sewer. When it is understood that about fifty gully connections, each running half full, would tax the full capacity of the 36-inch trunk sewer, the folly of discharging the street water into the sanitary sewers can be appreciated.

Drainage Areas.—The total area of the city is now 6,302 acres, while the water sheds of Carling's Creek and other water courses extending beyond the city limits constitute an additional drainage basin with an area approximating 5,000 acres. Mr. Chipman's report recommends the retention of the important natural water courses where practical, as open outlets for the storm water, thus saving the expense of large conduits. A trunk storm sewer is advised for the valley of Carling's Creek, and other storm sewers for London South, Hamilton Road, and Colborne Street. The construction of proper catch basins and the abolition of open gullies are

also recommended. One important measure is that emphasizing the advisability of constructing the storm sewers of at least one year in advance of laying down permanent roadways.

Summarizing the estimate in connection with this separate system, the figures in the report are as follows:

Carling's Creek area	$182,000
North area	28,000
Business area	40,500
Hamilton Road area	46,000
London South area	67,000
London West area	28,500
	$392,000

Sanitary System.—The report also includes some observations relative to the existing sanitary system, the proper maintenance of which is regarded of even greater importance to the citizens of London than the construction of storm sewers. The following remarks are taken from the report:—

"The sanitary system has from time to time been the subject of unfair and often dishonest criticism by the ill-informed public, some of which may possibly be traced back to the battle that was fought in 1896 when the system was adopted, but not without strong opposition. Many citizens cannot divest their minds of the idea that if a sewer be properly designed it should carry anything and everything that can be emptied or even forced into it, regardless of public health or of the cost of the works. Some unthinking people occasionally put forth the contention that the garbage and ashes should be disposed of by discharging them into the sewers. These ignorant opinions still exist, notwithstanding that sanitary engineers and city engineers now recognize and admit that the separate system of sewerage is the only scientific and sanitary system, and at the present day it is being universally adopted in Europe, the United States and Canada. The arguments used against the separate system at London in 1892, 1893, 1896, would not be seriously advanced to-day, and the doubts as to the successful operation of the separate system have been exploded by experience wherever the system has been adopted, particularly so in Canadian cities and towns.

"In 1908 gaugings of the flow in the interceptors demonstrated that they were not then overtaxed and that they were of ample capacity for the domestic sewage flow. In March, 1893, with the ground saturated with water, the north interceptor was found running nearly full, but there can be no doubt that one-half of this flow was due to infiltration of ground water. Portions of this sewer were laid in quicksand beneath the level of Carling's Creek, and as the storm water from the watershed of this stream is not now removed promptly, the subsoil becomes surcharged with water which finds its way into the sewer through leaky manholes and joints in the sewer. By examining these manholes when the water was high, the visible leaks could be marked and the repairs made during dry weather. With the construction of the storm sewer system the normal flow of the interceptors will be materially decreased, but during rains they may run full, as hundreds of 'gullies' are connected with them.

"The inverted syphon that conveys the domestic sewage from the entire city across the Cove flats to the disposal works site has been overtaxed for several years, the excess flow passing directly to the river through the River Street overflow from the Evergreen Avenue chamber. The discharge of crude sewage at this point is continually increasing in volume and will undoubtedly soon cause such a nuisance that litigation will ensue.

"For several years after completion the syphon was sufficient to carry the normal flow, the River Street overflow operating only during rains. As the normal flow increased, the capacity of the iron main was exceeded. It should be mentioned that with a depth of 14 inches flow in the Evergreen Avenue main sewer, the 20-inch syphon would be carrying its full rated capacity. The existing 20-inch cast iron main has a discharging capacity of 3,250,000 gallons per twenty-four hours at the disposal works, or about thirty per cent. of that of the main sewer east of Evergreen Avenue chamber when running full. Another main is required to convey the remaining seventy per cent. for which service a 30-inch pipe should be laid. The Evergreen Avenue chamber, which was never fully completed or equipped, should also be repaired and proper sluice gates provided. The River Street outlet also requires repairs, and improvements, after fifteen years of service. The cost of this proposed 30-inch main, with overflow at the Cove, will approximate $36,000 if cast iron be adopted. Steel pipes would cost about $5,000 less, but their durability is a matter of speculation. It is possible that a reinforced concrete conduit might be constructed at a less cost than cast iron, but the risk would be greater than with cast iron or steel.

"In 1896 the practicability of carrying the main sewer across the river by a bridge to be constructed at King Street was a matter of controversy, but the results have been most satisfactory, the bridge has proven a boon to the city by relieving traffic over the York Street bridge, and no trouble has arisen with the street sewer, supported beneath the roadway of bridge. An inspection of the pipe in March, however, showed that it was seriously corroded, evidently from washings from the plank roadway above, and no time should be lost in thoroughly cleaning the pipe and repainting it, otherwise it will be necessary to replace it at an early date. The sand blast method of cleaning, which is the only thorough method, should be adopted for this work, although the cleaning will cost several times the cost of painting. To lessen, if not to further prevent corrosion, the pipe should be protected by a roof placed above it, beneath the plank roadway, or a concrete roadway substituted for the planking if the trusses are of sufficient strength to support the extra dead load. The bridge and steel trestles supporting the approaches should be also thoroughly cleaned, repaired and painted.

Sewage Disposal.—"The existing disposal works comprise three sedimentation tanks of 200,000 cubic feet combined capacity, and two bacteria beds each with an area of 15,000 square feet. These beds were more or less experimental, and when constructed it was the intention to add others year by year. Funds were not appropriated, however, and the total flow of the sewage was often discharged through the beds. They are now useless except as crude strainers for part of the effluent from the tanks. By removing or washing the filtering materials, the beds may be revived. Whether additional beds be constructed, or spraying filters, or trickling filters, is a matter for careful consideration, but some system should be decided upon before the pollution of the river attains a dangerous or offensive degree. Material alterations should also be made in the three tanks, to convert them into sludge removers rather than sludge digesters, and provision should be made for periodic removal of the accumulations of sludge, without pumping. Beds should also be constructed for drying the sludge."

FIELD EXAMINATION AND TESTING OF CLAYS.

By J. Keele,
Geological Survey of Canada.

FIELD EXAMINATION.

THE testing of any clay or shale for commercial purposes begins with an examination of the deposit in the field. A clay deposit should be conveniently situated with regard to transportation, in a body large enough to keep a plant going for a considerable time, free from harmful impurities, and easily worked. There are many important questions to be considered, however, in the preliminary inquiry, for example:—

1. Can drainage be provided as excavation or mining proceeds, as it is necessary to keep the workings dry?
2. Is the water supply for all purposes adequate and of good quality?
3. If sand is required for mixing, or moulding, can it be obtained cheaply?
4. Consideration of the fuel supply.
5. Are conditions in the locality favorable for labor?
6. Can breakages of machinery be repaired quickly?
7. Can the kiln foundations be kept dry?
8. Would further prospecting reveal a more desirable deposit?

Some idea of the extent of a clay deposit may be gathered in a preliminary way from outcroppings either in plowed fields, hillsides or ridges and along the banks of streams or dry gullies. Springs issuing from hillsides sometimes furnish a clue to the upper level of a bed of clay, as the surface water cannot seep down through it. Wells and foundations excavated for buildings are useful guides; but, railway cuttings often furnish the best information, especially when they are freshly made. As soft clays in a steep bank are liable to be concealed by

Fig. 1.—Deposit of Brick Clay, Without Overburden, Easily Worked.

slide material which has washed down over them, it is often necessary to cut a deep trench up the slope from top to bottom of the deposit before the true character of the beds are seen. Some banks contain several different grades of clay, some of which may be worthless, and so situated as to render the good clay unworkable.

In addition to the information gained from outcrops, it will be necessary to make several borings in order to get at the extent of the deposit and its variations. Borings can be made quickly and cheaply in surface clay deposits with a 2-inch auger, coupled to short lengths of pipe and fitted to a cross-head. The auger is screwed into the clay for about six inches, then withdrawn with a straight pull, and the clay which clings to the auger removed. As the boring proceeds, extra lengths of pipe are added. The clay stripped from the auger is laid out in the proper order on boards or on the grass, from which small samples can be selected at any depth up to 30 feet or more if desired.

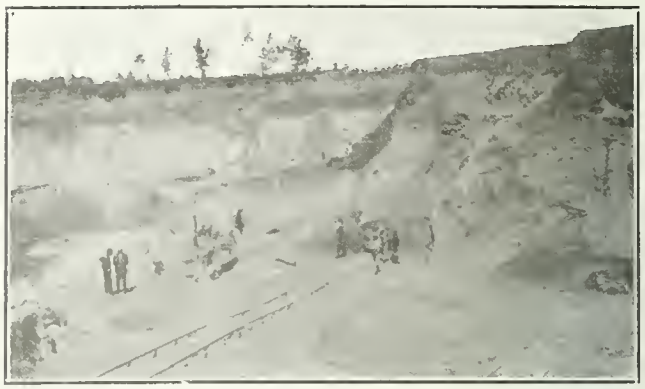

Fig. 2.—Pit Containing Sand, Gravel and Clay, Difficult to Work for Brickmaking.

The clay deposit may be covered with a varying thickness of either gravel or stony clay which cannot be used for any purpose. In most cases it will not pay to strip this overburden if it is very thick; but the higher grades of clay, like stoneware and fire clays, can have an overburden of one foot removed for every foot of clay obtained. If the overburden is composed of sand, much of it may be used for mixing with the clay, especially if it should be a fat clay with high shrinkage. An otherwise useless overburden may sometimes be used for filling or levelling up ground on which it is proposed to erect the plant, or it may be removed cheaply by hydraulicking, if a sufficient head of water is available. An overburden which contains pebbles, especially pebbles of limestone, should be removed completely and kept well back from the face of the bank which is being worked, so that there will be no danger of the pebbles rolling into the material that is being worked for the manufacture of clay products.

Shale deposits are often exposed in fairly steep banks, either in an escarpment or on stream banks or in a railway cutting. From exposures of this kind a good idea of their probable value may often be formed. If the outcrops on the property to be examined are not exposed to any appreciable depth, it will be necessary to sink some shafts before any sampling can be done or any decision formed regarding its economic value.

Several of the soft shale deposits in the plains region of Western Canada can be examined as easily as surface clays from borings with an auger, but the shales in the East are all too hard for this method of sampling.

The shale formation in Eastern Canada are generally uniform in character over very large areas, but those in the West are often extremely variable, so that they require great care in sampling and examination.

Impurities in clay or shale are of two kinds—those which are visible to the naked eye, and those which are not. The field examination detects the first kind, and the laboratory tests should reveal the second kind. Pebbles are probably the most serious visible impurities in surface clays. They may occur sparsely scattered throughout the clay or they may be in the form of gravel streaks, pockets, or regular layers. If the pebbles are mostly of limestone,

the deposit is practically hopeless. Some manufacturers in search of material will not consider a deposit, if they find it contains even a few scattered pebbles. Layers or pockets of sand, if not in too large a quantity, are sometimes beneficial in a surface clay, especially if it is of a highly plastic nature. Brickmakers like a clay bank to work itself, meaning one that carries the right proportion of sand for a proper mixture. An excess of sand layers is undesirable in a clay deposit, because the product made

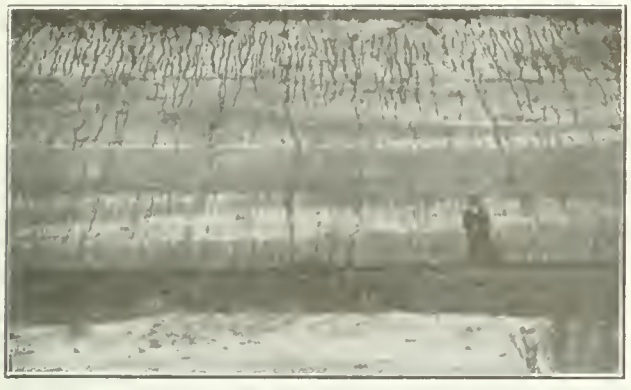

Fig. 3.—Bank of Soft, White Sandstone and Dark Shale These Shale Beds are Unworkable as the Sandstone Overburden is Too Thick.

from it is liable to be weak and porous, or lacking in clay bond. Although a shale deposit may consist largely of beds of true shale, it is possible that it may also contain so many layers of sandstone or limestone as to be of doubtful economic value. If the stone bands are thick enough they may be sold for building stone, if a convenient market exists for them. Ironstone constructions and lumps of iron pyrite are among the serious impurities in shales and clays. They sometimes occur of such large size that they may be discarded in mining. Gypsum or lime sulphate is a frequent impurity in the soft shales of Western Canada. It generally occurs in small glistening particles disseminated through the shale; or it may be in large crystals or rosettes. It generally follows in the west that clays carrying gypsum are hard to dry without cracking.

It is generally impossible to foretell much about the value of a clay or shale by simply inspecting the deposit in the field. An experienced clay worker, however, can gather some information for his guidance in the selection of material. The feel of the moistened clay when kneaded in the hands indicates its degree of plasticity and its probable working qualities. A shale may be distinguished from a slate by grinding a little with a hammer and moistening it. The moistened shale dust will have more or less plasticity, but a slate will have none. Any clay or shale that carries more than about 7 per cent. of lime will probably be useless for the manufacture of vitrified wares, such as paving brick or sewer pipe. If a few drops of diluted hydrochloric acid will produce strong effervescence in a clay it may be discarded as unsuited for this purpose.

Many clays will crack in drying. These can be easily detected by kneading up some of it with water to the proper consistency, shaping it into a rough brick or cube, and setting it to dry exposed to the sun and wind. Some clays thus exposed will crack in less than an hour after being set to dry. Others will not show cracking for several hours. If the clay dries intact, then make another brick by hand and set it over a boiler or in an oven at a temperature of about 150° F., and observe the results. A clay must be able to stand a certain amount of abuse in drying in order to give a large output of finished products.

Since few clay or shale deposits are uniform in character throughout their entire thickness, the selection of samples for testing purposes is a matter of some importance.

If the deposit appears to be uniform, then the sample should represent an average of the depth of the face it is proposed to work. The average sample should be supplemented by two or three other samples taken from different depths, as appearances are frequently misleading in clay investigation. Many persons pick a small sample of clay from the surface of a deposit and send it to be tested. The results of tests from this kind of sampling are generally useless. The body of material, when opened up for working, may give entirely different results from the thin veneer of weathered clay overlying it. In a locality where industries have been located for a long time, working satisfactorily on a material which occurs widespread and uniform in character, the necessary information may be obtained merely by inspection of a suitable site in the vicinity of the older plants. This proceeding is often, but not always, safe where the manufacturer of common brick only is concerned. Where any of the higher class of clay products were to be made, the cheapest method is to take every possible precaution at the outset of the enterprise.

Laboratory Tests.—The invisible impurities in a clay, which may produce defects in the process of manufacture or in the appearance of the finished ware, can be detected only by working up and burning test pieces made from the clay.

A good deal of time and money has been expended on the chemical analysis of clay, and many chemists have been rash enough to state in reports the kind of wares

Fig. 4.—White Clay in Central Alberta, Overlain With Worthless Shale.

a clay will make, from the results of their chemical analysis alone. There may be special instances, as in the case of some high-grade clays, where the chemical analysis is of value, but is is worthless for the general group of clays or shales used in the manufacture of structural ware.

What the clay worker desires to know about a clay or shale is:—

1. Its plasticity and working qualities.
2. The rate of drying.
3. The exact drying and burning shrinkages.

4. The commercial limit of burning.

5. The porosity and absorption of the burned wares.

6. The actual difficulties encountered in burning, such as cracking, warping, or swelling, and scumming or whitewash.

Many of the important clay-working plants in the United States and England, especially those making a variety of wares, have an experimental laboratory, with small kilns for burning trials in charge of a competent ceramist. These firms test a large number of clay samples which are sent to them from outside sources. Three or four of the State Universities give courses in Ceramic Engineering, and have very fully equipped clay-testing laboratories. A certain amount of commercial work is done, for which fixed charges are made according to the scope of the investigation. The tests are conducted by experienced men whose reports are reliable and extremely valuable to the person or company about to start a clay-working industry.

Most of the manufacturers of clayworking machinery have a clay-testing department on their premises. These people invite prospective customers for machinery to send samples of their clay and have it worked up into specimens of ware. They generally make the tests free of charge. The specimens of burned wares sent back by the machinery companies to their prospective customers are generally perfect in every respect. These samples should be regarded as a standard to be ultimately attained to, however seldom reached, in the everyday world of clayworking.

Tests Under Working Conditions.—If a company or individual wishes to establish an important clayworking industry at a certain place to make a certain class of wares, a reasonable way to proceed in the tests of their clay, provided the field examination was satisfactory, is as follows: Take an average sample of, say, 50 lbs. from top to bottom of the workable depth of the deposit, if it is uniform in appearance, or as many samples as

Fig. 5.—Shales along Red Deer River, Near Lignite, Alta., Overlain by Too Much Boulder Clay.

there are different beds. Have a complete set of laboratory tests made from the samples. If the laboratory tests prove satisfactory, then make arrangements with some firm, outside the zone of competition, who are making wares similar to those required, to put a large quantity of clay through their process and to burn it in their kilns. It is important to have an experienced man do the sampling and accompany the clay to its destination, so that he may observe the behavior of the material in the various stages of manufacture.

The proper location of the deposit and the assurance of the suitability of the clay for the purpose for which it is to be used, are absolutely essential to begin with.

The plan of the buildings, the design of the kilns or driers and the selection of the best types of clay-working machinery, should be done by a competent ceramic engineer.

It is impossible to provide against all the troubles which may arise in new localities when dealing with a new material; but the chances for the occurrence of trouble can be materially lessened by proper precaution.

Fig. 6.—Stratified Brick Clay Deposit, Overlain by Too Much Sand.

The business of manufacturing clay products is a desirable one in many respects. It gives healthy employment and produces articles of great use to a community. It is a fairly profitable business when brains and technical skill, as well as capital, are invested in it, varying nowise in this respect from any other complex producing business. It is just as easy, however, for the unwary novice to lose his money in a homely looking clayworking plant as it frequently is in the more spectacular operations of metal mining.

Work of the Geological Survey.—The Geological Survey has carried on a systematic investigation of the clay and shale deposits of the Dominion since 1909. The reports that are published at intervals contain complete results of laboratory tests, together with descriptions of the field occurrence of the materials collected. They are intended as guides for manufacturers in search of material, but are of general interest to all clay workers.

PEAT POWDER AS A LOCOMOTIVE FUEL.

Peat powder has been successfully applied as a locomotive fuel on one of the private railroads in Sweden. In steam raising value about 1½ tons of peat powder is equivalent to one ton of coal. Peat powder is used with a mixture of about 5 per cent. of coal, and is fed into the furnace by an automatic stoker. No change need be made in the boiler end in the fire-box, except for the mounting and application of the automatic stoker. An incidental advantage of the use of the peat powder is that no cold air can get into the fire-box and no smoke or sparks escape from the smoke-stack. As Sweden is very rich in peat bogs, and has practically no coal deposits, the success of the apparatus, which has been worked upon for years by eminent engineers, is of considerable importance. It has been estimated that the cost of peat powder would be only about one-half that of coal.—Conservation.

A DINNER IN HONOR OF DEAN GALBRAITH.

ON Friday, December 5th, the University of Toronto Engineering Society held its 25th annual dinner. This year it took the form of a re-union in honor of Dean Galbraith, the founder of the School of Practical Science, known for some years past as the Faculty of Applied Science and Engineering in the University of Toronto. Nearly six hundred engineers were in attendance, and the principal centres of Canada and the United States were well represented. Mr. F. C. Mechin, president of the Engineering Society, acted in the capacity of toast-master, and during the progress of the evening read innumerable letters and telegrams expressive of the profound regret of many prominent graduates in far away localities who found it impossible to attend.

As stated, the dinner was in honor of the Dean of the Faculty, and every toast, together with its response, reverted to his profound patience and unceasing perseverence in the building up of the institution which has broad-casted throughout the world nearly fifteen hundred men whose good fortune it was to partake of the advantages which his training in fundamental principles afforded to them. Many were the reminiscences which at one time or other during the evening ascended bouyantly to the surface and illustrated the spirit which dominated the engineering course since it was founded by John Galbraith thirty-five years ago.

President Falconer, in response to the toast "University of Toronto," outlined the remarkable influence of Universities upon the national life in Germany and other countries, as evidenced by the strenuous activity of these countries in the progress of the world. In this connection he referred to the evidences of spreading influence of the University of Toronto as shown by a recent trip through the Canadian West. The president referred in most kindly terms to Dean Galbraith and the regard in which he was held at the University, pronouncing him as the man who, above all others, had made possible in the engineering faculty of the University an atmosphere of integrity and cleanliness of character yielding results of untold value to this Dominion.

Col. W. M. Ponton, of Belleville, in an interesting response to "Canada," mentioned numerous instances in the career of Dean Galbraith indicative of his personality, his potentiality, and his position in the regard of men outside of the University and in other professions. His closing sentence related to those assembled, in the following terms: "Looking upon this throng that has assembled to honor Dean Galbraith, some of you from great distances and with much inconvenience, I cannot but admire your spirit of loyalty to the man who instilled into you those first principles of character and thought, and I can see in my mind's eye hundreds of others of the School graduates in all parts of the earth regretting with heartfelt sorrow that they cannot be with you to do honor to their Dean."

A toast to the "Profession" was responded to by R. A. Ross, Consulting Engineer, Montreal, a graduate, '91, and H. F. Ballantyne, '93, a prominent architect of New York. Mr. Ross referred to the preparatory importance of the University course in fitting a man for the profession of engineering. He noted the various ways it which the public regarded the profession in general, and intimated in this connection that possibly the engineer did not take the place in public life that he should, suggesting that too much work and too great a devotion to his own particular field, might be the cause of the engineer's shortcomings in the matter of participation in public affairs. The broadening field of engineering leading as it now does to administrative work and to positions on commissions was in itself an indication of the necessity for an exceptionally broad training for the engineer of the future.

Mr. Ballantyne's tribute to the profession centred chiefly about the Dean, and he dwelt briefly upon the remarkable appreciative manner in which the engineers of prominence in the city of New York regarded him and his work.

John Galbraith, M.A., LL.D.,
Dean, Faculty of Applied Science and Engineering, University of Toronto.

Dr. Galbraith, in responding to the toast given in his honor, dwelt reminiscently upon his early experiences at the University, which he entered fifty years ago as a student, his object being to learn engineering. Much to his surprise, he found that although the University assigned examinations and awarded diplomas in engineering in 1863, no actual instruction was given. Hence, he enrolled in Arts.

In 1878, he undertook the task of teaching engineering. This was the beginning of the "School." From 1878 to 1889, Dr. Galbraith and Dr. Ellis, assisted by professors in Arts, gave all the instruction. The Dean pointed out that his first assistant was Mr. G. H. Duggan, a graduate of 1883, now vice-President and Chief Engineer of the Dominion Bridge Company, who was present at the meeting.

Dr. Galbraith pronounced the graduates of thirty years ago to be as well trained as are our present graduates. The course of training given at that time equipped a man for the responsibilities of his work as fully as does the present curriculum, the difference being in the scope of the engineering field now as compared with thirty

years ago. He stated that his long experience indicated that the system of training engineering students in the University of Toronto compared very favorably with the systems which obtain in the other great Universities of the world.

This brief summary of the prominent features of the event does not serve to illustrate in any manner the general feelings of loyalty, appreciation and gratitude, which accompanied every remark and every occurrence throughout the occasion. From the first graduate of the School who left its halls in 1881, to the men who anticipate graduation ceremonies in 1917, it is sufficient to state that practically all years were represented, and that almost every city in the Dominion sent its quota to participate in an event to honor Dean Galbraith.

HANDLING SHIPPING IN PANAMA CANAL

Development of plans for meeting the demands of shipping in the Panama Canal in the way of terminals, coaling stations, warehouses, wharves, dry docks and repair shops, are outlined in the report to the war department of the Isthmian Canal Commission for the year ended June 30 last. The report was prepared by Colonel George W. Goethals, chairman and chief engineer of the Corps of Engineers, U.S.A.

Terminal facilities for shipping, the report states, cannot be completed by the time the canal is ready for passing vessels. The reason for this is the fact that the authorization for preparing such facilities was not made by Congress till August 24, 1912, and active operations could not be begun until the fall of that year.

The Pacific terminals which are being constructed by the commission, will consist of a main dry dock capable of docking any vessel than can utilize the locks, a smaller dry dock for use of smaller craft, a plant for supplying coal and fuel oil to vessels, the necessary wharves and piers for commercial purposes, and the permanent shops for use in connection with the dry docks.

The Atlantic terminals consist of wharves and piers at Cristobal, including the Cristobal mole, all of which are being constructed by the Panama Railroad at its own expense, and the main plant for supplying coal and fuel oil to vessels. The cost of the coaling plant will be divided between the commission and the railroad, while the commission will furnish facilities for oil.

Numerous applications, the report states, have been received from coal dealers for loading space for the handling of their coal in supplying vessels that will use the canal. In order to encourage the business of furnishing coal to vessels which use the canal, the policy has been adopted of providing storage in connection with both coaling plants for the coal piles of individuals and companies who desire to participate. It was never intended that the government should exercise a monopoly of the coal business on the Isthmus, but to utilize the coal stored there for the use of the navy in maintaining uniform prices of this product to shipping. There will be a certain rental charge for the areas occupied by the coal dealers, and, in addition, a real estate tax of 1 per cent. of the value of the improvements, should any be made, and a merchandise tax of 5 cents for each 2,000 lbs. of coal sold.

The government will attend to all the handling and charges for putting the coal into storage and taking it out; charges for the use of coal barges, and other labor in connection with this service will be fixed at cost price to the government for such service.

ARMSTRONG, WHITWORTH'S NEW CANADIAN PLANT.

PROMINENT among recent additions to Canada's home industries in the metal trades, is the new plant of Messrs. Armstrong, Whitworth of Canada, Limited, now nearing completion at Longueuil, Quebec, across the river from Montreal. Readers will recall a reference to this new industry in June 19th, 1913, issue. The parent English company, of Sir W. G. Armstrong, Whitworth & Company, Limited, with its several huge plants, is one of the oldest and largest manufacturers of high-speed crucible tool steel in the world. The new

Fig. 1.

Canadian plant profits from this experience, commencing its operations with the advantages of equipment and processes that have been found desirable by the older company. It will manufacture high-grade tool steel, including the "A.W.," "T.Y.R." and "A.W. Premier" brands, drills, reamers, cutters, taps and dies, machine tools, cranes, forgings, lock and dock gates, etc.

With complete equipment for the manufacture of these standard lines, and also of special steels where re-

Fig. 2.

quired, and with production capacity large enough to supply all reasonable requirements, the new plant will supply a real need in the Canadian metal trades. It is the company's intention to carry a complete and ample stock of standard lines, so as to insure quick deliveries.

The plant itself embodies the most modern ideas, in layout, construction and equipment. The accompanying illustrations give partial views of the main building, which is located near the main line of the Quebec, Montreal and Southern Railway. A siding was run in alongside of the building and continued to the water-front. Another siding runs along the north side of the building, and a third siding into the building. The total length of all sidings is approximately a mile. The building itself is 500 feet long, 175 feet wide at one end and 100 feet wide at the other end, with a boiler house separate from the main structure. It is of steel construction, with reinforced concrete walls and roofs, except on the north side, where the walls are of timber with metal lath and plaster, thus providing for future extension of all departments, seven in number, in this direction. Both by reducing the size of pilasters and cornices to the medium width, having due regard to strength, and by means of monitors and skylights, all the different departments have been made as light as possible.

Practically all of the foundations are on solid rock. A trench 5 feet wide and from 7 to 14 feet in depth was run from the main building down to the water-front, where the pump-house has been built. This trench contains a 24-inch vitrified clay pipe for water discharge, and an 8-inch cast-iron water pipe for the plant's water supply, provided by electrically driven centrifugal pumps. Underneath the pump-house, a concrete-lined pit was sunk to a depth of 6 feet below the lowest known water level of the St. Lawrence River. From the bottom of this pit, a tunnel lined with heavy timbers was run under the water-front road and from the point at which it emerged on the shore, a trench was dug for a distance of about 300 feet out into the St. Lawrence River. In this trench an intake or crib was built—the end being 5 feet below the lowest recorded level. This insures a continuous supply of water to the pump-house at all times of the year. As the formation in the bottom of the river was hard-pan, the trench was taken out without any sheet piling being used, the excavation from the trench being piled up on either side, thus forming a dam to prevent the trench being flooded. No seepage into this trench took place. A sludge gate is provided on the river side of the pump-house, so that the intake of water may be shut off at any time.

Wonderful turbines will drive the mammoth Cunarder Aquitania, which is now being completed at Clydebank. They have a total weight of 1,400 tons, and to enable them to be lowered into the hull of the ship, one of the four great funnels could not be placed in position. There are more than a million turbine blades, the combined length of which is more than 140 miles. The blades vary in length from one and a half to twenty inches. These turbines are absolutely the latest production of marine engineering.

In a lecture given in Berlin, Germany, before an audience consisting largely of electricians, Herr Reiss, an engineer, described an invention by which he claimed that the range of the telephone will be enormously extended. He stated that with the apparatus, which consists of a new form of relay, conversations over 2,000 kilometres can be heard with as much distinctness as those held over half that distance at present. It would appear that all the financial and other preparations have been made by big electrical companies here for putting the invention on the market without delay.

RESISTANCE OF STEEL TO WEAR.*

By George L. Norris.

THE increasing speeds and heavy duty of machinery and motive power with resultant shortening of length of service of parts through rapid wear, makes the study of wear-resisting qualities of metals, especially steel, one of increasing importance. In the railway field, the increasing wear of tires and rails due to increased loads and speeds is a serious problem. Not only is it desirable to have high resistance to wear, but it is necessary to have other qualifications, strength and toughness, to insure against failure or breakage. The tests described in this paper were undertaken with the object of studying the relations, if any, between the wear resistance of various steels and the various physical properties of elastic limit, tensile strength, and hardness. Owing to several protracted interruptions, only a relatively small proportion of the tests projected have so far been completed.

There are three classes of wear:—

(1) Abrasion, such as grinding, to which crushing and extracting machinery is subjected.

(2) Lubricated sliding or rolling friction; such as that to which machine parts, axles, shafting, etc., are subjected.

(3) Dry rolling friction, to which wheels and rails are subjected.

The first class, wear by abrasion, is in many ways less important than the other two. It has, however, been utilized frequently as a means of comparing the wearing qualities of metals for all three classes. The machines for the purpose are some form of grinding machine and the specimens are ground or abraded under a constant pressure for a certain length of time.

The signs of wear by lubricated friction in the past have been largely confined to bearing metals rather than steel. This has been due undoubtedly to the fact that steel is usually worked against soft bearing metals or bronzes. The investigation of the wear resistance of steel and iron under lubricated friction, however, is growing more important with the increasing severity of the requirements of service. Probably the most satisfactory device for testing wear under lubricated sliding friction is the Derihon machine, consisting of a hard steel disc revolving in oil, and against the edge of which is pressed the test specimen.

The third class, wear by dry rolling friction, is the most important, especially when we consider the vast tonnage of steel in service in the form of rails, wheels and tires.

A machine for investigating wear under dry rolling friction was described by Mr. E. H. Saniter in 1908, before the Iron and Steel Institute, and consists essentially of a revolving test specimen which drives by friction the inner ring of a ball-bearing, the outer ring of which is stationary and loaded.

The investigations of the author have been confined so far to the third class of wear, dry rolling friction. The machine used is a modification of Dr. Stanton's fatigue-testing machine. This machine consists essentially of three case-hardened rollers, 3½ in. in diameter. The two lower rollers are driven by gears, while the third, upper

*From a paper read at the Atlantic City meeting of the American Society for Testing Materials.

roller, is driven by friction. The upper roller is carried in the lever by which the load is applied to the test specimen. A load of 1,000 lbs. on the specimen is possible with this machine. The rollers each have a groove in the middle, ¼ in. wide, to take the corresponding band on the test specimen and to keep it from lateral motion. If the rollers all revolved at a uniform speed the amount of wear on the test specimen would be very slight, practically nothing, as there would be no slippage of the test specimen. In order to accelerate the wear and approximate as nearly as possible the actual wearing conditions of wheels and rails, the two lower rollers are driven at different speeds to produce a slippage of the specimen. This is accomplished by having two less teeth in one of the driving gears.

The test specimens are 2 in. long and ⅞ in. in diameter; the guide hand is ⅛ in. larger in diameter and a scant ¼ in. wide. They weigh about 160 grammes, and can be accurately weighed on a chemical balance to 1/10 of a milligramme. The diameter of the specimens which this machine will take can vary from ⅝ in. in diameter to 1½ in. in diameter, if desired. The driving speed of the machine is 1,000 r.p.m., and the speed of the test specimen is about 5,000 r.p.m.

The usual run before weighing is 100,000 revolutions of one of the driving rollers, corresponding to practically 500,000 revolutions of the test piece. In the tests included in Tables I. and II., the applied load was 224 lbs., or 100 kilograms; except in the cases noted in Table I., the specimens were all turned from rolled bars, 1⅛ in. in diameter.

While the tests show a general decrease in the amount of wear as the hardness and strength increase, the progression is irregular, and there are several instances where softer steels show less wear than the harder ones, as for example 12 and E-1; C-1 and F-1.

It is evident that the composition of the steel influences the resistance to wear to a considerable degree. Robin, in his investigations, found that nickel, chromium and vanadium each increased the resistance of the steel to wear. Nusbaumer in his tests found remarkable resistance to wear in low-carbon tests with manganese about 1.5 per cent. Saniter, on the contrary, did not find increased resistance to wear in the case of the few alloy

TABLE I.

Mark.	Wear; milligrammes per 1,000,000 revolutions.	Treatment; degrees Cent.	Carbon, per cent.	Manganese, per cent.	Silicon, per cent.	Chromium, per cent.	Nickel, per cent.	Vanadium, per cent.	Remarks.
P	3813.2	None	0.25	0.60	—	—	—	—	—
P-1	2436.4	825/600	0.25	0.60	—	—	—	—	—
O	1462.0	None	0.45	0.48	—	—	—	—	—
O-1	1334.8	825/600	0.45	0.48	—	—	—	—	—
8	1120.5	None	0.66	0.70	0.27	—	—	—	Tire
M-1	1104.1	825/600	0.28	0.61	0.28	—	3.10	—	—
12	1079.6	825/600	0.75	0.68	0.25	—	—	—	Tire
E-1	1043.1	825/600	0.43	1.30	—	—	—	—	—
U-1	958.0	825/650	0.58	0.65	0.20	1.26	—	0.20	Tire
C-1	829.8	829/600	0.38	0.30	—	1.16	2.08	—	—
K-1	436.8	900/600	0.46	0.90	0.11	1.03	—	0.14	—
F-1	371.9	825/600	0.48	1.15	—	—	—	0.22	—
22	368.8	900/625	0.62	0.62	0.27	0.95	—	0.24	Tire
Y-1	367.8	900/600	0.28	0.50	0.12	0.96	—	0.22	—
J-1	261.0	900/600	0.46	0.86	0.06	1.02	—	0.22	—
D-1	230.1	825/600	0.42	0.22	—	1.27	2.14	0.26	—

NOTE—Under the heading "Treatment," 825/600 degrees Cent., indicates that the specimen was oil-quenched from 825 degrees and drawn back at 600 degrees Cent.

TABLE II.

Mark.	Wear; milligrammes per 1,000,000 revolutions.	—Hardness— Brinell.	Scleroscope.	Elastic limit; lbs. per sq. in.	Tensile strength; lbs. per sq. in.	Elongation; per cent. in 2 in.	Reduction of area, per cent.	Treatment; degrees Cent.
P	3813.2	134	23	47,000	68,000	33.0	57.3	None
P-1	2436.4	170	27	58,000	80,000	28.5	67.0	825/600
O	1462.0	156	26	43,000	79,000	28.5	47.5	None
O-1	1334.8	207	30	71,000	96,000	23.0	57.3	825/600
8	1120.5	196	34	63,000	121,000	14.0	19.0	None
M-1	1104.1	207	30	87,000	100,000	25.0	67.5	825/600
12	1079.6	228	38	97,560	144,930	15.0	23.0	825/600
E-1	1043.1	223	35	91,000	105,000	23.5	58.6	825/600
U-1	958.0	248	43	98,000	120,000	19.0	52.8	825/650
C-1	829.8	286	47	127,000	134,000	20.0	57.3	825/600
K-1	436.8	340	54	156,000	163,000	15.0	45.0	900/600
F-1	371.9	262	42	115,000	127,500	18.5	54.7	825/600
22	368.8	302	43	128,000	147,000	16.5	42.0	900/625
Y-1	367.8	293	50	137,000	148,000	16.5	46.0	900/600
J-1	261.0	340	54	162,000	167,500	14.5	49.0	900/600
D-1	230.1	340	52	156,000	161,150	16.0	53.3	825/600

steels he reported, except for a high-manganese steel of the Hadfield type. His chrome-vanadium and nickel-chrome steel gave greater wear with greater hardness than simple carbon steel of about 0.70 per cent. carbon and 0.60 per cent. manganese.

The tests which I have made confirm the conclusions of both Robin and Nusbaumer, and also those of actual service experience, that manganese, nickel, chromium, and vanadium have a marked effect on the wearing qualities of steels. Manganese apparently has a greater effect than either nickel or chromium. Vanadium, however, evidently has a much greater effect than either of these three elements, as it only requires a very small percentage to produce a marked increase in resistance to wear. This is apparent in steels E-1 and F-1; and C-1 and D-1, each of which pair is practically alike, except for vanadium. These tests are only a small proportion of those planned, and it is the intention to cover not only a considerable range in composition and heat treatment, but also to study the effect of rollers of different composition and hardness, on the rate of wear of the various steels.

STRUCTURAL MATERIALS AND CLAY PRODUCTS

The following is a statistical table of structural materials and clay products as contained in the Economic Minerals and Associated Industries, by J. McLeish, Chief of the Division of Mineral Resources and Statistics, Canada:—

Product.	Quantity.	Value.
Cement, Portland .....Bls.	7,132,732	$ 9,106,556
Clay products: ($10,575,709)		
Brick, common .....No.	769,191,532	7,010,375
" pressed ..... "	125,180,422	1,609,854
" paving ..... "	4,579,500	85,989
" moulded and ornamental ..... "	371,356	8,595
Fireclay and fireclay products.	.....	125,585
Fireproofing and architectural terra-cotta	.....	448,853
Pottery	.....	43,955
Sewerpipe	.....	884,641
Tile, drain	.....	357,862
Kaolin .....Tons.	20	160
Lime .....Bus.	8,475,839	1,844,849
Sand-lime brick .....No.	96,448,402	1,020,386
Sand and gravel (partial record)..	.....	1,512,099
Slate .....Sq.	1,894	8,939
Stone: ($4,726,171).		
Granite	.....	1,373,119
Limestone	.....	2,762,936
Marble	.....	260,764
Sandstone	.....	329,352
Total	.....	$28,794,869
Grand total	.....	$135,048,296

Work was begun Nov. 5th on the one thousand foot pier in the Hudson River at Forth-sixth Street, that marked the beginning of harbor improvement which it is claimed by its initiators will place New York on a par in accommodations for shipping with the great harbors of the world. Other piers of equal length are planned, and eventually the entire Hudson River waterfront, city officials predicted to-day, would be re-built for the accommodation of the great ocean liners of the future.

COAST TO COAST.

Hamilton, Ont.—About one mile of Hydro street-lighting has recently been turned on in Hamilton on Barton Street.

Vancouver, B.C.—Preliminary work on the overhead bridge to be erected by the C.P.R. to produce Granville Street to the waterfront is well advanced.

Regina, Sask.—The report of Superintendent Venzke, of the civic Parks Department shows that 8⅓ miles of new boulevards were graded last year in Regina.

Moose Jaw, Sask.—Another street car service has been formally opened in Moose Jaw, e.g., the car line built to Boulevard Heights, about two miles from the centre of the city.

Ottawa, Ont.—It is stated that the surplus over operating expenses on the I.C.R. will exceed this year by a considerable amount the million dollar mark. Last year's surplus did not attain the million mark; but since rates have been raised, and traffic has increased.

Owen Sound, Ont.—Owing to an extraordinary expenditure upon bridges during the past year, the County Treasurer, Mr. S. J. Parker, has stated to the Council that, in his opinion, the treasury will show a deficit of about $10,000 at the end of the year.

Regina, Sask.—In the recent report made by Superintendent McKay, of the Waterworks Department, it is shown that 101,281 feet of water pipe have been laid under contract during the last ten months, and 2,941 lineal feet of pipe by day labor, making a total length of pipe laid in the city of 104,222 feet, or approximately 20 miles.

Ottawa, Ont.—The last connecting rail has been laid between Quebec Bridge and Yellowhead Pass, no particular ceremony being connected with the event. Though the laying of steel is by no means the final act in completing a line, authoritative information has been given to the effect that when traffic at Winnipeg is offered, the railway will be able to handle it.

Regina, Sask.—The Waterworks Department has shown very economical management during the past year, $17,000 less than the estimated amount of $59,670 having been expended. The estimated capital expenditure of $546,178.70 was also in excess of the actual expenditure of $496,082.06. The operation of the waterworks system showed a profit of $57,327.33, which gives a net surplus of $4,570.69 after debenture charges are deducted.

St. Catharines, Ont.—During the year thus far, building permits of approximately three-quarters of a million dollars have been granted in St. Catharines. A like amount has been expended on local improvements. The expenditure on new constructive work during 1913 will thus be in excess of $1,500,000 within this city; and on the new Welland Ship Canal construction in close proximity to the city, contracts amounting to $34,000,000 have already been let.

Le Pas, Man.—The first trial of the receiving instruments at the wireless station signals has been made, and Operator E. Richards reports signals obtained from Sayville, N.Y.; Arlington, near Washington, D.C.; Cape Cod, Mass.; Glace Bay, N.S.; and also from the stations on the Pacific Coast of the United States; so that this station can hear what is transpiring at both sides of our continent. The signals from all stations on the lake shores can be distinctly heard, and also from most of the boats on the lake.

Fort William, Ont.—The excavating of a tunnel under the main building of the Canadian Car and Foundry Company in connection with the construction of Stanley Avenue sewer has been commenced. The tunnel must be driven approximately 160 feet under the building, and a shaft will have

to be sunk in the centre of the floor of the building which will allow four gangs of men to work simultaneously, two gangs at the bottom of the shaft, one working west, the other east; and two gangs, one at either end of the tunnel working centrewards.

Victoria, B.C.—Several small forces of men are already engaged on the north-west sewer construction at different points along the ravine which runs from Burnside Road down to the Gorge Road and thence to Selkirk water. Arrangements with the C.N.P. Railway for the right-of-way are expected to be successfully concluded so that no delay or postponement of the work will be occasioned, and so that the whole work may be opened in this section in a short time. The next section of the undertaking to be commenced will be the Esquimalt section; and on this excavation work will be more difficult, owing to the more rocky nature of the district.

Estevan, Sask.—The experimental plant at Estevan, which the Saskatchewan Government has just lately finished erecting for the purpose of determining the exact value of lignite coal for power purposes, briquetting, etc., is in operation under the management of Mr. S. M. Darling, a well-known expert, under whose supervision the plant has been erected. Mr. Darling has shipped a car of "carbonized lignite fines" to Cape Breton, where this product will be tested as a powdered fuel in the Bettingen boilers of the Dominion Coal Company's plant. The larger sizes of the carbonized lignite it is the intention to use in gas producers to generate electrical energy, and in chain grate furnaces for steam power. It is expected that the result of these tests will solve the power problem of Saskatchewan.

Regina, Sask.—Good progress on the power house under construction at Regina has been reported by Superintendent Bull. The building walls, machine foundations, and a small part of the floor in the boiler-room of the new power house have been completed. Partial equipment of machinery boilers and piping is awaiting installation; and it is hoped to have sufficient equipment to operate the first 1,500 k.w. machine installed and housed under a temporary wood building by Christmas. The output of the plant for the past ten months has been 6,017,610 k.w. hours, while for the corresponding ten months of 1912 it was 3,186,938, which shows an increase of 88.8 per cent. The capital expenditure for the ten months was as follows: on the new power house by-law, $132,418.71, of which $18,994 has been in wages; on the by-law for electric light and power extension, $129,589.71, of which $16,688.10 has been paid in wages.

Vancouver, B.C.—Eight of the nineteen steel bridges on the British Columbia section of the Canadian Northern Pacific Railway have been completed, and are available for traffic. Of the remaining eleven, three are at present well under construction, and another has been commenced near Jackass Mountain, 126 miles east of Port Mann, at the present end of steel. One of the three bridges is at Lytton, where the C.N.P. line crosses the Fraser River a mile below the town. It will be 870 feet long, and will be constructed with four plate girder spans and three deck truss spans. Its foundations have been completed, and its superstructure well advanced. A 250-foot viaduct is being constructed in the Black Canyon, 189 miles east of Port Mann, and will be a 210-foot through truss span with a deck plate girder. At mile 81 on the section of the C.N.P. north of Kamloops, a 600-foot bridge is being erected over the North Thompson River at Birch Island, which will have seven spans. Late reports from the engineers in charge state that four of the spans have been placed, and traffic is being handled over the river to mile 90, the present end of steel, by means of a temporary structure.

Regina, Sask.—City Engineer McArthur has furnished a report of the works completed by his department during the past year. A total area of 140,288.5 square yards of pavement at a total cost of $481,372.12 have been laid. Of this area, 80,874.8 square yards are bitulithic; 58,922.6 square yards, sheet asphalt; and 421.1 square yards, Westrumite. The length of pavement would be about 8 or 9 miles, though the width for residential streets is 24 feet, and otherwise 32 feet. The total length of sewers laid in the city, including the work done on the contracts of the previous year, was 96,936.3 lineal feet, or approximately 18½ miles; and the total cost, $553,731.84. The total current expenditure of the department, which includes repairs to pavements, walks and sewers, street grading, street cleaning and salaries, was $85,174.65, which was about $7,200 over the estimated expenditure for this department. The total expenditure of all the work carried on under the department during the ten months totalled $1,226,939.36. The total engineering expenses, including salaries for the entire staff and inspectors and all office expenses and supplies, came to $23,643.68, being less than two per cent. of the cost of the work.

Calgary, Alta.—City Electrician Brown submitted on November 27th to Commissioner Graves a report on the estimated receipts and the expenditures for the municipal electric department. The total estimated revenue is given as $575,000; the total estimated expenditure, $545,053.01, leaving an estimated surplus of $29,946.99. Commissioner Graves proposes to use this surplus to help pay for the placing of wires underground. Electric light and power rates are now very low in Calgary, and placing the wires underground will add both security and an improved appearance to the city. An approximate estimate of the required electric light extensions for 1914 was also furnished to the commissioner by Mr. Brown. Approximate costs for these amounted in all to $350,000, the money to be secured by the customary by-law.

Kamloops, B.C.—Recently the Hon. F. W. Aylmer, Dominion Government engineer at Chase, had a conference with City Engineer Wilson, of Kamloops, concerning the proposed wharf extensions and promenade along the Riverside Park waterfront. It is expected that the government may consider, in addition to what it will be asked by the city to undertake in the work the erection of a permanent concrete wall along the waterfornt of Riverside Park and the dredging of the river, leaving the city to complete the decking, etc. This would give Kamloops one of the finest river wharves in the Dominion, besides affording easy and safe navigation to steamers at all stages of the water, as well as providing a park promenade and "embankment" that would be well in keeping with the ornamental plans of Riverside Park, as approved by the city, and a magnificent river frontage that would be second to none in the West.

Vancouver, B.C.—Mr. M. Swan, M.I.C.E., M.I.M.E., M.C.S.C.E., at one time engineer for the Montreal Harbor Board, and recently returned from South America, where he has been engaged as a government consulting engineer, has made a personal inspection of Vancouver harbor, and also the sites of harbor projects for Greater Vancouver, and has submitted a report to the Vancouver Harbor Commission. He states that Vancouver has in embryo the finest harbor in the world, and that no expense should be spared in developing it and providing proper facilities. He emphasizes the necessity of securing an eleavtor site and of erecting at once at least a small elevator. He recommends unhesitatingly the widening of the channel to 1,400 feet with a depth in the main channel at low tide of 40 feet. He says that the harbor lines along False Creek should be sharply defined without further delay, and the channel dredged; but points out very emphatically that the dredging must not endanger the basements of the bridge piers now existing. He urges the government to secure water frontage wherever it may be had on the shores of Burrard Inlet or False Creek; and, in re-

ferring to Greater Vancouver harbor propositions, he warns promoters to make careful tests to be certain that the works will not be endangered by quicksands.

Regina, Sask.—Superintendent McKay, in his recent report on the work of the Waterworks Department of Regina during the past operating year, urges the construction of a new 27-inch main from Boggy Creek to the city in the coming year. Considerable progress has been made at Boggy Creek throughout the past year. The Tohill 5,000,000 reservoir was completed and filled. This reservoir is at such an elevation above the city that the gravity pressure is sufficient for ordinary pressure. 3,525 feet of vitrified tile pipe have been laid in the Boggy Creek basin for the collection of water, bringing the total length of collection lines up to 10,925 feet. Twenty wells have been sunk, bringing the total to date up to 35 wells, of which 33 are yielding water, the other two being plugged with sand. The duplicate Crossley engine and Allan pump installed in the pumping-house this year gives two units, either of which is able to deliver the whole city's supply. The new 5,000,000 gallon capacity pump will be nistalled at the city power house this year, but in the opinion of Superintendent McKay it will be necessary to use it only for fire purposes.

Vancouver, B.C.—Steel structural operations are reported as started on the overhead bridge to be built by the Canadian Pacific Railway from the foot of Burrard Street to the waterfront in connection with the other units of its terminal improvement scheme. Material is being assembled and work is well under way with piers, the foundations for which have been ready some time. The footings for a portion of the new structure have been already set, but until the immigration sheds are removed it will not be possible to complete the dock-end of the viaduct. However, tenders for the new immigration building have been called; and when this has been completed, the old sheds will be removed. The viaduct will be a substantial structure. The steel bents will be set in concrete piers on concrete foundations. It will be about 300 feet long and 50 feet wide, with a ramp on an easy incline to afford communication with the dock levels. Until the immigration sheds are demolished and the necessary space afforded at the north end of the bridge the viaduct will only be available for pedestrian traffic. Steps will lead from the docks to the waterfront end of the bridge.

CORRECTION.

In the article, entitled "The Rotary Type Air Pump," on page 817 of December 4th issue of *The Canadian Engineer*, the illustration, Fig. 2, showing an interesting installation of a 4,000 K.W. Surface Condensing Plant, appears inverted. We trust the reader will mark it as such without delay, so that a future reference to it will not be misleading.

PERSONAL.

W. A. CLEMENT, engineer of South Vancouver, has tendered his resignation to the Municipal Council.

PATRICK WELCH, of the firm of Foley, Welch & Stewart, prominent railway contractors on the Pacific Coast, is dangerously ill at Seattle.

E. A. JAMES, C.E., of James, Loudon and Hertzberg, consulting engineers, Toronto, has been elected to the standing of member in the American Society of Civil Engineers.

ANGUS SMITH, late City Engineer of Regina, Victoria, and North Victoria, has been chosen by the City Council of Prince Albert to succeed City Engineer M. H. Baker, resigned.

W. L. COULSON, who for several years past has been general manager of the Canadian Collieries (Dunsmuir), Limited, has resigned from that position in order to obtain the rest necessary for his health.

T. C. KEEFER, C.M.G., Ottawa, who was recently elected an honorary member of the American Society of Civil Engineers, and a few months previous, of the Institution of Civil Engineers of Great Britain, entered upon his ninety-third year a few days ago.

GEORGE WESTINGHOUSE was formally awarded the Grashof medal at the annual meeting of the American Society of Mechanical Engineers in New York last week. This is the highest honor which the engineering profession in Germany can bestow upon any individual.

HILDER DAW, A. M. Can. Soc. C.E., has been engaged by the city of Sherbrooke, Que., to revise the existing plans and to design an adequate system of sewers for the city. Mr. Daw has had some years' experience in England upon drainage and sewage purification work, and has spent seven years in America upon similar work.

The City Council of London has appointed Hon. Adam Beck and Mr. Phillip Pocock, chairman of the Water Commission, for a term of two years, and Messrs. William Spittal and M. D. Fraser, for a term of one year, as Commissioners to electrify and operate the London and Port Stanley Railway. Mayor Graham is an ex-officio member.

GORDON KRIBS, the contributor of the first article in this issue, will be remembered by many of our readers as a graduate, with the class of '05, in engineering of the University of Toronto. He was then associated with the firm of Smith, Kerry & Chace, and for several years managed a branch office of that firm at Portland, Ore. Since then he has resided in Dallas, Texas, as assistant chief engineer of the Texas Power and Light Company.

R. P. D. GRAHAM has been appointed Canadian sales manager of the Goodyear Tire and Rubber Company, succeeding P. D. Saylor. Mr. Saylor, who won an enviable reputation while at the head of Canadian sales of both tire and mechanical rubber goods, has been advanced to the presidency and managing-directorship of Goodyear Tire and Rubber Company (Great Britain), Limited, with headquarters in London, Eng. While regretting his departure from Canada, Mr. Saylor's many friends are delighted by his appointment to such an important position. He will now have charge of all Goodyear sales throughout the world with the exception of the American continent.

PHIL. H. MOORE, who was formerly engineer of the McKiernan-Terry Rock Drill Co., of New York, and who has been for some time past sales manager of the cement mill and mining machinery department of Canada Foundry Company, has resigned to become general manager of Rock and Power Machinery, Limited. The last named firm is a new concern organized by Mr. Moore and four well-known Canadians to act as sole Canadian sales agents for a number of United States manufacturers of rock drills, crushers, hoists, pumps, concrete mixers, mining machinery, etc. The head office will be in the Royal Bank Building, Toronto, with sales offices in the King Edward Hotel, Toronto, and in Montreal, Winnipeg and other cities.

E. H. BENNETT, Chicago, has been engaged by the Ottawa and Hull City Planning Commission to take charge of the replanning of these two cities. E. L. COUSINS, engineer Toronto Harbor Commission, was appointed to assist him. As announced in this journal some months ago, the Commission propose to prepare a comprehensive plan for the enlargement and beautification of these cities and surrounding territory, the plan to include park schemes, arrangement of governmental and civic buildings, and indus-

trial sites, a treatment of the waterways, etc. The preparation of these plans constitute the work of the Commission. It is being financed by the Government and the cities, the Government to pay 50 per cent. of the cost, the city of Ottawa 40 per cent. and Hull the remainder.

ADAM CAMERON, M.A., B.Sc., who succeeds Prof. C. M. Carson as head of the Department of Chemistry at the University of New Brunswick, Fredericton, N.B., Professor Carson having resigned to become Professor of Chemistry at the Michigan College of Mines, has recently assumed his official duties.

Professor Cameron was born in Perthshire, Scotland, and as a student had a distinguished career at the University of St. Andrew's, where he later held the Carnegie Research Scholarship. In conjunction with Professor J. C. Irvine, of that University, he conducted valuable research on the sugars, the results of which work were published in the Transactions of the Chemical Society. Later, as assistant to Dr. James Walker, Professor of Chemistry in the University of Edinburgh, he spent five years of active study and research. He comes to Canada direct from the University of Edinburgh, and will be a valuable asset to the Department of Chemistry in the University of New Brunswick.

Adam Cameron, M.A., B.Sc.,
Professor of Chemistry, University of New Brunswick.

T. R. DEACON President and General Manager of the Manitoba Bridge and Iron Works, was, by acclamation, re-elected mayor of the city of Winnipeg on December 2nd.

The Shoal Lake water scheme of the Greater Winnipeg Water District, as it now stands, having successfully passed the periods of contemplation and discussion and reached the stage where actual engineering work is in progress, is the result of the untiring energy which Mr. Deacon has put into it. The furtherance of the scheme is largely accountable to him and his achievements in this respect are remarkable, considering the gigantic proportions of the enterprise, and a good deal of adverse opinion which had to be overcome.

Mr. Deacon graduated from the School of Practical Science, Toronto, with the class of 1891. He followed his profession of civil engineering for eleven years, during which period he was for a time town engineer of Rat Portage (now Kenora), Ontario. In 1902, he founded the Manitoba Bridge and Iron Works at Winnipeg, and since that time has taken a very prominent part in the municipal and administrative duties as a citizen. In 1907, he became a member of a commission to investigate the water supply of the city. Three years later, he was a commissioner in connection with the Workmen's Compensation Act. For two years he was Provincial Vice-President of the Canadian Manufacturers' Association, and for four years a member of the Council of the Winnipeg Board of Trade.

The admirable combination of finance, commerce and engineering, of which it is his good fortune to have such a composite knowledge, fits him well for the position which he now holds, and his re-election by acclamation to the chief executive chair in Winnipeg civic administration, is an indication of the evidences of his efficiency and capability to handle, among other things, the great undertaking upon which Winnipeg is entering to procure a safe and sufficient water supply.

BACK COPIES WANTED.

One of our subscribers, anxious to bind his copies of *The Canadian Engineer*, is minus the following issues: Feb. 19th, 1909; Jan. 19th, 1911; Jan. 26th, 1911; Feb. 9th, 1911; March 16th, 1911; March 30th, 1911; April 6th, 1911; April 13th, 1911; April 20th, 1911; April 27th, 1911; May 4th, 1911; May 11th, 1911; May 18th, 1911; May 25th, 1911; June 1st, 1911, and would be glad to pay 25 cents per copy for any of them. Will subscribers who happen to have these numbers, and who do not care to keep them, kindly send them in to this office, and we will see to it that they are put into the hands of the party interested?

OTTAWA BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The Ottawa Branch of the Canadian Society of Civil Engineers held its annual dinner at the Chateau Laurier on December 4th, and the function was well attended. Mr. Geo. A. Mountain, president of the Branch, presided, and his associates at the head table were Prof. Adam Shortt, Collingwood Schreiber, Lieut.-Col. Anderson, G. J. Desbarats, D. McPherson, T. C. Keefer, Mr. A. St. Laurent, and G. A. Mothersill.

COMING MEETINGS.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—Annual Meeting to be held in New York, December 10th to 13th. Secretary, C. D. Odsen, Polytechnic Institute, Brooklyn, N.Y.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—Seventh Annual Convention will be held at Great Northern Hotel, Chicago, December 29th to 31st. Secretary, I. W. Dickerson, Urbana, Ill.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

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ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20907—November 25—Authorizing G.T.R. to construct extension to its siding into premises of Manley Chew, on Lot 21, Con. 3, Tp. Tay, Co. Simcoe, Ont.

20908—November 27—Authorizing C.N.R. to remove spur to Exhibition Grounds, City of Brandon, Man., constructed under Order No. 18348, dated December 20th, 1912.

20909—November 28—Extending, until Dec. 31st, 1913, time within which B.C. Electric Ry. Co. complete work at crossing of tracks of Esquimalt and Nanimo Ry. Co., near Russell, B.C., as required by Order No. 18733 dated Feb. 18th, 1913.

20910—November 27—Authorizing C.P.R. to construct spur for Pembroke Shook Mills, Limited, Pembroke, Ont., from a point on Southwesterly limit of right-of-way of C.P.R. at mileage 106.5 from Ottawa, Chalk River Sub. Div., Eastern Div., into premises of Pembroke Shook Mills, Limited, in Lot 18, Con. 1, Tp. Pembroke, Ont.

20911—November 29—Anthorizing G.T.P. Branch Lines Company to carry traffic over portion of Mountain Park Coal Branch, Alberta, between mileage 0 and 30.24; trains be limited to a speed not exceeding 12 miles an hour.

20912—November 25—Directing that special eastbound tariff rates from Vancouver, B.C., published by C.P.R. from time to time, to apply to carload shipments of lumber, shingles, and articles taking lumber and shingle rates, shall, with addition of not more than 1c. per 100 lbs., apply as joint rates from stations between Vancouver and New Westminster on line of V.V. and E. Ry. and Nav. Co., (operated by G.N.R.), to carload shipments of same articles, to same points, which are routed via Vancouver or New Westminster and C.P.R., or C.P.R. and railways connecting therewith. G.N.R. receive not less than 2½ cents per 100 lbs. to Vancouver or New Westminster as its proportion of said joint rates. C.P.R. furnish new rates from Vancouver, together with regulations and conditions pertaining thereto, to G.N.R. so that new joint rates from said stations of V.V. and E.R. and N. Co. become lawfully effective, simultaneously with new rates from Vancouver to same points. Rescinding Orders Nos. 7277 and 9187, dated 16th June, 1909, and 7th January, 1910, respectively.

20913—November 28—Amending Order No. 20411, dated September 23rd, 1913, by striking out words, "within ninety days from date of this Order," in first line of paragraph 1, operative part of said Order, and substituting therefore words, "when its railway is ready for operation."

20914—November 28—Authorizing C.P.R. to construct Lacombe-Easterly Branch of Calgary and Edmonton Railway across two (2) highways, namely,—1. West Boundary, mileage 181.93 N.W. ¼ Sec. 19-33-28, W. 3 M. 2. West Boundary, mileage 186.01, N.W. ¼ Sec. 23-33-28, W. 3 M.

20915—November 29—Authorizing C.P.R. to construct, by means of grade crossing, across highway in Lot 109, (Provincial Government Survey), East Kootenay District, B.C., at mileage 64.32.

20916—November 29—Authorizing C.P.R. to construct road diversion in Sec. 27-8-8, W. 3 M., Sask. Also construct Weyburn-Stirling Branch across highway between Secs. 27 and 28-8-8, W. 3 M., Sask.

20917—November 29—Amending Order No. 18457, December 30th, 1912, by striking out words, "J. J. Wells, Assessment Commissioner of Fort William," in lines 2 and 3, paragraph 3 of Order, and substituting therefor "Hugh O'Leary, Esquire, Senior Judge, Dist. of Thunder Bay.

20918—November 29—Approving revised location C.N.O.R. through unsurveyed territory at Clemow Lake, Tp. Barron, Dist. Nipissing, Ont., mileage 133.45 to 134.75.

20919—November 29—Authorizing C.N.O.R. to open for traffic branch line, Oshawa Station to material yard, south of William St., town of Oshawa, Ont., a distance of 2¾ miles.

20920—November 28—Authorizing C.N.R. to construct spur for Laurentia Milk Co., town of Battleford, Sask.

20921—November 29—Extending, until April 1st, 1914, time within which subway be completed at Thompson Road, Tp. Bertie, Ont.; pending completion of subway, G.T.R., at own expense, employ day and night watchmen at said crossing.

20922—November 29—Authorizing G.T.R., to operate trains over interlocking plant, St. Lambert, Que., without first being brought to a stop.

20923—November 27—Authorizing G.T.R. to construct highway between Secs. 27 and 28-35-14, W. 3 M., Sask., across main line at M. 523.6.

20924—November 28—Authorizing V.V. and E. Ry. and N. Co. to open for traffic double track between mile post 145.84 and 153.619, B.C.

20925—November 25—Adding rating of 4 the class for peanut butter in carloads, to Canadian Freight Classification, said amendment be included in proposed Supplement No. 2 to Canadian Freight Classification No. 16, submitted by Canadian Freight Association for approval by the Board.

20926—November 29—Authorizing C.N.O.R. to construct transfer tracks between Oshawa Railway Company and Oshawa spur of C.N.O.R., east side of Lot 9, Con. 11, town of Oshawa, Ontario.

20927—November 29—Amending Order No. 20647, by striking out paragraph 3 and substituting following:— 3. Applicant Company put pipes in larger pipe-casing in such way that they may be withdrawn for repairs; and reserving right to make necessary repairs to Grand Valley Railway Company.

20928—December 2—Approving and authorizing clearances as shown on plan of Montreal Ice Company, Limited's buildings at siding of Canadian Pacific Railway, village of Como, Que., subject to condition that men be kept off sides of cars while operating said sidings.

20929—December 1—Authorizing C.P.R. to open for traffic portion of deviated line at Bridge No. 39.49, North Bay Subdivision, Lake Superior Division, Ontario.

20930—December 1—Authorizing C.P.R. to open for traffic Boissevain Lauder Branch, Man., mileage 00 to 36.4.

20931—December 2—Approving plans showing automatic signals to be applied on portions of C.P.R. Company's Eastern Lines, namely:—1. Montreal Junction to Iberville Junction, Montreal Terminals Farnham Subdivision; 2. West Toronto to Islington, London Subdivision; 3. Markstay to Stinson, Cartier Subdivision; 4. Mattawa, North Bay Subdivision and 5. Renfrew to Eganville, Chalk River Subdivision.

20932—December 1—Authorizing C.P.R. to construct, subject to terms of consent of Gus Pech Foundry and Manufacturing Company, spur for city of Regina, Sask., and to alter spur for Gus Pech Foundry and Manufacturing Company, Regina, Sask.

20933—December 1—Approving locations C.P.R. stations on Virden-McAuley Branch, Man., namely:—1. Two Creeks, mileage 13.5, N.W. ¼ Sec. 19-12-26, W. 1 M., and 2, at Harmsworth, mileage 8.7, N.W. ¼ Sec. 33-11-26, W. 1 M.

20934—December 1—Authorizing Tp. Magog, Que., at its own expense, to construct highway crossing over C.P.R. at Lot No. 4b, Rge. 21, Tp. Magog, Que.

20935—November 29—Authorizing C.P.R. to construct spur for Halliday Bros., Winnipeg, Man.

20936—December 1—Extending for a period of 30 days from date of this Order, time within which G.T.R. install bell at crossing of Mill St., Milverton, Ont.

20937—December 1—Authorizing G.T.P. Ry. to construct spur for James Latimer, Edmonton, Alta.

20938—December 1—Authorizing C.N.O.R. to construct its ballast pit spur across 2 highways, Tp. Gloucester, Co. Carleton, Ont.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Burlington Channel, Ont., pier.	Dec. 15.	Nov. 20.	82
Caldwell's Cove, N.S., breakwater	Dec. 15.	Nov. 27.	82
Calgary, Alta., machinery, etc.	Dec. 31	Nov. 13.	88
Grand Mechins, Que., extension to wharf	Dec. 22.	Dec. 4.	80
Halifax, N.S., and Esquimalt, B.C., stores for dockyards.	Dec. 1, 3, 15.	Nov. 20.	82
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., coaling plants, etc.	Jan. 7.	Nov. 13.	86
Ottawa, Ont., ice-breaker	Jan. 8.	Nov. 27.	84
Pritchard, B.C., wharf	Dec. 15.	Nov. 27.	82
Rimouski, Que., wharves and dredging	Dec. 22.	Dec. 4.	80
Toronto, Ont., mechanical filtration plant	Jan. 20.	Nov. 27.	88
Toronto, Ont., travelling crane.	Dec. 16.	Dec. 4.	88
Toronto, Ont., asphalt, paving blocks, etc.	Dec. 16.	Dec. 4.	88
Toronto, Ont., 36-inch water main	Dec. 16.	Dec. 4.	90
Winnipeg, Man., motor hose-wagons, etc.	Dec. 15.	Nov. 20.	82
Winnipeg, Man., water supply		Oct. 16.	86
Yorkton, Sask., electric machinery	Dec. 22.	Nov. 13.	86

RAILWAYS—STEAM AND ELECTRIC.

Hamilton, Ont.—It is believed that Engineer Royce's recommendation to the Ontario Railway Board will be to give Mr. G. F. Webb three weeks in which to put the east end incline into operating condition, and hope is entertained that the mountain situation will be solved by New Year's Day.

London, Ont.—The city council has given its ratification of the commission to operate and construct the electrified London and Port Stanley Railway. The motion was passed appointing Messrs. Beck, Pocock, M. D. Fraser and Alderman Spittal.

London, Ont.—As a result of two resolutions passed at the last session of the Middlesex county council, the Hydro-Electric Power Commission of Ontario will be petitioned to conduct surveys, supply estimates of cost of construction and maintenance on two electric radial lines within the county. One proposed line is from London to Stratford via St. Marys; and the other, from London to Grand Bend.

+—Montreal, Que.—The Montreal and Southern Counties Railway Company has awarded the contract to the NATIONAL STEEL COMPANY of Hamilton for six new passenger coaches with the latest equipment and five feet longer than the cars now in use; also for two trailer cars and two express cars.

Ottawa, Ont.—The cost of building the new St. Lawrence and Ottawa Electric Railway was announced to be between seven and eight million dollars, and it is understood that the bonds of the company will be placed for sale on the English market before next spring. It is believed construction work on the Britannia line to the South March Rifle Ranges will be started early next summer. Work of building the Morrisburg and Ottawa branch of the road will also likely be commenced next spring. It is also understood that a private right of way will be purchased to bring the interurban cars to the city terminal.

Ottawa, Ont.—The new Canadian transcontinental railway company will be capitalized for $1,000,000,000, large financial interests being at its disposal both in New York and in London. The line is to run from Cape St. Charles in Labrador to Dean Inlet on the Pacific Coast; and all arrangements have been completed for its incorporation at the next session of Parliament.

St. Catharines, Ont.—The Grantham township council has passed a by-law allowing Messrs. Baldry, Yerburgh and Hutchinson, contractors for No. 2 section of the Welland Ship Canal, the privilege of laying a single railway track on the road allowance between the 5th and 6th concessions for a period of five years.

St. Thomas, Ont.—The outcome of the meeting of the street railway committee of the city council was the decision that no by-law asking for funds to improve the street railway roadbed will be submitted to the people at present.

St. Thomas, Ont.—Railway directors of the London and Lake Erie Transportation Company have inspected the proposed route of the extension of the company's line from Union to Sparta, and have expressed themselves as well pleased with the future prospects of the line, which is planned to run through the centre of the most important fruit-growing district in Elgin county.

GARBAGE, SEWAGE AND WATER.

+—Assiniboia, Man.—The following tenders for sewer construction in the Deer Lodge sub-division have been awarded by the council of the municipality of Assiniboia:—Mandeville Street, W. H. WARRACK, $3,937.25; Guildford Street, MOEN, SWEENEY AND HORN, $4,204.60; Sharp Boulevard, JACKSON AND SONS, $6,204.75; Conway Street, C. VANHORRENBECK, $9,969.40.

Calgary, Alta.—The city will soon be in the market for water meters. A. W. Ellson Fawkes is city waterworks engineer, from whom all information can be obtained regarding quantities, etc.

Cornwall, Ont.—A deputation from Cornwall has waited upon the Ontario Government to seek a measure of aid in respect to two drainage schemes in which the township of Cornwall is involved. The government consented to take the debentures at 4 per cent. for the Dixon Creek drain, and will consider the Stoney Creek scheme.

+—Kingston, Ont.—The utilities committee has awarded the contract to the DIETRICH CONSTRUCTION COMPANY to lay conduit main from the power house on Queen Street to Princess Street.

London, Ont.—The city council has decided to resubmit to ratepayers in January the waterworks-hydro separation by-law. The by-law calls for the council to cease its control of the waterworks and to hand back the administration of the department to the water commission.

▲—Ottawa, Ont.—Tenders will be received up till February 3rd, for about 42 miles of welded steel pipe of 54-inch internal diameter, about 32 miles of welded steel pipe of 58-inch internal diameter, and about 11 miles of welded steel

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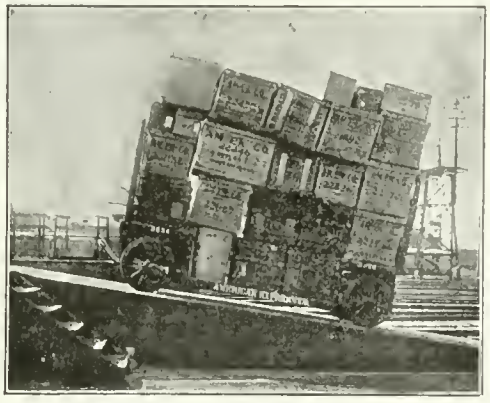

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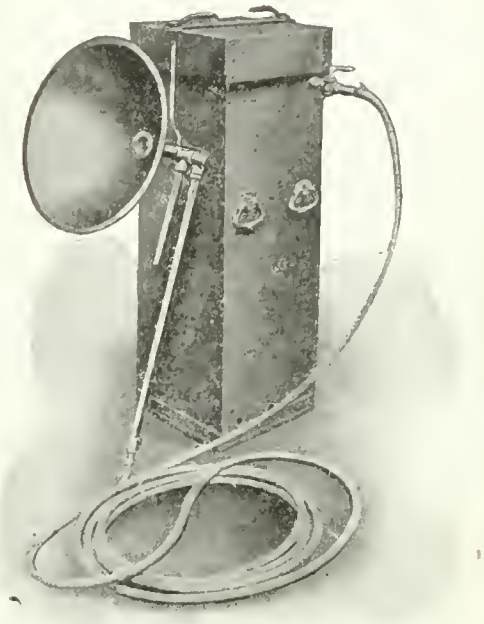

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pipe of 51-inch internal diameter. Plans and specifications may be from the City Engineer of Ottawa, or from Sir Alex. Binnie, Son and Deacon, St. Stephens House, Victoria Embankment, London, S.W., Eng. Signed, Sir Alex. Binnie, Son and Deacon.

Port Arthur, Ont.—After examining Port Arthur's new sewage plant and plans for extension, Mr. Fuller, of New York, the greatest authority on sewage and waterworks systems in North America, approved before a special meeting of the board of control the plans of City Engineer Jones and Mr. T. Aird Murray, of Toronto.

Port Arthur, Ont.—The by-law providing for the extension of the sewerage system in Port Arthur, and for the issuance of debentures for $53,740 to cover the cost, has been prepared for submission to citizens, and has been advertised.

▲—**Toronto, Ont.**—Tenders will be received up till December 16th, 1913, for the construction of sewers on a number of city streets. Plans and specifications may be obtained from the office of the Commissioner of Works, Toronto. Signed, H. C. Hocken (Mayor), Chairman, Board of Control.

▲—**Toronto, Ont.**—Tenders will be received up till December 15th for the construction of a sewer on Kennedy and Barrie Avenues, in the Township of York. Plans and specifications may be obtained from the office of the township engineer, Mr. Frank Barber, 57 Adelaide Street East, Toronto, Ont.

Victoria, B.C.—City Hall officials believe that the Victoria Council will reject the new tenders for rivetted steel pipe work in connection with the Sooke Lake water system, and will undertake the project by day labor.

Victoria, B.C.—Since the decision of the city council to carry out the construction of the pressure pipe from Humpback reservoir to the city by day labor the water commissioner and consulting engineer have been engaged in looking into the matter, and into the prospects of either purchasing and extending the plant started at Thetis Cove, Esquimalt harbor, by the Westholme Lumber Company, or else starting a new plant. Unless the receiver for the company will sell at a modest figure, a new undertaking will be initiated, and the work put in hand, its completion entirely depending on what financial arrangements can be made, the same financial problem applying to its prosecution by day labor as would have been experienced by contract.

LIGHT, HEAT AND POWER.

Brantford, Ont.—The Hydro Electric Commission has reported to the township clerk in reference to the supplying of power to residents of the township in the vicinity of Brantford. The commission is in communication with the city with regard to the matter of the city extending its system into the township to the districts desiring power.

Calgary, Alta.—The Eau Claire Lumber Company has decided to increase its plant, and will install two gas-driven electrical generator units, which will develop 1,500 kilowatts, and two large turbines, at a cost of $300,000. The work will not be undertaken until next spring. When the new equipment is installed, the company will be able to develop at least 2,000 h.p. in addition to that which it is at present supplying which is about 1,800 h.p.

Chatham, Ont.—At a special meeting of the city council it was practically decided to purchase the gas and electric light plants of the Chatham Gas Company at a price of $410,000, to be used as a means for introducing and distributing Hydro-Electric power in Chatham.

Edmonton, Alta.—That private corporations believe they can supply electrical energy to the city at a cheaper rate than it now costs the municipal plant to produce it, is evidenced by the fact that four companies are planning to lay proposals before the city council. Three of these concerns propose to place power plants at the mouths of coal mines. J. D. McArthur, president of the Edmonton-Dunvegan and British Columbia Railway, with D. R. Fraser and John Cameron are stated to be at the head of one of the companies. A fourth company is composed of Spokane men, who are planning to put in a hydro-electric plant on the G.T.P., just near the British Columbia border.

Fredericton, N.B.—The Eal River Light, Heat and Power Company have offered to supply electrical power for the public services in Fredericton, at the rate of 2 cents per kilowatt on a long-term contract. The proposition was made to the city council by Messrs. Andrews and Murchie, of St. Stephen, and R. G. Lee, of this city, who appeared on behalf of the company with Elecerical Engineer Prey, of Calais, Me., who had made an investigation of local conditions some time ago and estimated that about 450,000 kilowatts would be used annually in the existing services.

Hamilton, Ont.—Mr. E. I. Sifton, chief engineer of the Hydro, has submitted to the controllers an estimate of $15,490.35 for the installation, maintenance and operation of approximately 1,668 standard 100-watt tungsten lights, and approximately 273 corner 250-watt tungsten lights, in the district east of Sherman Avenue, which has been asked for by a committee of the board of works.

+ **Montreal, Que.**—The contract has been awarded the CANADIAN WESTINGHOUSE COMPANY of Hamilton, for the electrical equipment of an order of cars from the National Steel Company for the Montreal and Southern Counties Railway Company.

+—**Montreal, Que.**—The contract has been awarded the CANADIAN GENERAL ELECTRIC COMPANY by the Montreal and Southern Counties Railway Company for the electrical equipment of the Rougemont sub-power station.

Ottawa, Ont.—At the suggestion of the superintendent of water powers, the Minister of the Interior has placed under reservaion all vacant Dominion land that may be valuable for the development of water power. One of these includes Vermilion Falls on the Peace River, and there are similar reservations in the rivers of Manitoba, Saskatchewan, Alberta and British Columbia.

Ottawa, Ont.—The board of control has considered the municipal gas project for Ottawa and has decided that more definite information as to the comparative cost of gas and electricity for heating purposes must be had before a report is prepared for the city council on the municipal gas proposition.

Ottawa, Ont.—The Economical Light, Heat and Power Company, of Montreal, has written the city clerk, asking that they be allowed to install a gas plant in Ottawa. They have a process for making gas from peat, and they ask from the city permission to install plant and burrow for the pipes. They state they will be able to supply gas at 75 cents per thousand cubic feet.

Ottawa, Ont.—Tenders will be received up till January 8th for heating and ventilation of the Post Office building at Quebec P.Q. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

+—**Toronto, Ont.**—The contract has been signed between the HYDRO-ELECTRIC POWER COMMISSION and the Ottawa and Hull Electric Co. for the supply of 20,000 h.p., the contract to run for 33 years in periods of 13, 10, and 10 years, terminable by the commission at any time on two years' notice. The new price is $14 per h.p., with a graduated reduction to $11 on the following scale:—Up to 5,000 h.p., $14; 8,000 h.p., $13.50; 10,000 h.p., $13; 12,000 h.p., $12.50; 14,000 h.p., $12; 16,000 h.p., $11.50; 18,000 h.p., $11.

Vancouver, B.C.—A report submitted to-day by the chief engineer of the British Columbia Electric Railway Company showed that the company has at the present moment no less than 50,000,000,000 gallons of water in their dam at Lake Coquitlam for power purposes. This will be used to a large extent for the supply of light and power on the north shore of Burrard Inlet.

Walkerville, Ont.—The ratepayers have recently approved of two by-laws relative to the adoption of Hydro-Electric power—eg., the Enabling Act, authorizing Walkerville to enter into a contract with the Hydro Commission; and the by-law authorizing the issuance of debentures to cover the cost of a distributing station. Walkerville expects to contract for 1,500 h.p.

Weston, Ont.—The Weston Water, Power and Light Commission will make a bid for the contracts and extensions for Hydro power to Bolton, Woodbridge and Thistletown. Weston is the nearest distributing sub-station, and has about 13 miles of line from Cooksville. The town will communicate with the Hydro Commission to ascertain if a proposition allowing Weston to handle the needs of the three villages would be favored, and also to see if assistance in financing would be granted.

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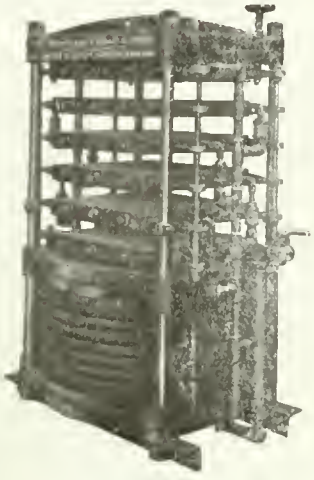

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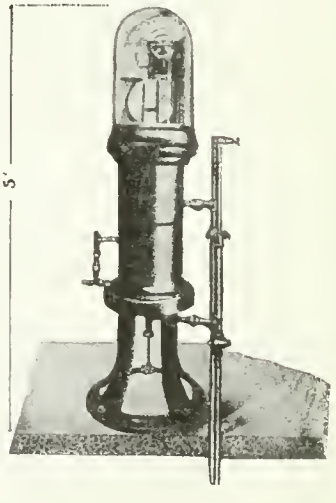

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BRIDGES, ROADS AND PAVEMENTS.

Assiniboia, Man.—The council of Assiniboia has just awarded a heavy paving contract to the BITULITHIC COMPANY, which constructed the Winnipeg-St. Charles Road. The result will be the extension of the present asphalting on Portage Avenue from St. Charles, its present ending, to Headingly, making a continuous road from Winnipeg to Headingly, ultimately to become part of the proposed transcontinental highway. The contract, which is for 90,000 square yards at a cost of $250,000, provides for a width for the first mile and a half past St. Charles of 24 feet, the remaining distance, 5½ miles, to be 18 feet wide.

London, Ont.—It is expected to submit to electors in January a by-law providing for money necessary for the improvement of the proposed east-end market. Chairman G. E. Rose of the market committee and City Engineer Ashplant are reporting on the cost of improvements. A brick, gravel, or concrete bottom will be constructed; also buildings and sidewalks. The city engineer will also report on the cost of paving the uptown market.

London, Ont.—The continuous road idea as proposed by the Dominion Highways Commission has met with the disapproval of the city council, and a committee is preparing a resolution to be presented at the meeting of the commission to be held in London on December 16, after having been approved by council.

Macleod, Alta.—The urgency of requesting the management of the C.N.R. to build two subways in Macleod before the construction work on the new line is started, has been set forth by Mr. J. L. Fawcett, vice-president of the city Board of Trade. Consultation upon the matter will be held with the city council.

+—Ottawa, Ont.—The DICKSON BRIDGE COMPANY has been awarded the contract for Campbellford Bridge at Lock 20, Galops Canal, at the recent session of Cabinet Council.

+—Ottawa, Ont.—The Dominion Government has awarded the contract to McKINNON, HOLMES AND COMPANY for bridges at Black River, Rivière le Bras, Sayabac, Ivory Road and Oxford Subway.

+—Ottawa, Ont.—The contract has been awarded by the Cabinet Council to the CANADIAN ALLIS-CHALMERS COMPANY for the construction of three bridges—at West River, at Barney's River, and at French River, N.S.

+—Ottawa, Ont.—The contract has been awarded by the Cabinet Council to the DOMINION BRIDGE COMPANY for four bridges—over the Becancour River, over the N.T.R. bridge, over the Rivière du Loup and over the Rivière du Sud.

Ottawa, Ont.—City Engineer Currie has written the board of control, stating that the bridge over the Rideau River at Billings' Bridge was in an absolutely dangerous condition, and that he would no longer assume responsibility. He asked that the bridge be closed at once. Concerning the suggestion of repairing the present bridge for use until the new one was constructed, he said that this would cost $8,200, which would be more than the cost of a temporary bridge; and moreover, that the abutments for the new bridge would have to be placed where the piers of the present structure are. Mr. Currie's letter is to be forwarded to the city council with the hope that that body may agree to pay part of the cost of the temporary bridge.

Peterboro, Ont.—The Government has shown its endorsation of the C.P.R.'s proposal to construct a 37-foot swing span in connection with that company's new bridge. The company will, in all probability, proceed with the eastern and western sections of the bridge. The centre span, which will constitute the swing portion of the structure, will not be erected for some months, as it will be necessary to make some extensive alterations to the original plans.

Peterboro, Ont.—Over 800 citizens have signed their names to a petition recently presented to the city council asking for a new bridge across the Otonabee River from the end of Dalhousie Street to Maria Street.

Thorold, Ont.—The municipal council recently decided that Mayor Broderick and Mr. McMann should wait upon Mr. Weller to request the building of a bridge from the G.T.R. station to Regent Street, the present road being both inconvenient and dangerous.

▲—Toronto, Ont.—Tenders will be received up till December 17th, 1913, for furnishing labor and material for waterproofing eight subways at North Toronto. Plans and specifications may be obtained from the office of the Engineer of Grade Separation, 262 Avenue Road, Toronto. B. Ripley, Esq., Engineer of Grade Separation.

Toronto, Ont.—At the last meeting of the city board of control, it was decided to provide labor for the unemployed by spending $250,000 by day labor on the grading of Bathurst and Christie Street hills. Commissioner Harris was instructed to hasten the calls for tenders, and a special meeting of council will deal with the tenders received.

Toronto, Ont.—The board of control has decided to provide the $3,000 required to change the plans of the new bridge of the C.P.R. over the Don ravine east of Leaside. The new bridge is close to the present one and the piers joggle, shutting off a roadway for the projected boulevard belt. Piers are to be changed to provide for the roadway.

Vancouver, B.C.—Tenders will be called on recommendation of the city engineer and board of works for new pavements, the estimated cost of which is over $500,000. Bids will be asked for immediately and will be considered by the committee on December 23.

INDUSTRIAL WORKS.

Fraser River, B.C.—Tenders will, it is expected, be invited within the next six weeks for the second "unit" of the Fraser River jetty; estimated cost, $750,000. Broley and Martin, contractors, will complete the first "unit" in about five or six weeks.

Goderich, Ont.—The county council of Huron has decided to urge upon the Government the completion of improvements to the Goderich Harbor as rapidly as possible. A petition will be forwarded to the Government, and it is probable that a deputation also will be sent to Ottawa.

+—Montreal, Que.—The C.P.R. have let the contract for the driving of ten miles of tunnel in British Columbia to the firm of JAMES A. McILWEE AND SONS of Denver, Colo. The contract price is $8,000,000. Work is to start on January 1, and must be completed within three years. A double-track bore five miles long will be driven under Rogers' Pass, 224 miles west of Calgary. A smaller and parallel tunnel will be driven with cross-cuts to the main survey at every 500 feet, and stations will be established from which headings will be run in either direction. In this manner the tunnel proper will shortly be driven from a dozen different directions. The contract is said to be the largest tunnel construction ever let in America. Construction camps costing $50,000 are now being erected at either portal.

▲—Ottawa, Ont.—Tenders will be received up till December 29th for the construction of a dam across the South Channel of the French River, at the head of Big Chaudiere Falls. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

+—Ottawa, Ont.—At the recent session of the Cabinet Council, the contract for dams and deepening of the channel of the Severn Bridge at Washago, Ont., was awarded to J. RODDICK at a cost of $8,925.

+—Ottawa, Ont.—The Cabinet Council has awarded to the KENNEDY CONSTRUCTION COMPANY the contract for improvements to Lock 20, Cornwall Canal, at $15,491.

Ottawa, Ont.—Tenders will be received up till January 5th for the construction of a wharf at Beloeil Village, Vercheres County, P.Q. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

+—Ottawa, Ont.—The contract has been let to the PACIFIC DREDGING COMPANY for the construction of the turning basin in connection with the Dominion Government's scheme of harbor development at False Creek, the contract price being $100,000.

+—Ottawa, Ont.—The contract for the jetty at La Prairie in connection with the King Edward Highway has been awarded to DURANCEAU & POPOURE, of Montreal, the contract price being $72,678.

Ottawa, Ont.—Tenders will be received up till December 23rd, 1913, for dredging required at Charlottetown, P.E.I. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. Signed R. C. Desrochers, Secretary.

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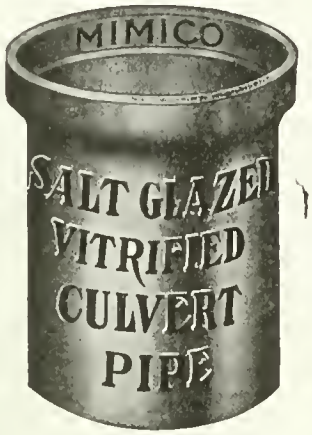

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MONTREAL.

Vancouver, B.C.—Plans for the sea wall across False Creek at Main Street have been approved by the bridges and railways committee, and objected to by Messrs. Champion and White. The matter has been referred to a committee comprised of the chairman, the engineer and the solicitor of the Harbor Commission, for solution. The plans show two slips 150 feet deep besides the city market and Armstrong and Morrison's wharf.

Vancouver, B.C.—An immense deep-water dock scheme is being planned for the south side of False Creek. The cost of the project will run to $250,000 or more. Sites have been secured already for wharves, and supporting the scheme at present is ex-Alderman J. D. McNeill, with a number of capitalists. Mr. McNeill will investigate the latest dockage developments before the scheme for False Creek is actually begun. The proposals as now on foot provide for extensive wharfage in connection with the Dominion Government development of the deep channel, and until the greater shipping expected from the Panama Canal direction begins, the company will run a building supply and coal business as part of the project, using the wharfage to be constructed shortly.

Vancouver, B.C.—At a meeting of the West Vancouver Ferry Company, the subject of strengthening the new wharf at Hollyburn was discussed. The firm of Cartwright, Matheson and Company will be asked to make an estimate of the cost of extending the anchorage space further into the land and of strengthening the structure to withstand the high winter tides. A large amount of dredging will be required.

Vancouver, B.C.—The city council has recommended the construction of sewers on several of the city's streets, and special work in Hastings townsite, alone costing $9,500, as relief work in clearing and rough grading certain streets.

West Vancouver, B.C.—A demand is being raised among the ratepayers of West Vancouver for a new wharf to replace the rough pile wharf now existent.

West Vancouver, B.C.—Plans for a wharf at Dundarave have been approved by Messrs. McAlpine, Robertson & Company, engineers, to whom they were submitted by a deputation consisting of the reeve and councillors of West Vancouver. Tenders for construction will be called for in the near future.

Winnipeg, Man.—A by-law is advertised in Winnipeg to be submitted to ratepayers to create a debt of $85,000 for the purpose of paying the cost of construction of a garbage incinerator plant within the district of Elmwood, Winnipeg.

MISCELLANEOUS.

Brandon, Man.—Dr. Pickard, health officer for Brandon, has submitted a report to the city council on his inspection of incinerators at Moose Jaw and Regina, advocating the erection of a garbage disposal plant at Brandon. He stated that he had an offer from the Decarrie Company to erect a plant here that could dispose of 50 tons of refuse per day, and they guaranteed the cost would not exceed 60 cents a ton. The plant would cost $45,000, and it was estimated that from it 100 horse-power would be developed. Another firm of makers, Heenan & Froude, would erect a plant for $51,400, but they did not attach any guarantee as to the cost of disposal. The council referred the matter to the health committee for thorough investigation and report.

Brantford, Ont.—The United Rubber Manufacturing and Reclaiming Company has purchased a site in Brantford, and the company's general manager, R. G. Wooten, has announced that a building of concrete will be erected early in the spring.

Edmonton, Alta.—In a recent meeting called for the purpose of hearing municipal candidates, Mayor Short, in discussing next year's program of works, referred to the incinerator. He said that a movement is on foot to have a central incinerator, the one situated on the south side being too far away for any great service. The power generated from a central incinerator could be used to operate the street railway department. It is estimated that the plan would save the city about $36,000, and it will be given the serious consideration of council.

Edmonton, Alta.—A check for $300,000 has been paid over to the Alberta Farmers' Co-operative Elevator Company, Limited, representing the Government's loan of 85 per cent. of the cost of 50 elevators now in operation. The remaining $50,000 will be paid the beginning of next year.

Ottawa, Ont.—The contract has been awarded by the Dominion Government to JOSEPH SHANK for the rebuilding of the Council House, Sarnia Indian Reserve, at a contract price of $4,153.

Ottawa, Ont.—Contracts for two boats for Hudson Bay traffic are being let in Britain. These boats are being built by the North Railway Company and will ply between Fort Nelson and Port Nottawa, Quebec. They will be known as the Nottawa and the Nelson, and each will have a carrying capacity of 200,000 bushels of wheat. They will be ready for service in 1915, when the Hudson Bay Railway will be completed.

Vancouver, B.C.—Plans and specifications dealing with the partial reconstruction of the Canadian Pacific steamer Princess Mary have been discussed in a conference between Captain J. W. Troup and the heads of the British Columbia Marine Railway Company. It is understood that the contract for the lengthening of the coasting steamer will be taken in hand without delay.

CURRENT NEWS.

Bellingham, B.C.—Skagit county farmers living near the Skagit-Bellingham interurban will have their homes served with electricity by the Puget Sound Traction, Light and Power Company, and work has started stringing wires for that purpose. The company will extend the service to the Skagit and La Conner flats as fast as business will justify.

Calgary, Alta.—Four new oil rigs are at present being located in the southern Alberta oil fields, and construction work has been started on four derricks, each of which is being built by a different company.

Calgary, Alta.—Mr. Eugene Coste, president of the Natural Gas Company, has stated to the city board of trade that, with the present installed equipment, the company can furnish 15,000,000 cubic feet of gas to manufacturers every 24 hours, which would generate in gas engines 60,000 h.p. at a cost to the manufacturers of from $18 to $18.50 per h.p. President Campbell of the board of trade has given figures to prove that 68,000 h.p. a day can be supplied by the present plants in the city.

Edmonton, Alta.—Two parties of surveyors are in the field on the route of the Alberta and Great Waterways railway and construction will shortly be commenced at a point some twelve miles north of the city, where the line to Fort McMurray will branch off from the main line of the Edmonton Dunvegan railway. The yards of the latter company at Edmonton will be used as the terminals for both lines.

Edmonton, Alta.—Steel is now being laid to within ten miles of Mirror Landing on the Edmonton Dunvegan line and representations will be made to the railway commission to allow a slow train to operate on the line for passengers and freight about the first of the year.

Edmonton, Alta.—The contractors are covering with tar paper and sand the deck of the bridge over the Canadian Pacific Railway at 109th Street at the south approach to the high level bridge. The back filling has yet to be done and it is possible that the filling and paving of approaches and the laying of the block pavement on the deck of the bridge will not be done till spring.

Esquimalt, B.C.—The G. T. P. steamer "Prince John" is at Esquimalt having an oil fuel system installed, and being fitted with a manganese bronze propeller. It is understood that the contract, which is being carried out by the B.C. Marine Railways Co., will be put through with all possible speed in order that the vessel may be delivered back to her owners by the early spring in readiness for the early rush to Northern British Columbia.

Port Arthur, Ont.—Work is being rushed on the new freight steamer at the Western Drydocks in Port Arthur. The big 625 foot hulk is commencing to assume shape. The steel frame work is completed with the exception of part of the stern and the plates are now being rivetted together. It is expected that the big shoe will be placed at the stern in a few days when everything will then be in shape for the rushing of the work to completion. It is expected to launch the new steamer towards the latter end of March.

MEXICAN EAGLE ASPHALT

TRADE MARK

Delivered to meet the specifications of the American Society for Municipal Improvements, the Association for Standardizing Paving Specifications or any other standard specifications

Purchase MEXICAN EAGLE ASPHALT because:

1—It is more cementitious than other asphalts.

2 Water will not readily injure it.

3—Exposure to sun and air will not cause its deterioration.

4—It has great cohesive strength.

5—It is more ductile and flexible than other asphalts.

6—Shocks will not crack it. It is very malleable.

7—We will supply asphalt having the proper penetration for your needs.

8—It is best adapted to Canada's climate—will not mark in hot weather—nor are snow or ice likely to crack it.

9—It has over 99 per cent. bitumen. Purest on the market—therefore free from deleterious matter.

10—It is so constituted that it will not be injured by the heat necessarily applied to melt it for paving operations.

Samples, prices, analyses, etc., on request.

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

TENDERS CALLED FOR

NOTICE TO CONTRACTORS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon, on Tuesday, December 16th, 1913, for the construction of the following works:—

SEWERS.—

Annette Street, from Quebec Avenue to Runnymede Road. Blackburn Avenue, from Gerrard Street to Mount Stephen Street. Clifford Street, from Walnut Street to Niagara Street. Danforth Avenue from Hillingdon Avenue to Woodbine Avenue. Gerrard Street and Hiawatha Road to Gerrard Street and Eight Avenue, via Gerrard Street, Coxwell Avenue and Gerrard Street. Lane 1st West of Grove, Foxley Street to 232 feet North Moore Park Drainage System, Western Section Outlet No. 1, from Rosehill Avenue and Grace Terrace to Summerhill Avenue, and MacLennan Avenue via Grace Terrace, Rosehill Avenue, Clifton Road, Oakwood Drive, Sighthill Avenue and Summerhill Avenue. Moore Park Drainage System, Western Section, Outlet No. 2, Grace Terrace from Rosehill Avenue to Clarence Street. Norway Place, Woodbine Avenue to 620 feet East. Orchard Park Boulevard, Orchard Park Road to East End. Oriole Parkway, Oriole Road to 122 feet North of Gormley Avenue. Waverley Road, North Limit lot 48, plan M. 252, to S.S Kingston Road. Warram Place, Belsize Drive to 100 feet South of Belsize Drive North. Woodbine Avenue, Kingston Road to N. C. Limits.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen, and forms of tenders obtained at the office of the Commissioner of Works, Toronto.

Tenderers shall submit with their tender, the names of two sureties, (approved by the City Treasurer, not members of the City Council, or officers of the Corporation of the city of Toronto), or in lieu of said sureties, the bond of a Guarantee Company, approved of as aforesaid.

The usual conditions relating to tendering as prescribed by the City By-Law must be strictly complied with.

The lowest or any tender, not necessarily accepted.

H. C. HOCKEN, (MAYOR),
Chairman, Board of Control.

Toronto, December 3rd, 1913.

CANADIAN PACIFIC RAILWAY COMPANY.

NORTH TORONTO GRADE SEPARATION.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the undersigned up to 12 o'clock noon, on Saturday, December 27th, for furnishing labor and material in connection with the waterproofing of eight subways at North Toronto.

Plans and specifications may be seen at the office of the Engineer of Grade Separation at No. 262, Avenue Road, Toronto, where proposal forms may also be obtained.

The lowest or any tender not necessarily accepted.

R. RIPLEY,
Engineer of Grade Separation.

Toronto, December 4th, 1913.

Sealed tenders addressed to the undersigned, and endorsed, "Tender for Dam on French River, South Channel, Ont.," will be received at this office until 4.00 p.m., on Monday, December 29, 1913, for the construction of a Dam across the South Channel of the French River, at head of Big Chaudiere Falls.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of the District Engineers, Confederation Life Building, Toronto, Ontario; Post Office Building, Montreal, and on application to the Postmaster of North Bay, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 5, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—51842.

TENDERS FOR A COMPLETE MECHANICAL FILTRATION PLANT.

BOILERS, STEAM TURBO-GENERATOR PLANT AND ALL APPURTENANCES.

Tenders will be received by registered post only addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on

Tuesday, January 20th, 1914,

for the installation of a complete Mechanical Filtration Plant, Boilers, Steam Turbo-generator Plant and all appurtenances at Toronto Island.

Specifications and Tender forms may be obtained upon application at the office of Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City by-law must be strictly complied with, or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or, in lieu thereof, the bond of a guarantee company approved as aforesaid.

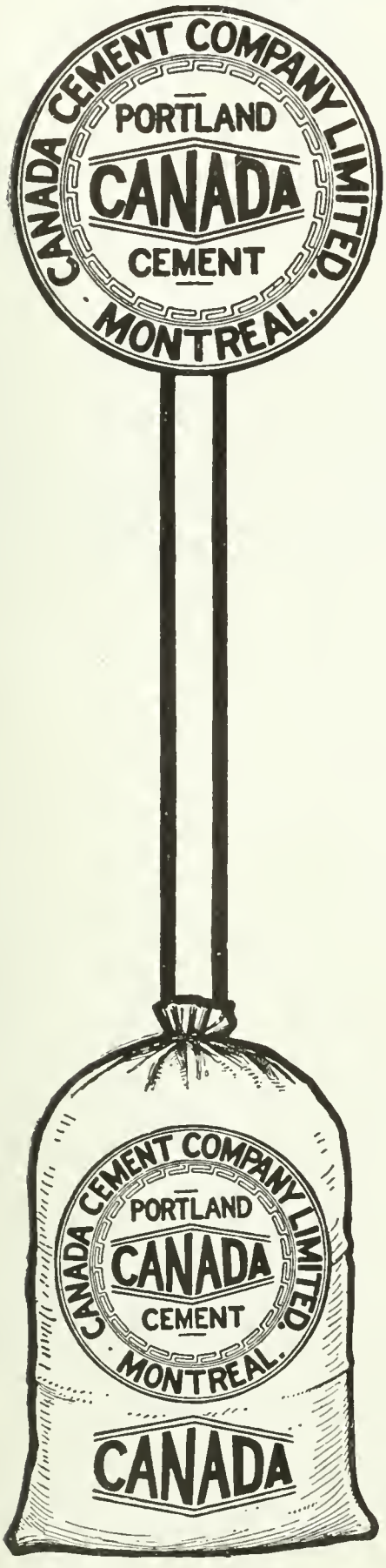
The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, November 25th, 1913.

(For further Tenders see Page 88.)

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

CITY OF OTTAWA, DOMINION OF CANADA.

TENDERS FOR STEEL PIPES.

Sealed tenders in duplicate addressed one copy to the City Clerk, City of Ottawa, Canada, and the other to Sir Alex. Binnie, Son and Deacon, St. Stephens House, Westminster, London, England, and endorsed, "Tenders for steel pipes," will be received until 4 p.m. on Tuesday, the 3rd day of February, 1914, for about forty-two miles of welded steel pipe, fifty-four inches internal diameter, about thirty-two miles of welded steel pipe, fifty-eight inches internal diameter, and about eleven miles of welded steel pipe, fifty-one inches internal diameter.

Forms of tender and specification may be obtained from Sir Alex. Binnie, Son and Deacon, St. Stephens House, Victoria Embankment, London, S.W., or from the City Engineer of Ottawa, Canada, on and after the fifteenth, on receipt by them of a cheque to the value of five hundred dollars, made out to the City Treasurer of the City of Ottawa, Canada, which sum will be returned on receipt of a bona fide tender.

The lowest or any tender is not necessarily accepted.

No tenders will be considered except from actual manufacturers capable of supplying the whole of the pipes within a period of two and a half years from the date of acceptance of the tender.

SIR ALEX. BINNIE, SON & DEACON,
Engineers in Chief,
St. Stephens House,
Westminster, London.

Dated December 4th, 1914.

TENDERS FOR SEWERS

Sealed tenders, plainly marked as to contents, will be received at the office of the undersigned up to noon of **Monday, December 15th, 1913,** for the construction of a sewer on Kennedy and Barrie Avenues, in the Township of York.

Plans, specifications and all necessary information may be seen at the office of the undersigned. Lowest or any tender not necessarily accepted.

FRANK BARBER,
Township Engineer,
57 Adelaide Street East, Toronto.

Toronto, December 8th, 1913.

TENDERS FOR ANNUAL SUPPLIES.

DEPARTMENT OF WORKS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on Tuesday, December 16th, 1913.

1. Asphalt (refined).
2. Paving Blocks (vitrified).
3. Granite or Stone Setts.
4. Treated Wood Blocks.
5. House Numbers.
6. Iron and Steel.
7. Special Castings.

Specifications and tender form for any of the foregoing may be obtained upon application at the Accounting and Purchasing Section of the Department of Works, Room 12, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. Conditions relating to tendering, as prescribed by city by-law, must be strictly complied with, or the tenders may be declared informal. Tenderers shall submit with their tenders the names of two personal sureties, approved by the City Treasurer, or in lieu thereof the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto, December 1st, 1913.

(For further Tenders see Page 86.)

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.:—A London merchant who has taken out a Canadian patent for a compensated rapid luffing-crane with self-balanced jib, is desirous of getting into touch with a firm of engineers in the Dominion open to undertake the manufacture of the machine in Canada.

From the branch for City trade inquiries, 73 Basinghall Street, London, E.C.:—A Yorkshire manufacturing company are in the market for amber mica and would be glad to receive samples and quotations from Canadian producers. An important London firm of mineral brokers are looking for further supplies of molybdenum, chrome ore, wolfram and tin ores, and are open to consider offers of regular shipments of these ores from Canadian producers. A firm at Hamburg, Germany, who handle mica, invite offers and quotations from Canadian shippers. A Canadian company producing amber mica upon a large scale is about to embark in export trade and wishes to be placed in communication with United Kingdom importers. A firm in Montreal, which has branches in Western Canada, would like to arrange for the importation of considerable quantities of Portland cement. A company at Vancouver wish to arrange to obtain supplies of wire-drawn tungsten electric lamps, and would be pleased to receive quotations from United Kingdom manufacturers of the same. A manufacturers' agent at Montreal who specializes in machinery lines, seeks a first-class agency in gas engines.

The following inquiries relating to Canadian trade have been received:—2093.—A South African merchant is making inquiry for catalogues and prices on Canadian-made shovels. 2094.—A South African merchant asks for catalogues and prices on axes of Canadian make. 2100.—Samples and prices are asked for by a South African merchant. 2118.—An East London firm asks for prices on all kinds of Canadian lumber. 2127.—Samples and prices are being asked for by an East London importer. 2130.—A South African importer asks for prices on all kinds of Canadian lumber. 2131.—A South African firm of merchants and engineers asks for quotations on Canadian formaldehyde. 2169.—Inquiry is made by a Paris firm of brokers for the names of shippers in Canada of iron ore.

The names of the firms making these inquiries, with their addresses, can be obtained upon application to:—"The Inquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary and Chambre de Commerce du District du Montreal.

AMERICAN ROAD CONGRESS, 1914.

The Joint Committee representing the American Highway Association and the American Automobile Association, has selected Atlanta, Georgia, as the meeting place of the 4th American Road Congress during the week of October 19th, 1914.

Sold in Canada by

AZTEC OIL & ASPHALT REFINING CO. of Canada

311 Shaughnessy Bldg., Montreal

Refined by

THE U.S ASPHALT REFINING CO.

AZTEC ASPHALT

Canadian municipal and highway engineers and road contractors should buy Aztec Asphalt on account of the qualities possessed by its bitumen. It is not—like other asphalts—merely "over 99 percent bitumen." Aztec is over 99 percent bitumen of special qualities that make it particularly suitable for Canadian requirements.

AZTEC BITUMEN

is solid, high-grade and best suited to Canadian conditions, because neither frost nor hot weather injures it. Aztec retains its tenacity under all conditions, also resisting all water action.

The extremes of temperature in most Canadian cities make asphalt more of a "problem" for Canadian engineers than it is for engineers in any other part of the Continent. Other asphalts that are entirely successful in South America, Mexico, Europe or in central or southern parts of the United States, might fail in Canada because of the extremes in temperature here.

For Canada asphalt must not only be pure (nearly 100 per cent bitumen) but the bitumen *must retain its tenacity at all temperatures*. In this regard Aztec excels. It is impervious to water, stays malleable even when buried under snow or ice for long periods, does not soften noticeably in summer and has great coherence, resisting wave tendencies.

Aztec is refined near Baltimore, Md., from liquid asphalt, or maltha, imported from Vera Cruz (Mexico), the land of the Aztecs. It is the expert North American labor, added to the high character of the Mexican maltha, that accounts for Aztec's superior qualities.

We would be pleased, upon request, to quote, send samples or mail further literature regarding Aztec Asphalt.

TRADE MARK

COMMERCIAL USES

Aztec is supplied with the consistency best suited to the special purpose for which it is required. Prompt deliveries on asphalt for

ROOFING
INSULATING
PIPE DIP
WATERPROOFING
BLOCK FILLER
RUBBER MAKING

For sheet asphalt or for road binder—either mixed or penetration method—Aztec excels.

Aztec Oil & Asphalt Refining Co. of Canada

311 SHAUGHNESSY BUILDING, MONTREAL

SOLE CANADIAN IMPORTERS

Second-Hand Machinery

Advertisements under this heading three cents per word per insertion, if not "displayed." Minimum 50 cents per insertion.

Hammers
Drills
Grinders
Flue Rollers
Stay-bolt Drivers
Wood-boring Machines

THOR AIR TOOLS

Simplest to operate: Costs least for repairs.

Send for Catalogue

Exclusive Canadian Agents

H. W. Petrie, Limited

General Machinery Dealers

TORONTO, ONT.

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED—Experienced electrical and mechanical draftsman. Address: Algoma Steel Corporation, Limited, Water Power Department, Sault Ste. Marie, Ont.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

STENOGRAPHER—Experienced in engineering correspondence, estimating and accounting, desires position, preferably as secretary. Gilt-edged references. Please address, Box 168, *The Canadian Engineer*, Toronto.

MECHANICAL CONSTRUCTION engineer and draftsman, experienced designer and erector of mining plants, Marcus screens, coal-washing plants, and buildings, cost estimator and supervision, all kinds of steam engines, boilers, air machinery, etc., seeks position. References. Box 188, *Canadian Engineer*, Montreal.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Any one desiring to obtain the invention covered by Canadian Patent No. 137,375, granted on December 12th, 1911, to Jacob David Wolf, of London, England, for Ore Separation, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention, and from whom full information may be obtained. Fetherstonhaugh & Smart, 53 Queen Street, Ottawa, Canada. Russel S. Smart, resident.

MONTREAL MARKET LETTER.

Montreal, Dec. 6th.

Conditions show very little change this week as compared with a week ago. In the matter of prices there is no change whatever. Until navigation opens up again all the stock will be quoted and delivered from storehouse, so that the cost of cartage and handling from the storehouse will require to be added to the previous cost on dock. As is usual in the month of December, trade is very quiet; in fact, it is rather quieter than is usually the case. There is always a rush before the close of navigation, and anyone wanting iron in the near future will place his orders before that time; others will delay ordering until after the turn of the year.

Merchant furnaces in Ontario are said to be fairly busy, but purchases are only being made for immediate requirements, there being considerable doubt on all sides respecting the near future. Reports of a discouraging nature continue to come in from across the border, and everyone seems to be a bear on the price of iron. Furnaces are being blown out, and some of the steel mills are also ceasing to manufacture. Notwithstanding this, the output is larger than the requirements, so that the orders on hand are being gradually reduced. How long this will continue is difficult to say, but in the meantime it is exercising a depressing influence not only on iron and steel and other trades of the United States, but upon the iron and steel trade of Canada. The output for the Nova Scotia Steel and Coal Company for the month of November, although smaller than that of the month of October, showed an increase as compared with a year ago. It is understood that the Dominion Steel Corporation is also showing an increased output. Prices are said to be a little disappointing, and it was not difficult to believe that this would be the case. However, both companies are said to be making a satisfactory showing. The probabilities are that the directors of each concern will meet here during the next week to decide upon the dividends. There has been no talk of any alteration with respect to the dividend of the Nova Scotia Steel and Coal Company; but, as may be remembered, there was considerable discussion a few weeks ago concerning the dividend on the common stock of the Dominion Steel Corporation, and the claim was made that this might have to be passed. The feeling here, however, is that no matter what the future may bring forth, the dividend will be declared at the usual rate during the coming week.

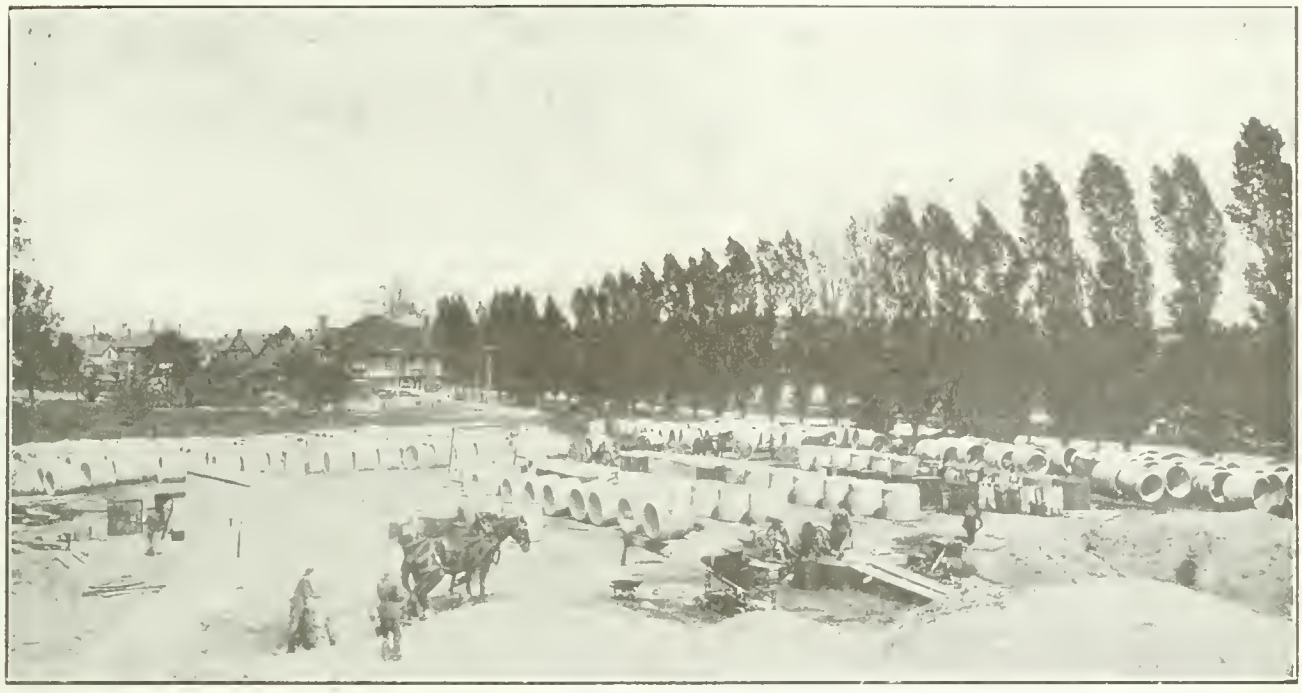
The various car companies are evidently not very cheerful over the outlook for orders for the coming season. These have not been given out at all freely, although the Grand Trunk is now inquiring for prices on a considerable number of cars, the number spoken of being well on towards 1,000. It is thought now that orders may be delayed until after the turn of the year.

CURRENT NEWS.

Fort William, Ont.—Although the joint street railway board will not hand over the management of the inter-city street railway until the expiration of that body's present term of office, January 1, the railway, on December 1, became two distinct systems, Fort William formally taking over its half of the line which was purchased five years ago and since managed by a joint board. Under the agreement the cities were not to assume individual management until December 1, 1913. Cars and crew run through as formerly but conductors exchange ticket boxes at the boundary between the cities.

Fort William, Ont.—Among the eleven by-laws to be submitted to the people of Fort William on civic election day, are several of engineering import; one calling for $125,000 for telephone purposes; one for $37,000 for waterworks purposes; for electric lighting purposes, $115,500; and for street railway purposes, $238,000.

Ottawa, Ont.—The Commission on Conservation is preparing a report upon the extensive timber cutting and general forest depletion in the Trent watershed, and upon the danger of this eventually removing the source of water supply and rendering useless the Trent Valley Canal. The commission will recommend that either the Dominion or Provincial government acquire properties in the district and protect the forest growth.



Manufacturing 48" Pipe at Berlin, Ontario, Canada.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, December 8th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1 40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜-in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3 45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25 lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength per 100 fuses:—4-ft. wires, $3; double strength, $3.50; 6-ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21.25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine, mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2 10; XX, $2.40· XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the follnwing is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22 50; 1½-inch, $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57 50, and 3-inch $75,50; 72½ per cent. off for black, and 62½ per cent. off for galvanized; 3½-inch $95 4-inch, $1.08.

Toronto, December 10th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet cooper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additinnal 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case ots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3 55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40 60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot.....	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long ...	1.00	1.60	2.60	4.00	13.00
Double junctions.....	1.25	2.00	3.25	5.00	16.25
Increasers and reducers.....	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 28-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand— Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c. " H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excellent demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, December 9th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41.50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3 16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜ $5; 7-16, $4.75; ½, $4.50, 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.80 22, $4.30; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.35; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe caulk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Dec 18, 1913 Contents of this issue on page 871

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

AN EMERGENCY STOP-LOG APPARATUS

NOTES ON THE DESIGN OF THE SYSTEM TO BE USED ON THE TRENT CANAL — APPARATUS INCLUDES AN EIGHTY-FOOT SWING BRIDGE, TRAVELLING CARRIAGE AND WINCH CARRIAGE—ONE-MAN OPERATION.

THIS apparatus, as designed and used on the Trent Canal, is designed primarily to shut off the flow of water through the lock, should the gate be carried away, and also to serve as a coffer dam, should unwatering be necessary. It is an apparatus that is seldom used, but it must be instantly available, under all conditions of weather and at any time; hence great precautions were taken in its design to provide for any emergency. Also, as the distance between entrance walls is 33 feet a heavy log was indispensable, and its effect is necessarily carried through the structure.

The logs, as shown in Fig. 1, are of a built-up section and are provided with double rollers at each end to lessen the friction in raising and lowering. The total weight of each log is 5,800 pounds, and the pull required to raise is about 5,700 pounds at each end, for load and friction.

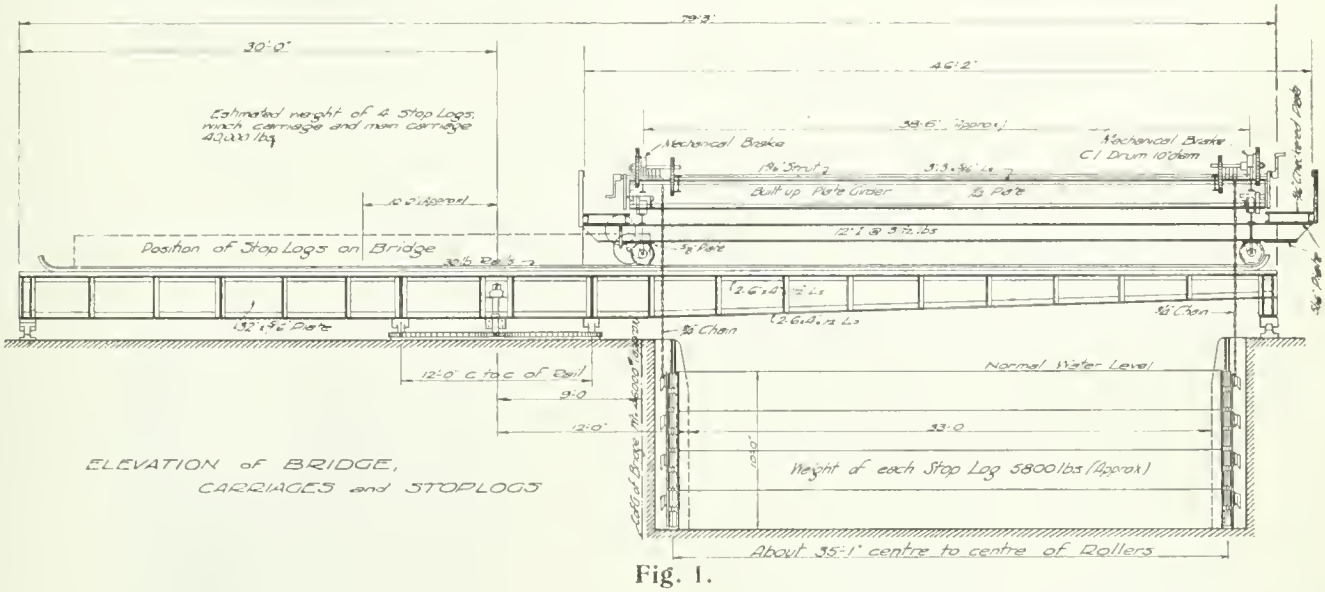

79'3"
30'0"
46'2"
Estimated weight of 4 Stop Logs, winch carriage and man carriage 40000 lbs
38'6" (Approx)
Mechanical Brake
Mechanical Brake C.I. Drum 10 Diam
Built up Plate Girder
Position of Stop Logs on Bridge
12'0" C to C of Rail
9'0
12'0
33'0
Normal Water Level
Weight of each Stop Log 5800 lbs (Approx)
About 35'1" centre to centre of Rollers
ELEVATION of BRIDGE, CARRIAGES and STOPLOGS

Fig. 1.

The component parts are swing bridge, travelling carriage, winch carriage, and winch, as may be noted in the diagram of Fig. 4 and in the other illustrations.

Fig. 2.—Normal Position on Entrance Wall.

Fig. 3.—Apparatus Swung Across Channel, Lowering Stop-Log.

The swing bridge is pivoted on the upper entrance wall, and is 79 ft. 3 ins. over all. It is composed of 2 plate girders, as shown, spaced 10 ft. 6 ins. centre to

centre, and is braced transversely on the shore or anchor end, but with no lateral bracing on the channel span where it is held with an end brace frame. This leaves a clear aperture sufficiently large that the log may be dropped through. This bridge is swung across the channel by means of a rack and pinion gear, as shown in the figure, and automatically locks into place.

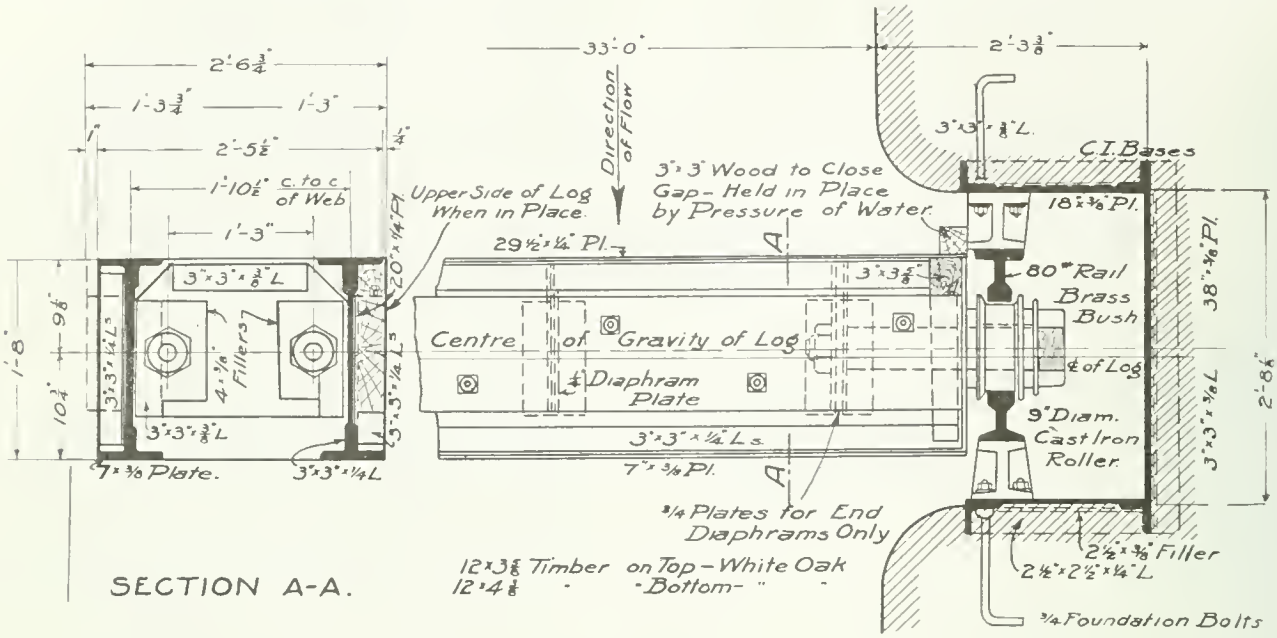


Fig. 4.

Rails are laid on this bridge on a 10 feet 6 inches gauge, and on these runs the travelling carriage, which can be run from one end of the bridge to the other by a crank-actuated mechanism. It is composed of two 12-inch I-beams at 31½ pounds, end braced.

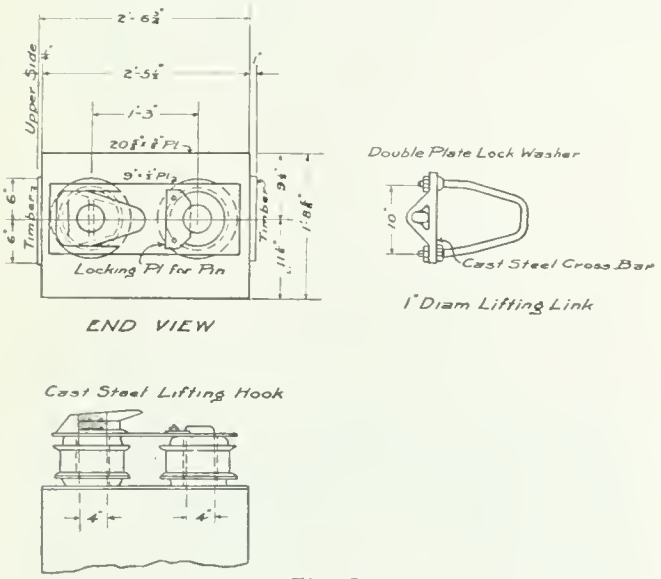


Fig. 5.

On I-beams fastened transversely on the ends of the travelling carriage the winch carriage runs. This carriage is made up of two built-up girders of ¼-inch plate and two 3-in. x 3-in. x 5/16-in. angles, and moves laterally the width of the travelling carriage. This carriage supports the winch. The method of operation is as follows: In its normal position on the upper entrance wall the four logs and travelling carriage rest on the shore end, and in this position the bridge is racked across the channel. The winch carriage is then centered over a log by its lateral motion, and by means of the winch the log is raised sufficiently to clear the floor. The travelling carriage is then run across the bridge to the automatic stop, the winch carriage again centered over the stop-log check, and the log lowered. This process is repeated until four logs are lowered and all flow stopped.

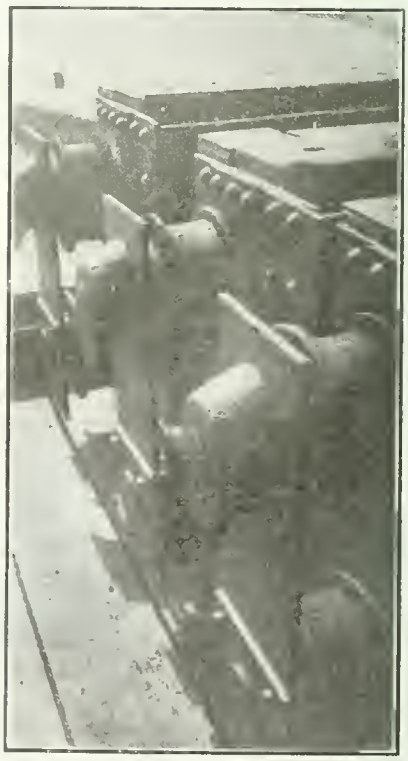


Fig. 6.—Detail of Ends of Logs on Bridge.

The whole operation can be performed by one man, but quicker gears are provided to be used if more men are available. As the majority of the reaches are of considerable size, both above and below the locks, speed in

shutting off the flow is not a highly important factor. However, the flow could be checked in twenty-five minutes, and completely shut off in an hour and a quarter.

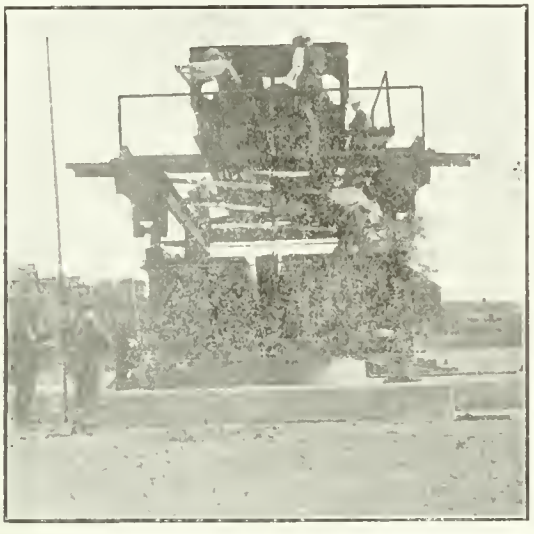


Fig. 7.—End View, Lowering Stop-Log.

The mechanism has been thoroughly tested. It has been satisfactorily operated by one man at night, and under all adverse conditions, and has given complete satisfaction.

The steel work was supplied and erected by the Dominion Bridge Co., Limited, and inspected in the shop and field by the Canadian Inspection and Testing Laboratories, Limited.

According to the United States Bureau of Standards, the melting points of fire brick are as follows: The most common fire brick, or those made of clay of which the main ingredient is kaolin, will melt at a temperature ranging from 2,831 to 3,137 degrees F.; bauxite brick, from 2,949 to 3,245 degrees; silica brick, from 3,092 to 3,101 degrees; chromite brick, at 3,722 degrees, and magnesia brick, at 4,929 degrees. These melting points, which represent the lowest temperature at which a small piece of the brick could be distinctly seen to flow, were determined in an electric vacuum furnace, the temperature being measured with an optical pyrometer.

The following is quoted from *Building Age;* "The freezing process in connection with excavations for the foundations of buildings appears to be something of a novelty in foreign countries, although many instances of it have occurred in America. The process, however, has recently been applied with economy and general satisfaction in Berlin, where the foundations of a large building had to be carried 10 ft. below the foundation of the abutting structures. As the latter were built on running sand, it was entirely out of the question to excavate for the new structure without special precautions, and the freezing process was adopted as an alternative to the pneumatic caisson method. Freezing pipes of 5-inch diameter were sunk around the space to be excavated and connected by headers with a brine pump and tanks. The cold brine was pumped through 1-inch pipes enclosed in the 5-inch pipes, and the brine was returned to the tanks through the latter. When the apparatus was put into operation the effect was to establish a stable barrier of frozen quicksand, permitting the foundation space to be excavated by ordinary means without difficulty."

TREE-PLANTING ON CITY STREETS.

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THE aims and objects of this paper are not so much to submit any fresh or original ideas on the subject as more particularly to awaken the civic conscience to a sense of its duty and obligation towards, and to enlist the sympathy of the public in, a matter which so much affects its personal and civic welfare. That there is a close connection between our civic well-being and the condition of our public places is generally conceded, and the relationship becomes increasingly more apparent as our public places are made more amenable and pleasurable through beautifying with well-kept boulevards and ornamental trees and shrubs. Although the subject is one which generally has the sympathy and approval of public and private bodies, as well as the majority of individuals, it is astonishing how little specific information there is concerning it, and how very little action is taken to make the matter a practical reality. So far as the West is concerned, the movement is in its infancy. While many of our older towns and cities have achieved something towards this end, the majority of places either overlook or disregard this important feature of civic planning and beautifying.

Design of Streets.—The uses and purposes for which streets and highways are intended may be classified in the following order of importance, viz., traffic, building and aesthetic considerations. While utility must of necessity precede aesthetics, the latter demands and deserves more consideration and attention in street planning than it usually receives. Although a well-designed and well-constructed street primarily serves traffic and building conditions, beauty and harmony are necessary to give the street character and tone. Such an atmosphere is created by the scenic beautifying of streets and thoroughfares with impressive shade trees and well kept boulevards. The accomplishment is not the work or skill of the single individual, but is indirectly the combined results of many minds and activities. The co-operation of the landscape gardener, the engineer, and a sympathetic public is essential to achieve any successful and satisfying results in street beautifying. Wise discretion, unlimited enthusiasm, and infinite patience are all necessary to further any beautifying scheme, and even after the designer and gardener have done their parts one has to watch and wait for results, for nature objects to be hustled and must have her own way.

Important preliminary steps in any permanent scheme for tree-planting and boulevarding are (a) the establishment of the permanent grades of the streets, and (b) the classification of streets, as far as possible, according to traffic and building requirements, present and prospective; (c) the proper proportioning of the street width to equally suit traffic and aesthetic conditions. While street trees can frequently be planted before the permanent grading by making due allowance for same, unless for merely temporary effect, it is not wise to carry out any extensive boulevarding until the permanent grade of same is fixed.

Where street widths have not been generally established, such as in this neighborhood, at a minimum width of 66 feet, they should be standardized and classified as business, residential, or semi-residential streets, and any construction or beautifying carried out along systematic lines to typical designs. To derive the best results and prettiest effects it is very essential to have the travelled roadbed, the sidewalk and the boulevard symmetrical pro-

portions of the entire street. While as wide a road reservation as possible is generally desirable, it is not good policy from either an aesthetic or economic standpoint to construct more than a certain proportion of the street for traffic purposes, but obviously this will depend upon whether it is a business or a residential street. Too frequently in narrowing the boulevard the aesthetic features of a street have been sacrificed for its utility. Just as the relationship of the roadbed, sidewalk and boulevard should be equalized, so should the disposition of the public utilities, existing or projected, be carefully planned so that the finished street shall be complete and in harmony with its component parts. The lack of judgment and foresight is seen in our neighboring cities, where matured trees have been wantonly cut down to make room for curbs, and also where in cutting sewer trenches the larger roots of the trees have been cut through, practically giving the death-blow to the tree. While such unfortunate instances are not always avoidable, regrettedly they are more in evidence than might be with careful and scientific planning of the entire street and its component parts.

In strictly business streets, or in streets where the boulevards are not sufficiently wide, the planting of shade trees is not to be commended. It is a question of trees versus traffic—one must make way for the other or both will suffer. Hence, unless for purely temporary effect, it is not a wise policy to plant trees in spaces more urgently required for roadway or sidewalk.

It is the most common of errors to provide trees with too narrow a planting strip for full development. Besides, the effect being crude or incomplete at maturity, the trees tend to force out curbs and undermine walks. The width of the parking strip will be somewhat affected by the species of the tree, but, generally speaking, a minimum width of six feet is to be recommended. On narrower spaces it would be preferable to substitute evergreen shrubs for shade trees. A factor which sadly militates against any street beautifying scheme is the presence of pole lines. Indeed, in most localities it is, or becomes, a question of pole system or tree system, as both cannot exist together harmoniously, the merciless lopping of branches and the stumping of beautiful trees interfering with wires being within common knowledge. This matter might be better controlled by limiting the height of the lowest wires above the ground to, say, 25 feet, or, better still, by enforcing the use of underground conduits.

Advantages of Tree-planting and Boulevards.—Commercially good streets regularly and systematically lined with beautiful trees are a paying investment, tending to increase the value of property abutting thereon. They are the index of a city's character and well-being, and attract the attention of the casual visitor or the prospective investor. Who that has visited Portland, Ore., is not favorably and delightfully impressed by the restful and refreshing atmosphere of its tree-lined and rose-girt residential thoroughfares?

Physically, trees have a beneficent effect on the atmosphere. In the heat of summer they serve the double purpose of cooling the air with the evaporation from their foliage and of affording protection from the sun's rays. In affording protection from the glare of streets and in tending to diminish the nuisances arising from noise and dust, trees add materially to the comfort of residents. The restfulness to the senses which their verdure, form and proportion produces is also a healthful influence. In short, shade trees add to the beauty, health, comfort, and charm particularly of residential districts and lend an air of dignity and repose to the thoroughfares therein. Socially, tree-planting and boulevarding foster civic welfare and further "community efficiency." The efforts and results are inspiring and contagious—property owners copying examples become imbued with the idea of beautifying the streets in which they live, move and have a good deal of their being—until the entire community has become affected and enthused. Thus is the sense of civic righteousness increased, the public taste elevated, beautiful cities developed and good citizenship produced.

Disadvantages of Trees.—That shade trees have their drawbacks and disadvantages must be admitted. Especially in rural districts they keep the roads damp, and frequently they do not admit of a free circulation of air and wind. The constant dripping of rain from their leaves has also deteriorating effects on macadam roads. That shade trees interfere with traffic is not a valid argument against their adoption, but invariably a result of injudicious planting or inefficient maintenance. Reference has already been made to the destructive effects of tree roots on curbs, sidewalk and pavements, and mention might also be made of instances where sewers have been rendered useless, but most of the above drawbacks could be avoided by foresight in the designing and planting of the trees.

Kinds of Trees and Characteristics of Each.—Although there is such a large variety of forest trees, comparatively few of them are suited to or adaptable for street planting, and altogether it is somewhat difficult to find a tree possessing all the desirable qualities for street use. Generally speaking, trees should be selected particularly with regard to locality, climate, quantity and quality of soil, extent of space and special environment. Hence shade trees suited or appropriate for one locality, or even for one street, might not be equally suited or appropriate for the neighboring locality or street.

Of the above requirements the nature and extent of the soil are of great importance. The most suitable soil is one which contains neither too much clay nor too much sand, but a proper proportion of both. A hole about three feet deep, with an area of not less than a square yard, is desirable to produce the best results, but obviously the depth and area of the hole will depend greatly on the size and nature of the tree. In any event it is important that the young tree should have ample room in which to properly develop. For the very best cultivation the use of prepared soil is recommended. The following are the general essential qualifications of a good street tree: It must be hardy and not adversely affected by extremes of temperature; it must be able to withstand spells of drought, the dust of rural districts, and the smoke and soot, etc., of cities. The hardier the tree, the less susceptible it will be to the insidious attacks of insects and borers. It should have such recuperative powers as to quickly recover from malicious or accidental injury. The best tree should have a straight, clean stem, with shady foliage and a compact root system. To fulfil its chief function it should be graceful in full leaf or when bare in winter, namely, the length of leaf period should be as long as obtainable, the finest trees being those which leaf early in spring and provide shade and beauty well into the fall. A too rapidly growing tree, being usually soft and brittle and short lived, is not always desirable. A slow-growing tree, having better staying qualities and being less liable to be broken by the wind, is to be preferred where the planting scheme is to be of a permanent nature. A good tree should not branch too low—8 to 10 feet from the ground is desirable in the interests of traffic. The foliage of a good tree should be attractive, but not too dense to prevent a free passage of air and sunlight.

Whatever types of shade trees are selected—and the selection demands the care and discrimination of the experienced—the following precautions should be observed to ensure the trees flourishing and eventually producing the best and happiest results. The trees should have been well nourished and tended in the nursery. They should not be planted in the street until they are about eight feet high, with the stem at least two inches thick. The stem should be clean and as straight as possible, and the entire tree symmetrical in shape. Trees about eight years old are preferable. If the ground and soil are not suitable, they should be made so; special treatment will be necessary in hardpan, where it is very essential that a hole should be made sufficiently wide to accommodate the roots of the tree in a well-advanced stage. Trees should not be planted any deeper than their original nursery marks indicate. Most trees flourish best when the tops are trimmed about a foot when planted, although many experts contend that young trees are best left to their own resources. It is generally wiser to erect proper wind protection shields, which will further tend to safeguard the trees from the ravages of animals and mischievous children. The age, nature and kind of tree and its environment will determine this matter. As moisture is next in importance to air in the nourishment of young trees, the roots should be well watered, especially during the first and second summers after planting. Sprinkling the foliage is also beneficial in removing the dust and soot therefrom.

In cities or districts where trees are to be planted extensively the establishment of corporation nurseries (which could be conveniently done in actual or prospective parks in play-grounds) will make for uniformity, efficiency and economy in tree-planting.

Setting-Out and Planting.—The setting-out and planting of shade trees are highly important matters so frequently ignored as to minimize the initial, and particularly the final effects. The spacing of shade trees will naturally depend upon their variety and nature and the extent of the boulevard. As a general rule they should be planted so far apart that at maturity they will not meet. Planting too close is the most prevalent error in setting out shade trees. In their desire to have immediate effect the inexperienced too frequently plant trees so close together that it is only a question of time before well-developed trees have to be cut down to make room for their neighbors. For permanent results it is better to err on the safe side and plant trees too far apart. Where temporary effect is the main object in view, trees and evergreen shrubs might be planted alternately and the shrubs transplanted when the trees begin to expand and require the maximum of space. Generally speaking, a spacing of from 30 to 40 feet should be adopted. As regards the distance from the property line, this will depend upon the width and layout of the street, but where possible a distance of from 10 to 12 feet is to be recommended.

To produce the most pleasing and aesthetic effects, shade trees should be planted at equal distances apart and on a line as parallel as possible to the curb or centre line of the street. It is a matter of opinion, but especially on the narrower streets trees should be planted alternately on opposite sides of the street. The practice of planting one kind of tree for one block and an entirely different type of tree on the next block on the same street, as has been adopted on the Grand Boulevard in North Vancouver, is not commendable, as naturally the different trees grow at different rates and in different shapes, and the results at maturity are unsymmetrical and the effects patchy at the best. Several sorts of trees of varying ages, sizes and shapes should not be adopted, although two kinds of a similar nature might with aesthetic advantage be planted alternately on the same street. Streets named after trees should, as far as practicable, be planted with trees to correspond. Very pretty after-effects can be produced if trees are properly and symmetrically disposed of at street intersections so as to produce the maximum of shade. Shade trees should not be planted in a careless and haphazard manner. As has already been said, the combined skill, taste, and experience of the engineer and the landscape gardener are essential to secure the most finished and most artistic effects. Truly, tree-planting and tree preservation is a science and not what it is too frequently thought to be, the easy, simple matter for the unskilled.

Maintenance of Trees.—Such necessary and important matters as the care and maintenance of shade trees are so often neglected for so long a time that frequently many originally fine trees are found to be beyond recovery. Trees should not be left wholly to their own resources, for with due care, constant watchfulness and regular attention they will flourish oftentimes in unfavorable conditions. Instances of trees having been stuck in rather than planted are too common, and in such cases, instead of being a thing of beauty and a joy forever, as often as not the carelessly planted and untended trees soon present a lifeless appearance and a sorry spectacle. Young trees should be regularly and properly trimmed, preferably in the late fall, all broken or rotten branches being removed. Any injuries to, or disease in, the bark should, however, receive prompt and careful attention whenever found necessary.

Trees affected by moths or insects should be sprayed at the proper season to keep the nuisance and blight from spreading. Where borers are the source of trouble special treatment will be necessary, "capital punishment" being, of course, most effective. Cavities in older trees, in which water and dirt lodge, tending to hasten decay of the tree trunk, have been successfully treated and the life of the tree thereby increased, by carefully filling with concrete. Reference has already been made to the necessity for regularly watering young trees during the summer months. Altogether, the "tree doctor" is an essential in successful tree culture.

In his Presidential address to the British Concrete Institute, Mr. E. P. Wells dealt with some practical matters connected with concrete construction. He urged the necessity of keeping a more careful watch on the cement used than had hitherto been done. During the past year it had been found in several cases that cement had been "air-slaked" to such an extent that it was almost useless for reinforced concrete work. Instances were mentioned of faulty storage by manufacturers' agents and of careless handling by builders, and it was suggested that cement should be brought on to the works in casks and stored in air-tight bins. Reference was made to the unsightly contraction cracks that took place in reinforced and other forms of concrete construction, but so far no remedy had been found. Some experiments had been promised to see whether it was not possible to stop cracking to a large extent, and if satisfactory the results would be given to the Institute. The extended use of reinforced concrete work in the Colonies, notably in New Zealand, was referred to, as was also the apparent slackening in the home production of steel. Touching upon the difficulty of obtaining assistants capable of designing reinforced concrete work, he stated that much of the inadequacy of reinforced concrete design was attributable to the inexperience and want of proper technical training among structural engineering draughtsmen.

LEGAL SUGGESTIONS RESPECTING ROAD CONTRACTS.*

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ETYMOLOGICALLY and technically the word "contract" should mean an agreement enforcible by law. "The Law of Contract may be described as an endeavor of the State . . . to establish a positive sanction for the expectation of good faith which has grown up in the mutual dealings of men of average rightmindedness." How do our present public contracts for road construction and their interpretation by officials satisfy these old definitions? As a part of the great work of properly linking our states and their cities and towns with uniformly good roads, it is incumbent upon us to better and if possible make uniform the contract conditions respecting the construction work and to secure that co-operation and esprit-de-corps between officials, engineers and contractors which alone will give us the best roads for the least money with a minimum of trouble and wasted energy. It has been wisely remarked that "you get only what you pay for" and in the long run that is as true in road construction work as in any other field.

Let us first consider some general principles respecting states, municipalities and roads which should be known in order to appreciate the special subjects which will be considered.

The state is a sovereign body and as such is not responsible by action at law or in equity. There are a few isolated cases holding that when a state goes outside its governmental capacity, it may then be used in the Federal Court. No dependence, however, can be placed upon these decisions by a contractor. The result is that a contractor with a state has no way to enforce his contract rights nor to secure redress against official oppression unless the state legislature has provided therefor. The best and usual plan is the formation by the legislature of a court or board of claims to hear and determine claims against the state, its departments and boards. One state allows a contractor to sue it, provided the legislature passes a special bill for the specific matter. The value of that right is well illustrated by a statement made to the writer by an offending official that when he got through with the matter I would have to have more political influence than he thought I had in order to get such a bill through the legislature. It is also the general rule that in such instances the offending official himself is beyond the legal reach of the contractor. Thus it is that except in those states having a court or board of claims, official oppression and even financial ruin can be honestly or dishonestly caused without any hope or prevention or redress for the contractor. A so-called agreement where the contractor depends solely upon the action of an official and his engineer should not be called a contract. It violates the true meaning and our understanding of that term. This inability of a contractor to enforce his contract rights or even to demand fair play and justice cannot but be detrimental to good economical road construction. Under such circumstances the work becomes political—only favorites dare bid or accept contracts—and the other results of political work naturally follow.

Due to this fact that most states could not and still cannot be compelled to live up to their contract conditions, the terms of a state contract have been considered practically unimportant by the contractor. He knew that he must follow the direction the plans and specifications called for. While conscientious and honest officials and engineers predominate in state work, yet they at times need the restraint which a chance to be heard by the contractor affords. Furthermore, the atmosphere and the mental attitude of all concerned is bad in such a situation. Those opposed to granting the contractor this right to properly and legally present his claims before a disinterested court or party will be interested to know that even so great a sovereign as Emperor William of Germany last year lost an action to one of his tenants in the German Supreme Court over the value of certain improvements. Therefore, unless a state has a board or court of claims open at all times to those contracting with the state, its departments and boards, or unless it provides for a submission to an impartial and disinterested arbitrator or arbitrators any changes in the present state contracts that are discussed or suggested will, of course, be useless except as they may influence the controlling official. In this connection it has been very noticeable that both the judges and the juries favor the state or municipality when they are sued. This is even found where it is necessary to construe the iron-clad terms and conditions of our present day one-sided agreements which are required to be signed by those desiring to engage in public work and where it would be expected there would be some sympathy for the contractor. In all seriousness, then, it is submitted that there seems to be no logical reason why the contractor should not be given an opportunity to get a square deal if he believes he is not being fairly or honestly dealt with.

Municipalities are the legal creatures of the legislature, and their powers and rights must be found in the law creating them. Throughout this paper the term municipalities will signify cities, counties, towns, boroughs, road districts, etc. As a governmental agent, a municipality is immune in respect to mere errors of judgment, but in its ministerial capacity it is liable for consequences of negligence and maladministration. As regards plans for public improvements some courts attribute negligence to a municipality in the adoption of a defective plan and the test of the liability of a municipality which causes injury is not the fitness of the engineer, but the efficiency of the work. Where a defective plan is the result of bad faith or oppression or is so clearly unreasonable as to inflict needless injury, a court may enjoin performance, or, if the work is completed, hold the municipality responsible.

Roads are in the control of the state. In doing road work a municipality acts as the agent of the state performing a public duty imposed by law. On this account those dealing with either roads or municipalities must ascertain the legislative acts pertaining thereto as a basis for any serious investigation. In determining the powers or rights conferred by such statutes the investigator must remember that the wording of the law will be strictly adhered to and that the tendency is to restrict powers granted and to deny any implied powers or rights.

Since a contract may be either wholly void or voidable at the option of the state or municipality unless certain preliminary steps are properly taken, and since in such instances it usually results in a total or partial loss to the contractor of his compensation for work done and material furnished it is essential that a brief warning in this regard should be given.

*Read at American Road Congress, Detroit, Mich., Sept. 29 to Oct. 4, 1913.

With respect to roads; the proceedings to acquire the land; the report upon the advisability of a road; the estimate of the cost; the description of the road; the survey and resurvey; the proper sanction of the voters or taxpayers; the proper formation and action of the boards or courts, etc., all must be in compliance with the statutes and laws pertaining thereto. In addition the actual preliminaries to the contract itself must be regularly and legally complied with:—A proper and sufficient appropriation or available funds; a proper advertisement for bidders; a proper letting to a proper party; a properly constituted board or official acting strictly in accordance with its or his authority; a proper bond for performance, etc. The contract itself must be in the required form properly executed, for the purposes allowed by the special statute, with proper persons entitled both to give and to have such contract and in accordance and in conformity with the preliminary reports, plans, specifications, survey, description, etc. As has been previously stated, failures, omissions, or negligence on the part of any of the state or municipal officials or agents in the above respects may cause the contractor to lose his compensation for work done and for benefits actually conferred by the contractor. There are some decisions and some statutes which are based on equity to prevent such unjust enrichment of such bodies at the expense of a contractor, but it is not safe to rely on such law in any particular instance. The general rule may be likened to the ancient rule of "caveat emptor" or, as it might be expressed here, "let the contractor beware." This warning, while primarily for the contractor, should be taken to heart by the official who is trying to do right and be honest, since usually he is the unfortunate party that causes the contractor's troubles and losses.

Contracts.—As we have already seen, most present day state contracts for road construction are not really "contracts," because of the inability of the contractor to sue thereon. In addition, I have also seen one state contract which stated that "all right or rights of any action at law or in equity under or by virtue of this contract and all matter connected with it and relative to the same are hereby expressly waived by the contractor." Practically the same result is accomplished by other states and especially by municipalities by the requirement that upon or before final payment the contractor must execute a release in full of all claims arising out of or by reason of the work done and material furnished under the contracts. Is this *good* faith in the dealings of men of average right-mindedness? I cannot conceive of but one answer to this question. The remedy then is simple. Provide either fair and disinterested boards of arbitration to pass upon a contractor's claims or provide a court of claims and eliminate any waiver of appeal to such arbitrators or court and the general release as a condition precedent to final payment from all road construction contracts. In other words, give the contractor a chance for a square deal upon a two-sided mutually agreeable contract. In passing, it might be noted that the United States Government is probably the worst offender in this matter of unfair and objectionable clauses, including that requiring a release, and it is setting a disgraceful example for the states and municipalities.

Satisfaction Clauses.—It is probably a safe statement that there is no state or municipal contract in use to-day which does not provide for the "satisfaction" of some official, board or engineer or all combined. Is this a necessary, fair and honest requirement in road construction contracts, or is it merely a club to compel the contractor to do what the official or engineer wants regardless of the plans and specifications?

In most states it has been properly held that this requirement merely necessitates work satisfactory to the mind of a reasonable man. Thus if the work has been performed substantially in compliance with the contract, the law will hold the official, engineer, etc., to be satisfied. With plans and specifications so clear and concise as they generally are in road construction, and especially with the work required to be done "under the direction" of an engineer and under constant inspection, it would seem that legal satisfaction would be presumed in 99 out of 100 cases, and hence the use made of this requirement in such states would be merely to bluff or bulldoze the contractor. In no way does it improve the requirements of the plans and specifications.

In such a state as Pennsylvania, where work can be held unsatisfactory by the official or engineer even though the plans and specifications are rigidly adhered to and where only honesty of purpose is required, the result of such a contract requirement may be heartbreaking. Under the guise of dissatisfaction I have known an official in that state to deliberately violate every essential provision of an agreement and to settle at his own figure with the contractor; or, in plain English, to rob the contractor not only of his contract right but also of thousands in money with no redress. A contractor who accepts state work in a state where this personal satisfaction of private taste in road construction is required must understand that he is at the beck and call of the official or engineer regardless of his contract requirements and conditions. What could the contractor in such a state do when he has to satisfy not only the engineer in charge, but the Road Commission and a state board? Suppose the work satisfied one and not the other two, or two and not the third party?

Our considerations recommend that "satisfactory" requirements be dropped from road construction contracts as either unnecessary, harmful or unfair and as not being a sanction for the expectation of good faith between men of average right-mindedness.

Contract Work.—In looking over many of the latest forms of road construction contracts it is noticeable that there is a very decided improvement in the manner and method of setting forth the contract work and specifying what is variously designated as alteration, addition, miscellaneous, or extra work, etc. Road work is now generally specified in various units and a price bid for each respective unit. In one such contract we find this definition: "Extra work is any work in connection with the execution or completion of the contract for which no price is included in the proposal sheets and contracts." Compare this simple and concise statement with a New York City form which had different requirements for ordering additional work as differentiated from extra work, the distinction not being stated and being such that there would be times when the average engineer or contractor would not know to which class the work belonged to. Result—the contractor would be refused payment for additional work done pursuant to extra work requirements or vice versa.

In the same regard why should a contractor, as is now frequently demanded, be responsible for unknown or underground conditions? Just lately in New York City a paving contractor found a lot of rock above grade which should have been taken out by a prior grading contractor. Under notice to bidders to examine the site, etc., the

Court of Appeals held that the plans of the completed grading contract on file in the city offices did not constitute a representation to bidders of the condition of the road bed and hence the paving contractor had to do this work of grading without extra compensation.

Let us, then, have definite contract units of work at unit payments clearly specified, and provide payment for any other work necessary which may arise either at the unit prices or, as is becoming popular, upon a percentage basis. This latter method seems a fair means of providing for extra work as hereinbefore defined but the contract must specify exactly what is to be considered the "cost" upon which the percentage is based, as there is great difference of opinion on the subject. For example, in one state, the statute provides for certain construction work at cost plus 15%. There being no provision against subletting, the actual work was done by subcontractors at a fixed price. The "cost," as sustained by the highest court, included the cost to the contractor for the work as agreed and paid to the subcontractor, the contractor's overhead expenses for supervision, engineering, office rent, etc. In this way the state actually paid 53⅓% on the actual cost of labor and materials at the job which is the popular conception of the word "cost" in percentage contracts. The rules of law applicable to percentage contracts are the same as those to the ordinary lump sum contracts. Under proper contract conditions with definite plans and specifications and with honest officials and contractors, contracts on the percentage basis of "cost of labor and materials at the job" would, in my opinion, give as wide scope for competitive bidding and should give better results in actual construction work. It should do away with many of the conflicts now common between the official, the engineer, or both, and the contractor. The tendency would also be to give closer competition between the large corporation with heavy overhead charges and the small concern with practically no such expenses. There would seem to be no question but what in the long run this would be less expensive to the municipality because it would tend to cut out the contracts with enormous profits and at the same time lessen the broken contracts because no contract should be given out for less than the defined "cost" price. This is merely a suggestion in passing, but I should like to see it given a fair trial.

Duties of the Engineer.—Under most of our road construction contracts the engineer takes his time-honored dual capacity of agent for the state or municipality and arbitrator between the contracting parties. It has been noted that if the contract provides that the engineer will make an estimate and issue a certificate he will often do so where he may refuse if such wording is not used. There is no question but what the engineer is given too much "discretion" under our present contracts. In road construction work there would seem to be no excuse for a lack of definite plans and specifications which of themselves should reduce the engineer's discretion to a minimum.

There always will be objections to the salaried or paid engineer of a state or municipality acting as an arbitrator without appeal as is the result accomplished by practically all state and municipal contracts. Upon the wording of such contracts some courts have even gone to the extent of holding the contractor but not the state or municipality bound by the engineer's decisions within the scope of his authority. Clearly such a result is unjust. In addition to this, state and municipal contracts are so replete with oppressive or "club" clauses for the engineer that a contractor knows he must take care of that official one way or another. It has been well said that no man should be placed in such a position where bribery and graft is often the easiest and cheapest solution of differences or disputes. Whether or not the engineer is an arbitrator depends upon the strict wording of the pertinent clauses of the contract. All such clauses will be strictly considered and no implied powers will be given the engineer. Where an engineer is made an arbitrator he must remember that he has greater powers than the judges on the bench, because he may intentionally decide contrary to the law and still have his judgment stand. On this account an engineer's decisions should be beyond reproach. The fact that in the exercise of his duties as arbitrator he cannot be held legally responsible for lack of skill, carelessness and even negligence should create an ambition to merit the honor bestowed. The engineer should never forget that he is, under present day clauses, taking the place of the court and that his action may close the door to either party to appeal from his decision. Professional honor and reputation often depends more upon the engineer's action in such matters than upon his pure engineering knowledge. However, the engineer must know that he cannot ordinarily deprive the contractor of his right to judicial construction of the contract after it has been performed so far as such construction involves matters of law. These considerations show us that the engineer holds under our present day construction contracts an almost impossible position for a human being. Would it not be better to relieve him of some of these onerous duties? Experience seems to show that better feeling, better work, and co-operation between the engineer and contractor may be secured by more precise, concise and definite plans and specifications, and the elimination of all unnecessary "discretion" and "arbitration without appeal" clauses respecting the engineer.

Construction of Contracts.—Since we cannot expect any sudden change in present road construction contracts, this paper would not be complete without a statement of some of the most general legal principles which should govern the actions of officials and engineers even if the contractor cannot sue or get a fair hearing for his side. Since all state and municipal contracts emanate from the contracting official the ordinary rule is that the contract provisions should be construed most strongly against the author. Especially is that so when such construction is necessary to save a contractor from fraud and injustice, or where, as in these contracts, one party is at the mercy of the other. The following instances where municipalities have been held responsible in damages on account of the actions and orders of officials and engineers should be known and avoided:—

(*a*) Mistakes in lines, grades, elevations, plans or specifications or directions whereby the contractor had either to do additional work or do over work already done.

(*b*) Requirement that the contractor do the work in a way not called for by the contract, entailing more expensive work than would customarily or otherwise be entailed.

(*c*) Requirement that the contractor do over work already done properly or repair or maintain the same unreasonably.

(*d*) Requirement that the contractor do work not within his contract as contract work.

(*e*) Refusal to permit contractor to perform work called for by his contract.

A substantial performance of a contract creates a situation where the contractor is entitled to his full con-

tract price less the expense of supplying the omissions and defects. From a study of cases all over the country the following rule would seem practical for contracts under $25,000. Provided the contractor has honestly attempted to complete his contract, and particularly when he has followed the directions of the official or engineer, and when the omissions or defects do not pervade the whole work or make the object of the parties impossible or difficult of accomplishment, or when the usefulness or value of the construction is not materially impaired, and provided the cost or reasonable value of correcting such defects or omissions does not exceed 6% of the contract price, then there has been a substantial performance. No practical working rule can be given for contracts over $25,000. Substantial performance also excuses the production of an engineer's certificate.

In this connection it is important to note that in correcting defects, supplying omissions or completing a contract the state or municipality becomes bound by the terms of the contract and its plans and specifications. For example, if the contract permitted the use of native stone the state cannot use trap rock and expect to charge that against the contractor. In such instances a burden is imposed upon the official to complete the performance in good faith pursuant to all the contract provisions and with reasonable care and regard to the rights of the contractor. There seems to be a tendency on the part of some officials to make an example of a contractor who has defaulted. Their chief object often seems to be to spend all the retains and, if possible, all they think they can collect on the contractor's bond. This is neither legal nor honest. The completion work must be done diligently, and the damages mitigated as much as possible. High-priced men cannot be used for cheap labor, nor can completion be delayed until market prices have risen. Thus it has even been held that a municipality was bound by the date of completion when it assumed a contract.

If a contract calls for liquidated damages for delay after a specified date, such damages are waived or are not recoverable by the state or municipality where they render the contract incapable of performance within the specified time or where they assume as agents of the contractor to complete the contract. Similarly if the delay after a specified date is caused, both by the state or municipality and the contractor, the liquidated damages cannot be apportioned. It has been held that a city cannot retain a substantial sum under the guise of liquidated damages for delay when in fact only nominal damages have been sustained. Where the liquidated damage clause falls, then actual damages caused by the contractor must be proved as an offset. There is still one very important matter pertinent in this respect. Where a contractor follows detailed plans and specifications and the directions of the engineer and completes any part or all the work there should be no deductions for variations from the contract since the parties have practically construed the contract as one for work in accordance with the engineer's directions and such construction must prevail over the literal meaning of the contract. Also under these same conditions and circumstances a contractor is not responsible for a result nor is he responsible for any defects or repairs (except where there is a repair clause) beyond those required by the failure of the contractor's materials or by the contractor's own work. In other words, a road contractor usually does not warrant the road as capable of standing any particular traffic, etc., that should be determined by the plans and specifications.

Naturally the most important thing to the contractor is prompt payment, not only of his partial but also of his final payment. It is a general rule of law that a failure of a state or municipality to pay an instalment on the due date causes a breach of contract which relieves the contractor from further performance and enables him to collect the contract price or reasonable value of all work done to date. The failure of the engineer to make his estimate and issue his certificate may not excuse a failure to pay partial payments even if they are required to be made only upon engineer's certificates. The refusal of an engineer, under ordinary circumstances where there has been work done, to make his estimate and issue his certificate in time so that the contract payment can be made is of itself presumptively fraudulent. Again, it is often found to be the case that the engineer refuses to act upon the direction of the official, which, of course, is collusion, and which excuses the production of such certificate. It is a rule of law that an engineer's certificate will not be considered as a condition precedent to a partial or final payment unless it is definitely and distinctly stated so to be in the contract. The control of the money bag is often supreme and in this way engineers and officials have it in their power to make or break a contractor. A reputation of an engineer for prompt and fair estimates and of an official for prompt payments is sure to result in lower bids and better construction work.

Having considered these few most important matters and with an understanding of the legal principles involved cannot we in the future have justice and equity and not vengeance, spite or bossism in road construction work? The result of such a change, where it is necessary, cannot but be beneficial to all concerned.

Repairs.—There seems to be a tendency in some of the present day road contracts to require a contractor to maintain the road for a specified length of time, usually one to five years. Is that a good and economical requirement? Does it not, to a certain extent, restrict bidding and contracting to local parties? Are not the unit prices and hence the contract total largely increased to take care of an unknown amount of repairs? Is there not a gamble on that matter? The best of roads require constant inspection and repairing to keep them in shape. That work should be done either under a strictly repair contract or by the state or municipality itself. This criticism, of course, is more applicable to country roads as differentiated from city streets.

Summary.—In a late article of mine advising architects respecting employment by state or municipalities the following rules were formulated which would seem pertinent here:

(1) Know that the municipal corporation is acting pursuant to the law creating it.

(2) Know that your contract does not cause the indebtedness of the municipality to exceed its constitutional or statutory limit.

(3) Know that your contract does not exceed a limit above which advertisement and acceptance of the lowest bidder is required or that proper advertising, awarding, etc., has been done.

(4) Know that assessments or taxes to pay for public improvement work which include your compensation are valid.

(5) Know that the board or official employing you do so in the proper legal method required by the oct incorporating the body or by the charter or by the local rules governing such body.

(6) Know that funds are available or a specific appropriation made by the proper authorities to pay you before proceeding with your contract work.

(7) Have your contract in writing and know that it is worded properly.

(8) Have and put everything in writing and act only upon the strict wording of all contracts.

(9) In state work ascertain first if there is a state board or court of claims; if not you must depend on the official honesty and integrity of the official with whom you deal. Remember personal honesty and official honesty are contradications in some officials.

(10) Never consider or do any public work without first consulting competent legal advice.

While the above advice for the contractor will give him some knowledge of his position in a road contract, yet it does not protect him from the many abuses now possible under such contracts. Those must be corrected by honest, conscientious officials who will countenance only the same character of engineers. Contracts and general specification conditions for road work must be drawn solely for that class of work and not copied slavishly from ancient documents used for buildings, etc. There must be no discrepancy between the contract clauses and the general conditions or other parts of the specifications. Unit prices for unit quantities of specified work with full details in the plans and specifications or cost plus percentage contracts for definite work with opportunities for honest, competitive bidding and awards to lowest bidders are essential. All unnecessary "satisfaction," "discretion," "warranty," "final and conclusive decision," "waiver of damages," "waiver of claims," "waiver of right of action," etc., clauses and other similar oppressive or "club" clauses for the official and engineer must be eliminated. They certainly are anything but a sanction for the expectation of good faith . . . in the mutual dealings of men of average right-mindedness. Lastly, and most important, the agreement between the parties must be made a real contract by giving the contractor the power to assert and prove his claims before a competent court or board.

It is probable that next year a commencement will be made with the construction of the railway bridge between Rugen and the mainland, which will be the longest in the world, exceeding even that over the Hohangho, with its 3,580 yards. The cost of this great engineering work is not expected to amount to more than $5,000,000, or less than a third of that on the Forth bridge. When the bridge, which, it is said, is to include a track for pedestrians, though none for road traffic, is completed it will substantially shorten the journeys between Berlin and Hamburg on the one hand, and Stockholm and Christiania on the other.

The value of the mineral production of Queensland for 1912, according to the annual report of the Minister for Mines, was £4,175,355, including coal. The increase over the preceding year was £514,292, due to the stimulating influence of high prices for metals, together with a noticeable advance in the yield of copper, tin and other minerals. The value of the gold yield for the year was £1,477,979, less than that of copper, and a decrease from 1911. Mount Morgan continues to be the leading mine. Of the copper mines, the Cloncurry is the foremost producer, making a contribution of 10,435 tons. The total copper production was 23,120 tons. While prospecting for tin was active, there were no new discoveries of importance made during the year. The tin-ore production was 3,230 tons, valued at £364,503. The silver production was 569,181 oz. Lead, tungsten, manganese, bismuth, molybdenite, opal and other gems were also produced.

A NEW PROCESS OF CLEANING PRODUCER GAS.

IN 1902 Mr. H. F. Smith, Mem. Am. Soc. M.E., instituted a series of investigations to determine the nature of the mechanical impurities present in producer gas from bituminous coal with a view to devising more effective methods for their removal. These investigations have since been continued and have resulted in the development of a commercial apparatus involving some new and interesting principles which are described in the following article, recently presented as a paper to the American Society of Mechanical Engineers, and appearing in the Journal of the Society:

The tar and other mechanical impurities present in raw bituminous producer gas are in an extreme state of subdivision. The number of particles present is so great and the quantity of gas to be handled in commercial plants so large that the problem presents more than ordinary difficulties. The effectiveness of the ordinary types of mechanical gas washers and purifiers leaves much to be desired. The primary object has accordingly been to produce equipment that will be capable of yielding gas of a higher degree of cleanness than obtainable by ordinary

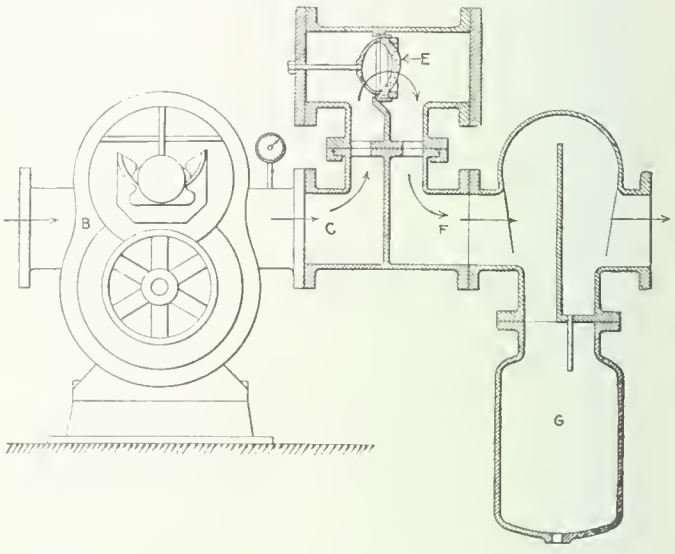

Fig. 1.—Static Scrubber Layout.

methods. The apparatus in its present stage of development can be readily understood from Fig. 1.

The raw producer gas, on leaving the producer, is first cooled to a point where the tar vapors are condensed by being passed through a primary cooler or condenser. From this the gas is carried into an ordinary rotary gas pump *B* which delivers the gas under pressure into the main *C*; it is then delivered through a porous diaphragm *E* and discharged from there into the main *F*. A sump or separator *G* is provided in which the tar accumulates.

The structure of the diaphragm *E* is a matter of considerable importance for the successful carrying out of this process and the materials used seem to have an important bearing on the operation of the equipment. The diaphragm must be sufficiently porous to permit the gas and tar to pass freely, otherwise it will soon become blocked with deposits from the gas and fail to operate. Many materials may be used for this purpose, but at present spun glass is preferred. The glass fibres are not only entirely unaltered by chemical action but seem to possess the necessary physical properties for the successful carrying on of this process. The spun glass in the form of ordinary glass wool (which should be carefully distinguish-

ed from slag wool, as the latter is not practicable for this purpose) is built into the form of a uniform diaphragm and is retained between two metal screens. The density of the diaphragm can be regulated by the quantity of glass used and by the degree of compression maintained between the metal screens. Ordinarily, this diaphragm is made up to a thickness of approximately one-quarter of an inch. The diameter of the diaphragm must be adjusted in accordance with the quantity of gas to be treated. Ordinarily, about 400 cu. ft. per hr. can be handled for each square inch of diaphragm area. No tar is retained in the diaphragm, both tar and gas being discharged together.

In passing the diaphragm an important change in the physical state of the tar occurs. On the entering side the tar exists in a large number of minute particles, ordinarily known as tar fog. In passing the diaphragm these particles are caused to coalesce so that on the discharge side the tar particles are of relatively large dimensions, so large in fact that they can no longer be carried forward in the gas current and immediately separate out by gravity. All that is necessary for the complete separation of the tar from the gas is to provide a sump, or drip, into which the precipitated tar can drain.

It appears to be possible to secure almost any desired degree of gas cleanness simply by regulating the pressure maintained across the diaphragm. In ordinary commercial operation, it is found that a difference in pressure of from 2½ to 4 lb. will give a degree of gas cleanness that is ample for any commercial requirement. Thirty cubic feet of gas cleaned in this way can be passed through a white filter paper without producing any discoloration.

The distinction between this process and the process of purification by filtration can be best shown by outlining the conditions essential for each process:

(1) In filtration the best separation is secured when the rate at which the materials to be separated pass the filtering medium is slow. One of the substances to be separated remains in the filter.

(2) In the process in question good results can be secured only when the velocity of the gas passing through the diaphragm is very high. Nothing whatever remains in the diaphragm.

At low velocities the gas will pass through the porous diaphragm used in this apparatus without any apparent alteration, and the degree of effectiveness of cleaning is directly related to the velocity of flow. For example, the degree of cleanness produced with the velocity of flow resulting from 1 lb. pressure, and when the velocities are as low as those produced by a pressure of a few ounces only, there is no perceptible change in the tar content of the gas after passing through the diaphragm.

No water is used in connection with this process except that required to cool the gas. As a consequence there is no production of tar emulsion and the water flows from the condenser perfectly clear. The tar separated by this process is practically water free, and can accordingly be used for any purpose to which cool tar is adaptable. One sample of tar drawn directly from the receiver showed on distillation a water content of less than 1 per cent. as compared with from 20 to 60 per cent. which is ordinarily present in gas producer tar from mechanical washers. The calorific value of producer tar from Hocking coal is approximately 15,800 B.t.u. per lb., about 140,000 B.t.u. per gal.

For the maintenance of continuous operation the tar must be sufficiently fluid to pass through the porous diaphragm without creating undue resistance, and therefore it is necessary to maintain the temperature of the gas entering the diaphragm at a point that will reduce the viscosity of the tar to as low a point as is consistent with complete condensation of the tar vapors.

It is also apparent that this apparatus would not be well suited to use on gas containing large quantities of lamp black or for purification of gas from coals yielding very heavy viscous tars. For high volatile coals, however, such as are found in Ohio, Indiana and Illinois, and for lignite, it has been found in practice to be thoroughly practical and effective. It is possible that further developments may extend the applicability of this method to conditions which are not now considered practical.

The exact method by which this tar extractor operates has not been conclusively demonstrated. Two theories have been advanced which may possibly cover the ground: The first and most obvious is that the tar particles are precipitated by being brought into direct collision with the threads or filaments of the porous diaphragm.

That this does not constitute a complete explanation of the process is indicated by the fact that the material of which the porous diaphragm is constructed has a marked bearing on the effectiveness of the process and would indicate some action other than simple mechanical collision. For example, if the porous diaphragm is made up of steel wool instead of glass wool (the physical structure of the diaphragm being as nearly as possible the same in each case) the process does not operate with anything like the effectiveness secured with glass diaphragms. It would seem that the possibility for collision would be the same in both cases.

A phenomenon, first observed by the writer in 1902 during some experimental investigations, gives further credence to the theory that there is some action other than pure mechanical collision. If the gas is caused to pass through a small tube with perfectly smooth walls, as for example a tube of glass, no particular precipitation of tar occurs as long as the velocities of travel are slow. However, as the velocities increase to a point where there is considerable friction between the gas and the surface of the containing tube a heavy precipitation of tar occurs on the surface of the glass. This fact leads to the conclusion that friction is in some way concerned in this process, since the probability of mechanical collision is rather remote. Since friction between rapidly moving gases and enclosing tubes is known to be productive of electrical phenomena, it was assumed that this might possibly have some bearing on the action of this process. In fact this interpretation was the one first placed upon the phenomenon observed in 1902 and an effort was made to work out a tar extractor along this line.

An experimental apparatus was constructed at that time in which heavily charged electrodes were employed to precipitate the tar particles and it was found that fairly effective results could be secured. Experiments along this line continued for a number of years, but the difficulties in the way of producing commercially practical apparatus caused its final abandonment. The rate at which the tar particles could be moved through the gas under the influence of moderate potential gradients was very slow. It was accordingly necessary to use exceedingly high potentials in order to secure effective results. With the spacing of electrodes of approximately 1½ in. a potential dif-

ference of 25,000 to 35,000 volts was required for effective precipitation. On account of the difficulty of maintaining proper insulation under these potentials and on account of the great danger of serious injury to an unskilled operator in manipulating apparatus of this kind, this method was not considered practical. It was noted, however, that by decreasing the distance between the electrodes a very marked decrease in potential was observed. Accordingly another experiment was devised which will perhaps throw still further light on the method of operation of the process under consideration.

A series of electrodes was prepared with exceedingly small intervening spaces, and placed in connection with a source of direct electro motive force, the potential difference between the plates being much below that required to produce any ionizing discharge. It was found that at these small distances distinct cleaning effects could be obtained without ionization. Maintenance of the electric charge from external sources was troublesome owing to electrolytic short circuits occurring between the electrodes through deposits of tar and moisture from the gas. The fact, however, that there is a distinct attraction exerted by electrified plates at comparatively low potentials (which is sufficient to cause a precipitation of tar particles from gases) leads to the conclusion that if the distance between the electrodes could be reduced sufficiently the potential differences required for effective electrical action would be very small.

It would seem possible, therefore, that in addition to the effects of mechanical collision there might be a distinct electrical attraction exerted by the glass fibres constituting the porous diaphragm which are located at microscopic distances from each other and which are undoubtedly subjected to some electrification from friction with the gas currents. If the possibility of such electrical action is considered, the increased effectiveness of glass as compared with steel for the construction of the porous diaphragm is satisfactorily explained. That friction of this nature is capable of producing electrical disturbances of considerable magnitude is well established.

It might be interesting in this connection to refer to recent experimental determinations by Professor Dolezalek of Charlottenberg, Germany, who showed that the friction of liquid benzol against the sides of containing pipes may set up potential differences of as much as 3,000 volts. As a very small fraction of this potential would be sufficient to account for the observed effects, it would seem only reasonable to presume that in addition to the effects of mechanical collision which undoubtedly exist, there is some electrical action which is of material aid in causing the coalescence of the particles of tar fog.

Whatever may be the correct explanation of the phenomenon, its effectiveness and practical importance are beyond question. The first commercial equipment of this kind has now been in continuous operation for approximately 18 months. This outfit is handling gas for a producer gas power plant of approximately 1,000 h.p. capacity. The second commercial equipment is handling approximately 900 h.p. producer gas, and has been in daily service for approximately ten months. The largest single installation is an equipment for cleaning 200,000 cu. ft. of gas per hour. This installation is operated in connection with a single producer unit which is of interest because it is one of the largest single unit plants ever installed in the United States. This producer has an effective grate surface of 250 sq. ft. and is rated to gasify 3,000 lb. of Illinois bituminous coal per hour.

SUCTION CONVEYERS.

By Reginald Trautschold, M.E., New York City.

THE economical handling of ashes from the furnace in power stations, etc., has always presented one of the most difficult of conveying problems, for the hot ashes cause rapid deterioration of any apparatus that they come in contact with, and the fine dust is detrimental to bearings, links and all pivoted connections as well as any surfaces of contact as it works into or lands on surfaces and produces destructive abrasive wear of the moving parts. Quenched ashes may be even more destructive owing to chemical properties of the ashes, so that the handling of ashes, either as they drop from the grates or after being sprayed with water to lower their temperature, cannot be performed with maximum economy by any of the continuous conveying or elevating systems of mechanical handling. Systems of the intermittent type are usually more satisfactory, owing to the fact that the ashes may be thoroughly cooled before delivery to the conveying apparatus, but ordinarily some car system or even more manual system of handling the ashes proves the most satisfactory in the long run—at any rate, in installations where but a relatively small quantity of ashes have to be disposed of. In a power house developing less than 2,000 h.p., the skip-hoist, a heavy bucket elevator or some car system is generally the most economical equipment for the handling of the ashes, but for larger plants —from 10 to 15 per cent. of the coal consumed being converted into ashes that have to be removed from the ash-pits—the suction conveyer proves an economical system to install.

The suction conveyer may also be employed for the handling of cement clinkers, comparatively fine materials of any description, etc., which, on account of their heat, chemical properties, fineness, etc., prove unsuitable for conveyance or difficult to handle by the ordinary mechanical types of conveyers. Even fine coal and similar materials have been economically and efficiently handled by the suction conveyer, but as the logical field for its operation is the handling of ashes, cement, lime, wood chips, etc., and the progress made in the development of this comparatively new method has been largely limited to ash handling installations, a description of a typical installation of such character will serve to show the advantages and convenience of the system.

Primarily, a suction conveyer consists of a heavy steel or cast iron duct in which the material to be handled is carried; an overhead storage tank of steel or concrete, in which a partial vacuum is maintained by an exhaust fan, to which the conveyer duct discharges; and a water spray in the storage tank for cooling the ashes, precipitating the fine dust, etc. In an ash-handling installation, the duct, consisting of an ordinary pipe, runs directly in front of or under the boilers below the boiler room floor, and is provided with a small intake in front of or under each grate. These intakes are each provided with an easily removable but tight-fitting cover which is kept closed except when the conveyer is being charged at that particular intake. On leaving the boiler room, the conveyer duct rises to the top of the elevated storage tank to which it discharges downward, the discharge pipe or conveyer duct extending downward in the storage tank for some little distance. From the storage tank, usually also from the top, an exhaust pipe extends to an exhaust fan which sucks the air from the storage tank, creating a partial vacuum throughout the conveying system. Below the ex-

haust pipe from the storage tank and above the discharge end of the conveyer duct, a water pipe in the storage tank delivers a fine spray over the material from the conveyer duct, quenching the ashes and precipitating the fine particles of dust and thus preventing their being drawn up into the suction pipe by the exhaust fan. As a further precaution against damage to the exhaust by fine particles of material that might not be precipitated by the water spray, the exhaust pipe is frequently equipped with a special dust collector.

The operation of the system consists simply in removing the cover from an intake and bringing the ashes or other material to be handled to the opening, the air rushing through this open intake then picks up the material and carries it to the storage tank. The velocity of the air through the conveyer duct being at a maximum at the centre of the pipe and decreasing towards the walls of the conveyer duct, the tendency of the load is to remain in suspension while being swept along by the rushing air, thus reducing the wear on the sides of the duct to a minimum—in fact, no wear or deterioration of the conveyer duct pipe on straight stretches is apparent even after several years' operation, the rapidly moving air preventing the gathering in the duct of any moisture or other agents that might have injurious effects. Any depreciation of duct, on level stretches, must therefore come from the outside and this can, in large manner, be guarded against and prevented. At elbows, however, the abrasive wear is great, the particles of material striking the elbow obliquely and being deflected back into the path of the moving air. This scouring action is so marked that ashes will wear away an ordinary elbow in short time. To overcome this drawback, the elbows are constructed with removable backs of manganese steel, carborundum or other substance possessing high resisting qualities to abrasive wear which may be easily and relatively inexpensively replaced as they wear out. Such wear-resisting elbows are placed wherever the general path of the conveyer duct changes direction. The scouring effect of the load on the elbows, which is so great as to bring them to a high state of polish, tends to keep the reduction in speed of air and load through the duct, due to a sudden change of direction, at a minimum.

For a simple installation of small capacity, the rotary exhauster for removing the air from the storage tank consists of a centrifugal fan, while for a larger and more complex system a cycloidal blower is employed. The exhauster discharges to the atmosphere and is in operation for only long enough to create the necessary vacuum in the system before the load is delivered to the conveyer duct intake and while the conveying is in actual productive operation. At other times, the vacuum in the system gradually disappears and the material handled may be removed from the storage hopper, the emptying gate of the hopper discharging to wagon, car or other conveying system, as the case may be. Though the conveyer duct of a suction conveyer may have several intakes, any one of which may be used to load the conveyer, the discharge from the duct must always take place into the storage hopper of the system. In the case of handling ashes, this is no great drawback, as, ordinarily, no further handling of the ashes is necessary, the ashes being discharged from the storage tank to the vehicle removing them from the plant. When handling other material than ashes, such as coal, other systems of conveying machinery or some type of car is necessary for delivering the material from the storage tank to storage or to whatever point it is to be used. If material is placed in storage before being used, it can frequently be reclaimed by the suction conveyer through a duct running under the stor-

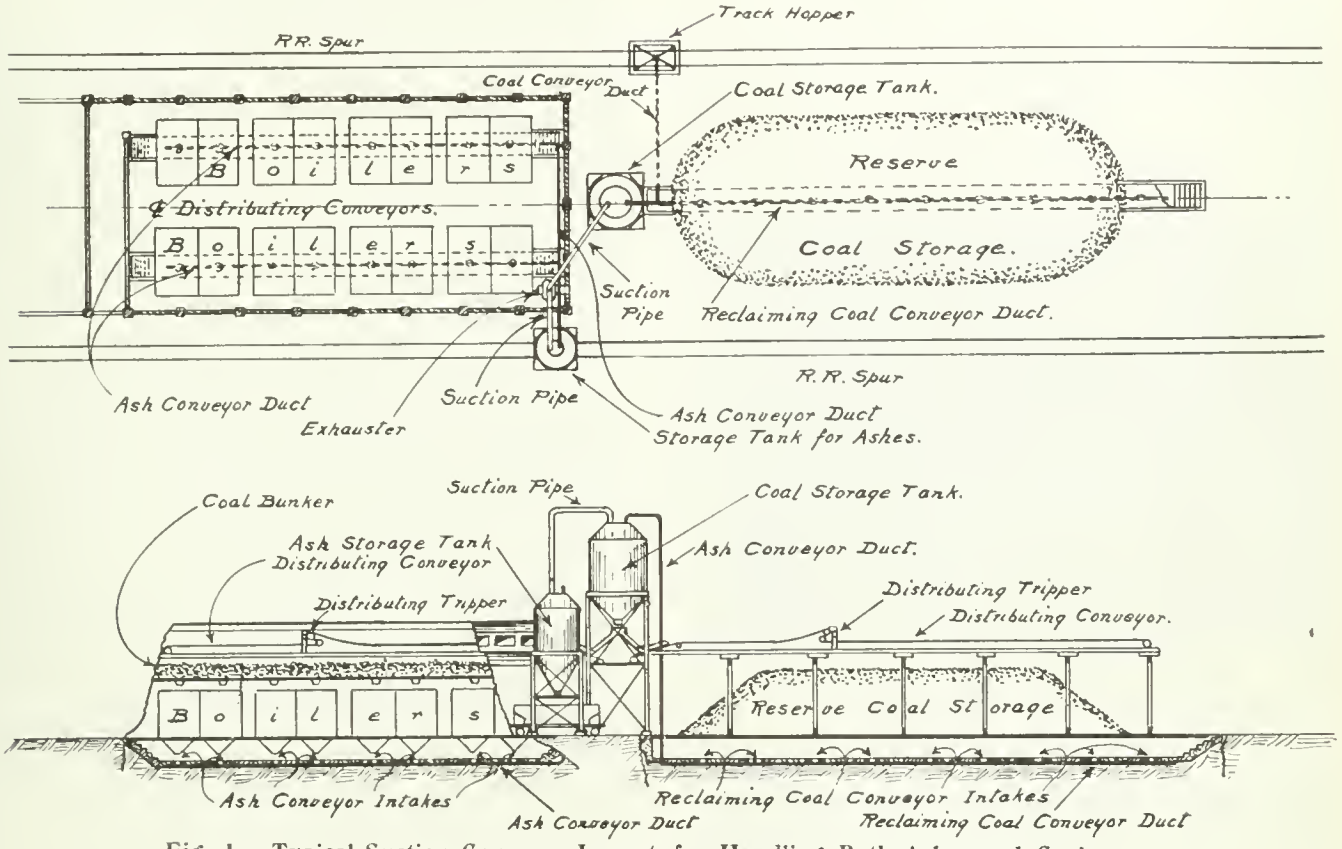

Fig. 1.—Typical Suction Conveyer Layout for Handling Both Ashes and Coal

age pile and discharging to the same storage tank serving for the conveyer duct handling the material before it is put in storage, distribution to point of consumption, either before the material is placed in storage or after it is reclaimed, being performed by other type of conveyer or car.

Capacity.—With a fixed velocity of air through the conveyer duct, quantity of air that can be removed by a centrifugal exhauster varies with the square of the diameter of the duct and as the degree of vacuum that can be maintained also depends upon the rate of air removal, the carrying capacity of a suction conveyer varies directly with the square of the diameter of its duct. The diameter of the conveyer duct being used to designate the size of the conveyer, Table XIII. gives the carrying capacity of the various sizes of suction conveyers handling ashes and handling fine coal. The range of sizes of conveyers given in the table is somewhat greater than those which may be termed standard, for a 6″ conveyer, the smallest standard size, has an ash-handling capacity sufficient to care for a power plant of from 2,000 to 4,000 h.p. capacity, while the largest standard size, 10″, can handle all the ashes from a 30,000-h.p. plant. The capacity of the standard sizes of conveyers, 6″, 8″ and

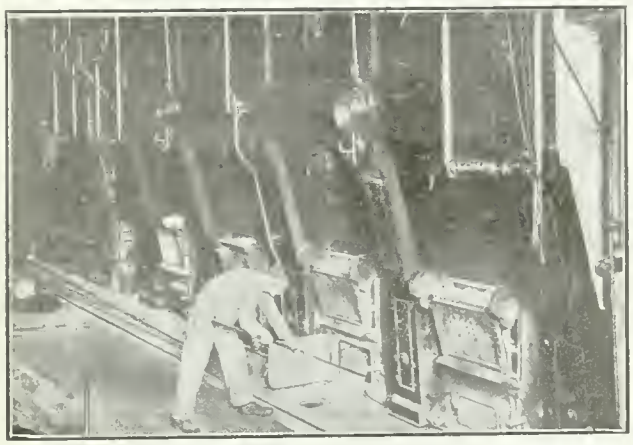

Fig. 2.—A Suction System in Operation. Conveyer Duct is Directly Beneath the Floor.

10″, are compiled from results actually attained in practice and show that not only does the capacity of the system vary with the square of the size of conveyer, diameter of its duct, but that the capacity appears to vary directly with the respective weight of the material handled. Though this appears to be so for ashes and fine coal, it is doubtful if such a relationship can be taken as a law. However, for the materials particularly adaptable for handling by the suction system such relationship is doubtless sufficiently general for all practical purposes. Expressed in the form of a convenient equation the relationship existing between capacity of the conveyer and its size (diameter) and weight of material handled is given as Formula XXVI.

Table XIII.—Capacity of Suction Conveyers in Tons Per Hour.

Diameter of duct. Size of conveyer.	—Capacity of handling— Ashes. Tons.	Fine coal. Tons
4″	2.60	3.70
6″	5.85	8.00
8″	10.35	14.10
10″	16.30	23.05
12″	23.50	32.25

$$W = 0.00385\ w'd^2 \quad \text{.....Formula XXVI.}$$

Where:—

W = Capacity of suction conveyer in tons per hour.
d = Diameter of conveyer duct in inches.
w′ = Weight of material handled in pounds per cu. ft.

Though the foregoing capacity table and formula are approximately correct, it must be remembered that suction conveyers, which may be classified as belonging to the class of conveying apparatus of the continuous type, cannot be operated continuously and the results attainable in practice must be based on very occasional service. That is, such a conveyer must necessarily be idle much of the time, so, in choosing the proper size to install, the capacity per hour must be taken as the maximum rate during the occasional periods of operation.

Power Requirements.—In the consumption of power, the suction conveyer differs from any other type of conveyer in that the length of conveyer has practically no effect upon the power requirements, these depending almost entirely upon the size of conveyer and therefore upon its capacity. This peculiarity is due to the fact that after a certain degree of vacuum is created in the system no more power is required to maintain such vacuum in a long conveyer than in a short one. Leakage through intakes that are not tightly closed do tend to destroy the vacuum of the system, but this leakage is so slight compared to the inrush of air through the intake that is being used for loading that for all practical purposes the length of the conveyer has no effect upon its power requirements. A long conveyer, it is true, requires more air to be withdrawn to create a given vacuum, but the volumetric contents of the duct per foot is so small compared with the contents of the storage tank from which the air must also be exhausted that it takes practically no more time to produce the partial vacuum in a system 1,000 feet long than in one of half that length. The height to which any material of given weight can be raised by suction is fixed, but the maximum lift for any substance suitable for conveyance by the system is well in excess of the elevating requirements of any ordinary installation, so that the power requirements of any suction conveyer may be simply expressed in terms of its diameter and the weight of the load handled. (See Formula XXVII.).

$$d^2 = \frac{260.4\ W}{w'}$$

$$HP = 0.555\ d^2 = \frac{144.52\ W}{w'} \quad \text{.....Formula XXVII.}$$

HP = Average HP required
d = diameter of conveyer duct in inches.
W = Weight of load conveyed in tons per hour. (Table XIII.)
w′ = weight of material conveyed in pounds per cu. ft.

By far the most expensive pieces of apparatus required for a suction conveyer are the exhauster, storage tank with its accessories and the dust collector, and the cost of these depends not upon the length of the conveyer but upon its size. The cost of the balance of necessary equipment, including the conveyer duct, suction pipe, intakes, elbows, etc., varies with both the size and length of the conveyer, but form such a relatively small part of the total cost of equipment that there is really little difference in the cost of the average installation of any given

size. That is, the length of conveyer for the average installation may be neglected in figuring an approximate initial cost for the installation—it being understood, of course, that the length of conveyer be neither extremely short nor unduly long. Neglecting the question of length, then, its cost will vary closely with the square of its diameter, or with its carrying capacity. The average relationship existing between initial cost and size of conveyer and capacity of conveyer, deduced from an examination of actual costs of numerous installations, is given as Formula XXVIII.

$$C = 145\ d^2 = \frac{37{,}750\ W}{w'} \quad \text{.....Formula XXVIII.}$$

C = Initial cost in dollars.
d = diameter of conveyer duct in inches.
W = Weight of load conveyed in tons per hour—capacity, Table XIII.
w' = weight of material conveyed in pounds per cu. ft.

Net Operating Cost.—To arrive at the economic value of a suction conveyer, represented by its net cost of operation, a number of assumptions must be made, as this method of handling materials is of such recent development that there are no authentic records from which depreciation, expense for attendance or the cost of incidental supplies can be calculated. However, as these expenses are all practically limited to those in the operation of the exhauster and as records of similar centrifugal fans and cycloidal blowers are known, calculations may be made that should be approximately accurate in the majority of installations. (See derivation of Formula XXIX.). The consumption of power, or the amount of power chargeable to each ton of material handled, is also difficult to ascertain accurately. Careful tests have ascertained the power consumed during actual operation under capacity (see Formula XXVII.) but this type of conveyer must necessarily operate under frequent and considerable variations of degree of load, all of which require approximately the same supply of power as does also the conveyer when carrying no load at all but maintaining the necessary degree of vacuum. Assuming that during 20 per cent of the time that the exhauster is in operation, the conveyer carries its capacity—a record that careful attention to efficient operation should make possible—the average net operating cost of the system, per ton of material handled or other unit, may be expressed in the form of a simple equation. (See Formula XXIX.).

$$\text{Average cost of equipment per ton capacity} = \frac{145\ d^2}{NW}$$

Average hours of operation per year at capacity = 180 = N

Average cost of equipment per ton capacity = $0.806\ d^2/W$

Cost of Power:

Net = $0.555\ d^2\ P_o/W$

Actual = $5 \times 0.555\ d^2\ P_o/W = 2.775\ d^2\ P_o/W$

Attendance—

Average = $1.850\ d^2\ P_o/W$

Supplies—

Average = $2.375\ d^2\ P_o/W$

Interest 6% total cost
Insurance 1%
Taxes 2% ¾ cost
= $0.0685\ d^2/W$

Depreciation, renewals, etc.
Dep. acc't., 10% of dep.
= $0.0265\ d^2/W$

Net operating cost = $0.0950\ d^2/W + 7.000\ d^2\ P_o/W$

$$\text{N.O.C.} = \frac{(95 + 7000\ P_o)d^2}{1000\ W} \quad \text{.....Formula XXIX.}$$

N.O.C. = Net operating cost per ton handled, in dollars.
d = diameter of conveyer duct (size of conveyer) in inches.
W = Weight of load (capacity) conveyed in tons per hour.
P_o = Price (cost) of power per horsepower.

Example:

Conditions—
Size of conveyer .....8″
Material handled .....Ashes
Cost of power .....$0.02 per HP.

W = 10.35 tons (Table XIII.).

$$\text{N.O.C.} = \frac{(95 + 7000 \times 0.02)\ 64}{1000 \times 10.35} = \$1.424 \text{ per ton of ashes.}$$

The conditions of the example cited are typical of a coal-burning power house of about 8,000 hp. capacity, and the work entailed consists of conveying the ashes a total distance of some 500 to 1,000 feet and placing them in an overhead storage tank from which they can be easily removed for final disposition. The total cost of performing such operations is equivalent to a charge of about 14¼ cents for the disposal of ashes per ton of fuel consumed. In such a plant, the expense of disposing of ashes ordinarily amounts to from 15 to 25 cents per ton of fuel consumed, depending upon the conveying system employed. The difference between such rate and 14¼ cents does not, however, indicate the full economic value of the suction conveyer. The cleanliness, convenience and reliability of the system adds greatly to its real worth and it is unfortunate that the high initial cost of a suction conveyer installation and its consumption of power prohibits its use for small plants. When handling heavier materials, or at such service as permits its more continuous operation, the net cost of operation per ton handled is reduced, and further development and progress in this method of conveyence will, without doubt, open many new fields in which the peculiar advantages of the suction conveyer will enable it to show decidedly higher financial economy in operation.

The list of the various awards made at the International Building Exposition, held in the city of Leipzig, Germany, during the past summer has now been received. Among those who were awarded the gold medal of the Exposition and the various silver and bronze medals and diplomas is found quite a number of United States firms, mostly of a commercial nature, but it is gratifying to find near the end of the list three engineering organizations and an individual engineer. The Alsace Lorraine prize was awarded the Board of Water Supply of New York, while Gustav Lindenthal, the American Bridge Company and the Strauss Bascule Bridge Company, of Chicago, were awarded the gold medal of the city of Leipzig. Mr. Lindenthal, in connection with the American Bridge Company, exhibited plans of the Hellgate Bridge, etc., while the Strauss Company had a small exhibit of models and photographs of Strauss bascule and lift bridges, which, however, attracted considerable attention, owing to the large number of successfully completed structures which the exhibit represented.

SALT IN CONCRETE.

In July 31st issue of *The Canadian Engineer* an article appeared containing a summary of observations made by the U.S. Bureau of Standards upon the action of salts in Alkali and sea water on cement and concrete structures. The reader is referred to the conclusions therein, in connection with the following report of a series of tests to determine the effect of sodium chloride and calcium chloride, separately and together, upon 1:2:4 concrete were made at the University of Wisconsin during the winter and spring of 1912 by Messrs. H. E. Pulver and S. E. Johnson, instructors in mechanics. The test pieces were cured at temperatures of from 60 to 75 deg. Fahr. and below freezing. The results have been published in the "Wisconsin Engineer" by Mr. Pulver.

All mix was by volume and the salts were dissolved in the mixing water. The test pieces were 4-in. cubes, and those cured at a temperature below freezing were broken after fourteen and sixty days, while those cured at normal room temperatures were broken after fourteen, sixty and three hundred and sixty days. Four pieces were tested at each age for each batch of concrete. Atlas Portland cement was used, and to prevent variation in the quality it was mixed thoroughly in the beginning and a sufficient quantity stored in airtight cans.

The test curves show that as the percentage of NaCl is increased there is a nearly straight line decrease in the strength of the concrete cured under normal conditions. The effect of NaCl alone, when added to concrete cured at low temperature, is probably to reduce the freezing temperature, and hence retard the freezing of the concrete, thus permitting of its setting and hardening. The curves show an increase in strength for the addition of NaCl up to 12 per cent., after which there is a decrease. It may be that beyond 12 per cent. the weakening of the concrete due to the excess of NaCl more than offsets the strengthening due to the reduction of the freezing temperature.

When $CaCl_2$ alone is added to the concrete, cured either at normal or low temperatures, the effect is to increase the strength up to about 4 per cent. $CaCl_2$, at which point the maximum strength seems to be obtained. This increase in the strength of the concrete may be due to the acceleration of the setting of the cement by the $CaCl_2$. Serious disintegration was observed on the surfaces of the cubes cured at low temperatures with 6, 8 and 10 per cent. of the $CaCl_2$. This disintegration did not appear on any of the cubes cured at normal temperature or where NaCl was used.

With concrete cured at low temperatures, the best effect seems to be obtained by using both NaCl and $CaCl_2$ in the mixing water. It was noted that a 2 per cent. $CaCl_2$ and 9 per cent. NaCl mixture appears to give the most satisfactory results. For concrete cured at low temperatures this mixture gives about as much strength as any of the mixtures tried, and for the concrete cured normally there was not a very great reduction in strength due to the addition of the salts in those percentages.

All tests were made with only one brand of cement. It is probable that there would be some variation in the results with other brands, but it is not thought that this variation would be great enough to affect the general conclusions. It is also possible that some brands of common salt might contain a sufficiently high percentage of calcium sulphate to affect the results to some extent.

TRAFFIC SUITABLE FOR VARIOUS ROAD SURFACES.

The Massachusetts Highway Commission, after some years of study and experiment, has made the following statement of the effect of traffic on roads and the necessity of legislation governing the relation of width of hard tires to the loads carried by them:

A good gravel road will wear reasonably well under a daily traffic composed of 50 to 75 light teams, 25 to 30 loaded one-horse vehicles, 10 to 12 loaded two or more horse-drawn wagons, and 100 to 150 automobiles. With a larger number of automobiles, the gravel should be oiled. The oiling presents what is spoken of as a "blanket surface" consisting of heavy asphaltic oil and sand. If the oil be applied hot, the blanket surface will last 3 to 5 years, if cold, it must be renewed every year.

Oiled gravel will stand fairly well under 75 to 100 light teams, 30 to 50 heavy one-horse vehicles, 20 heavy wagons with two or more horses, and 500 to 700 automobiles daily.

Waterbound macadam will stand under a daily traffic of 175 to 200 light teams, 175 to 200 heavy one-horse vehicles, and 60 to 80, perhaps more, heavy wagons with two or more horses. If even 50 to 100 automobiles per day go over the road at high speed dust-layers will be serviceable. With a really good dust-layer the road will stand 300 to 500 automobiles a day, although the stones will wear.

Waterbound macadam with an oil and sand blanket, applied hot, will be economical with 150 to 200 light teams, 75 to 100 heavy one-horse vehicles, 25 to 30 heavy wagons with two or more horses, and automobiles, up to 1,400, or more with fewer teams and with 50 or more motor trucks. The large number of automobiles seems to keep the oil rolled down when it would cut up and crumble without this traffic.

Dr. Alfred Thompson, M.P., stated recently that this year in the Yukon more than $5,000 in gold was taken out, chiefly by the Guggenheims and the Boyles. The production of gold by individual miners was comparatively a negligible quantity. Most of the gold was taken out by dredges, the two big companies each operating four mammoth diggers. Two of the dredges operated on the Boyle concession are among the largest in the world. Power for operating the dredges was furnished by the development on the Yukon River, installed and controlled by the Treadwell people. During the low-water period in September a steam power plant installed some years ago at Coal Creek, a short distance down the river from Dawson, was brought into service, so that the dredges were operated for full six months.

The main line of the Transcontinental will total a trackage of 3,550 miles from Moncton to Prince Rupert; but that does not comprise the whole system by any means. There are to be many branch lines taking care of settlements in sections of the country hitherto unprovided with transportation facilities. These lines, upon which, in some instances, a beginning has been made, will amount to over 1,000 miles of added trackage, and will tap large territories hitherto inaccessible. These branches, or lateral lines, are to serve new populations, which will follow them in line of the system, and then spread over the new country served by spur trackage, which will connect them with the great artery through which their products will be brought to the centres of population in older Canada.

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CONTENTS OF THIS ISSUE.

	PAGE
Editorial:	
Ottawa Water Project and Engineering Fees..	871
Leading Articles:	
An Emergency Stop-Log Apparatus	855
Tree Planting in City Streets	857
Legal Suggestions Respecting Road Contracts	860
New Process of Cleaning Producer Gas	864
Suction Conveyers	866
Salt in Concrete	870
Traffic Suitable for Various Road Surfaces	870
Letters to the Editor	872
Pavement Requirements in Ottawa	874
Electric Iron Smelting	877
The Oxidation of Coal	880
Coast to Coast	882
Personals	884
Coming Meetings	884
Railway Orders	885
Construction News	76
Technical and Municipal Societies	94

OTTAWA'S WATER PROJECT AND ENGINEERING FEES.

The letter, which appears in another column, relating to the nature of the contract between the City of Ottawa and Sir Alexander Binnie in connection with its Gatineau Lake water supply scheme, is misleading in a general way and does not do justice to the Ottawa civic authorities. The writing of this letter was evidently occasioned by the editorial comments of a New York journal which apparently created an erroneous impression by associating statements and comparisons respecting percentage fees, with the Binnie contract.

In *The Canadian Engineer*, October 16th issue, an article appeared outlining the proposal accepted by the City of Ottawa to bring its water supply from the Gatineau Lakes, a distance over all of fifty miles, at a total cost approximating $8,000,000. It was later announced that Sir Alexander Binnie, a well-known English engineer, whose recommendation had been adopted, had been retained by the city as designing and supervising engineer of the entire work.

In the letter, and in the New York editorial as well, the impression is conveyed that the engineer is receiving a fee of $75,000 for the privilege of drawing $1,000,000 for "engineering and contingencies," and of allowing a lawyer to buy $500,000 worth of land. From a $400,000 contract to carry out an $8,000,000 scheme, it is deduced that the fee is on a five per cent. basis, which is pronounced "good." Further, the editorial urges engineers who have become discouraged at the lack of financial recognition of the engineering profession, to take heart.

It was never proposed to pay Sir Alexander Binnie on any percentage basis whatever. The $400,000 fee includes $250,000 to pay assistant engineers and inspectors, while $50,000 more will no more than provide for the working out of the plans, specifications, salaries of draftsmen and office staff, etc.—leaving approximately $100,000 as the engineer's remuneration. The city had the alternative of paying the assistant engineers and inspectors, and leaving to Engineer Binnie the financing of drawing office and other disbursements. From this proposition he was to receive $140,000, and, as in the other case, his own remuneration would approximate $100,000. The city accepted the former proposal as the better of the two, although it thereby created apparent food for discussion.

As it stands, $100,000 is a good fee for an engineer on an undertaking such as this. For, analyzing this expenditure of $8,000,000, deducting the $500,000 for land purchase, on which small engineering service is required, also $976,000 for engineering and contingencies, and $3,600,000 for the gravity flow steel pipe line, on which the cost of design and supervision of construction is also comparatively small, (but essential, nevertheless, as it is a vital question with Ottawa), we have $2,900,000 left to be expended on construction work requiring a considerable amount of high-class engineering ability. But if Ottawa pays its engineer $100,000 for his services on this alone, what can we say by way of criticism, when Toronto has paid out $72,000 for engineering services in connection with the filtration plant that has cost $778,000 all told, designed and supervised by a New York engineer? Ottawa is taking no chances on the possibility of unsatisfactory work. It is not to be inferred that we parallel the case with that of the Toronto filtration plant, or that the expenditure connected with the latter was wasted. However, in Nov. 27th issue of *The Canadian*

Engineer we reviewed specifications for a new mechanical filter plant large enough to handle Toronto's entire requirements; and the name of the New York engineer who drew the $72,000 for the old (two years old) Toronto plant is not connected in any way with the design of the new plant.

Mr. Macdonald's reference to the new intake pipe and aqueduct has recalled an instance which may or may not have been in the minds of the Ottawa City Council. An editorial observation in a previous issue of the journal referred to, that two previous supply schemes were voted down by Ottawa, presumably owing more or less directly to the fact that each had been worked up by a New York engineer, may or may not have had its weight. With the first instance, Mr. Macdonald associates the word "disastrous." In the second, an engineer referred to has designed and superintended the construction of a number of Canadian engineering enterprises, and if there is a single one that has been popularly pronounced satisfactory, we have yet to learn of it, and it is our belief that the City of Ottawa cannot outdo us in the enumeration of instances.

Ottawa has an excellent source of supply in the Gatineau Lakes. The city is sorely in need of it. A satisfactory job is essential to the scheme. It is a big undertaking and it is worth money to the city to know that the man to carry it out entertains no scruples in the matter of remuneration.

Ottawa's recognition of engineering ability is not to be depreciated but praised. Deduct, however, the $75,000 which has been regarded as questionable, and who would care to undertake the work?

EDITORIAL COMMENT.

The last of a series of eight articles by Reginald Trautschold, M.E., appears in this issue of *The Canadian Engineer*. The series entitled "The Mechanical Handling of Materials," has created a good deal of interest among manufacturers, engineering-contractors, mining and structural men. The separate instalments, with the date of issue of each, are as follows:—

"Mechanical Handling of Materials," August 21st.
"Spiral or Screw Conveyers," September 4th.
"Belt Conveyers," September 18th.
"Belt Conveyers" (Part II.), October 2nd.
"Bucket Conveyers," October 16th.
"Handling Materials by Bucket Carriers," Nov. 6th.
"Skip Hoists," November 20th.
"Automatic Railways," December 4th.
"Suction Conveyers," December 18th.

* * * *

The piercing of Mount Royal within a few hours of the time at which it was estimated some months ago that the headings of the tunnel would meet, took place on the morning of Dec. 10th, and a train went through in the afternoon. How successfully this work has been carried out is indicated well in the extreme accuracy with which the headings were found to align. There was a difference of 0.75 inch in line and 0.25 inch in grade. The remarkable speed at which this accurate work was carried along shows that the undertaking was attended by clever supervision and excellent engineering skill throughout.

LETTERS TO THE EDITOR.

Fixed Carbon Limitation.

Sir,—In connection with the articles on the desirability of introducing a fixed carbon determination into specifications for the purchase of asphalt, I have only to add that, based on an experience of 25 years in the determination of this and other characteristics of the native bitumens, I believe it to be of the utmost value in several directions, and I may say that in the hands of a person of experience and enjoying daily practice in conducting the operation, there is no difficulty in obtaining results which are reliable within any error which is of importance.

The value of the determination of fixed carbon in any bitumen, and I should preferably denominate its residual coke, ash free, as involving less uncertainty as to the nature of this material, depends upon the direction in which it is applied and the manner in which the results are interpreted. Determinations of fixed carbon aid in differentiating bitumens of various characteristics or origin, and the requirement for such a determination in any specification may mean that under such specification bitumen of only a certain character is desired. If an engineer, in the light of service tests, prefers material which has been well proved to be satisfactory rather than residual pitch which has been a failure or is of an experimental nature, he will properly introduce into his specifications a provision that no bitumen would be acceptable under them which contains more than 15% of fixed carbon. In this direction a requirement of this nature is of the greatest value. On the other hand if he desires to purchase the cheaper and more experimental forms of bitumen, there would be no object in such a provision. In another direction, as Mr. Pullar has shown, the determination of fixed carbon in bitumens, representing any particular class of materials is most important in determining their uniformity, and the fact that they have not been overheated in the process of manufacture.

The value of the fixed carbon test, therefore, may be said to be based upon the care with which it is carried out, the objects for which it is used. and the intelligence with which the results are interpreted. We are certainly very much indebted to Messrs. Kirschbraun and Pullar for the efforts that they have made to show in what directions this determination is important and how it is to be interpreted.

If a city desires to use some of the cheaper and carelessly prepared residuals to the exclusion of the more expensive natural asphalts, there would be little object in introducing a fixed carbon clause in the specification, but if the highest grade of material is desired to the exclusion of the cheaper residual pitches made from oils which are unstable at the high temperatures used in their production, such a clause should certainly be one of those which should be provided.

CLIFFORD RICHARDSON.

New York, N.Y., Dec. 11th, 1913.

[NOTE—See issues of *The Canadian Engineer* for Nov. 13th, Nov. 20th, Nov. 27, Dec. 4th and Dec 11th for previous articles and discussions concerning the value of the "Fixed Carbon Test" in specifications for asphalt. This is an important subject for Canadian city engineers to consider, and the opinions which have already been expressed in these columns respecting the limitation of the percentage, being those of well-known engineering

chemists who have given the subject a careful study, differ to a degree warranting thorough discussion.—Editor.]

* * * *

Discussion on "Stresses in Circular Pipes."

Sir,—The bending moments in Circular pipes due to an uneven distribution of the internal pressure, the subject of Mr. Hogg's very interesting and timely paper, have been persistently ignored by many alleged experts to the detriment of the structure.

In reading over Mr. Hogg's paper, it appeared to the writer that, besides those formulæ Mr. Hogg has given for the bending moments due to a vertical load distributed over the horizontal section of the pipe and to a horizontal pressure uniformly distributed over a vertical section, it might be useful to give formulæ for the case

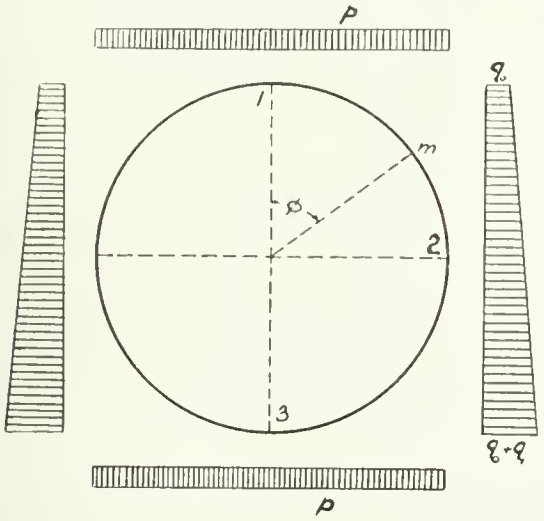

Fig. 1.

when the horizontal pressure is unevenly distributed, as shown in the accompanying diagram.

A circular structure is, generally speaking, three times statically indeterminate, but on account of the vertical diameter in this case being an axis of symmetry for the load, there will be no transversal force at the top of the pipe; by choosing the stresses at the top as the statically undeterminate quantities, it will be seen that there are only two in this case, the horizontal force and the bending moment.

By proceeding in the usual manner it will be found that the bending moment and normal force at the top (point 1) is

$$M_1 = \tfrac{1}{4} r^2 (p - q - 5/12\ q)$$
$$N_1 = -(q_0 + 5/16\ q) r$$

p being the vertical load per unit length, q_0 and $q_0 + q_1$, the horizontal load per unit length at the top and bottom respectively (see Fig. 1) and r the radius. The bending moment is taken positive when it produces compression on the convex side of the pipe and the normal force positive for tension.

At the end of the horizontal diameter (point 2) the forces are

$$M_2 = -\tfrac{1}{4} r^2 (p - q_0 - 6/12\ q_1)$$
$$N_2 = -pr.$$

and at the bottom (point 3)

$$M_3 = \tfrac{1}{4} r^2 (p - q_0 - 7/12\ q_1)$$
$$N_3 = -(q_0 + 11/16\ q_1) r$$

The bending moment and normal force at the various point in (see diagram) can readily be determined from the values of the statically indeterminate quantities which (acting from the centre of the circle on the top section) are for this loading case

$$\text{(Normal force) } X_n = r (q_0 + 5/16\ q_1)$$
$$\text{(Moment) } X_m = -\tfrac{1}{4} r^2 (p + {}^1 q_0 + 5/16\ q_1)$$

and the bending moment M_m and the normal force N_m at the point which has the co-ordinates X and y.

$$M_m = M_{01m} - X_m - X_n y$$
$$N_m = N_{01m} - X_n \cos \phi$$

where M_{01m} and N_{01m} are the corresponding values in the statically determinate auxiliary system.

V. J. ELMONT.

Montreal, Dec. 9th, 1913.

* * * *

The Binnie Contract.

Sir,—The engineering papers are taking considerable interest in the Ottawa pure water scheme, and particularly in the terms of contract which the city of Ottawa has made with Sir Alexander Binnie, who, after proposing the scheme, has been retained as its designing and supervising engineer. A New York engineering paper, which has always taken a sympathetic interest in Canadian engineering matters, apart from the size of the fee, appears to be struck with the peculiar nature of the contract. It points out that he is to substitute his own staff and force for the ordinary city department, which usually has control of the construction of a new waterworks for its own city. It calls this "an extraordinary contract," and decidedly unique "in a civilized, modern city the size of Ottawa." The contract is certainly both unique and extraordinary. One would expect to see such a contract, as the journal suggested, in those out-of-the-way countries where local authority is not sufficient to undertake the establishment of its own engineering force.

It certainly does seem ridiculous, if not manifestly unjust, to pay Sir Alexander Binnie a percentage on the costs of his own services; for, in this contract a sum of $1,000,000 (to be exact, $976,320) has been included for "engineering and contingencies," on which amount Sir Alexander Binnie gets $50,000, or 5 per cent. Again, there is the sum of $500,000 for land damages, and on this amount Sir Alexander is to receive $25,000. One would imagine the lawyers as best entitled to receive this latter sum. What engineering features there exist in the purchasing of right-of-way, and of the lands to be flooded, is difficult to discern, being little more, at any rate, than the survey of the outlines of these lands. Here, then, is a sum of $75,000, which is to be paid Sir Alexander Binnie, but to which, manifestly, he has no right, either by reason or engineering ethics.

By all means let Sir Alexander Binnie be paid his 5 per cent. on the cost of the construction of the Ottawa pure water scheme, estimated, apart from land damages and engineering, at $6,500,000, the percentage allowance of which would be $325,000, a fairly good fee as engineering pay goes; but there is no logical reason, ethically or morally, and least of all from a business point of view, in paying him $75,000 on a percentage basis for "engineering and contingencies" and for "land damages."

The total cost of the new system will be $8,000,000, on which Engineer Binnie, at the rate of 5 per cent. of

this cost, gets $400,000. The items of cost are approximately:—

$5,500,000 for gravity flow steel pipe line.
500,000 for land, compensation, etc.
1,000,000 for engineering and contingencies.
1,000,000 for cost of construction.

In the first item, which is also the chief item, the cost of design and supervision is comparatively small. In the second item the engineers have little or no work to do. The third comprises the cost, not of any part in the construction of the water scheme, but the time and skill of the engineer. The fourth item is wholly constructional, but of a kind that does not involve any excessive amount of high-class engineering work. Evidently, there is room for criticism and objection on the most practicat ground.

In justice to the city of Ottawa, it should be stated that if there was one thing more than another that decided the City Council in favor of placing the whole responsibility for the construction of the Gatineau Lake project on the shoulders of the eminent engineer who recommended the scheme, it was, undoubtedly, the disastrous experience which the city had had with its new intake pipe and aqueduct. "Once bitten, twice shy." This probably accounts for the almost perfect unanimity of the citizens with the agreement, in the face of the most extraordinary conditions, as above set forth, in the provisions of the contract.

Ottawa people have the greatest confidence in the Mayor, and heartily congratulate themselves on having at the head of their municipal administration, a man so capable of grappling with any new situation as it comes up. But Mayor Ellis is not an engineer, and, however faithful and honest his intentions, he is scarcely capable of judging the merits of this agreement submitted by Sir Alexander Binnie.

The proper course to be taken by the Mayor and Council, would be to consult some capable engineer, not necessarily "eminent" or "knighted," of which there are men residing in Ottawa, or at any rate, in other Canadian cities, before agreeing to the Binnie contract, and binding the people of Ottawa to pay out to an engineer the large sum of $75,000 to which he is in no way entitled.

Yours truly,

J. A. MACDONALD.

Ottawa, December 4th, 1913.

PAVEMENT REQUIREMENTS IN OTTAWA

A REPORT ON THE COST OF PUTTING INTO GOOD CONDITION ALL THE STREETS OF THAT CITY—RECOMMENDATIONS INCLUDE TEN TYPES—BRIEF DESCRIPTION OF EACH PAVEMENT

PURSUANT to instructions from the City Council of Ottawa to prepare a report on the estimated cost of placing all the thoroughfares within the city in good condition, Mr. Arch. Currie, the city engineer, has presented to the Board of Control the following summary (Table I.) of the lengths, areas and costs of the various classes of roadways it is recommended should be constructed:—

TABLE I.

		Miles.	Length, lin. ft.	Area, sq. yds.	Cost.
1.	Asphalt	9.81	51,814	183,263	$ 502,297.50
2.	Asphalt macadam	15.24	80,495	260,308	558,370.00
3.	Asphalt and stone blocks	5.53	29,205	140,672	472,955.00
4.	Asphalt macadam stone blocks	1.20	6,340	36,320	96,068.40
5.	Concrete	1.09	5,770	23,520	39,420.00
6.	Macadam tar painted	47.01	248,214	783,013	1,300,266.80
7.	Macadam tar painted and stone blocks	.42	740	2,460	5,072.50
8.	Macadam tar painted and granitoid	.75	3,970	13,055	23,755.75
9.	Stone blocks	.87	3,560	15,338	66,782.00
10.	Tar macadam	2.87	15,150	52,912	107,121.60
		84.32	445,258	1,511,361	$3,172,119.55

In deciding on the various classes of roadways proposed to be constructed, very careful consideration had to be given to the amount and nature of the traffic on any particular road, with a certain assumption of what it might be in the future.

The following descriptions of each type of roadway will be of some interest.

Asphalt.—As there is nearly 40 miles of asphalt pavement in Ottawa at present, very little need be said about it, but some alterations are required in the specifications, such as altering the proportions of the mixtures, etc. It is proposed to construct asphalt pavement on streets with very heavy traffic, such as will be found near railway freight yards and on streets where street cars are running, except in the track allowance and 18 inches on either side, which should be paved with stone blocks or setts. It has to be understood that asphalt pavement should not be used on grades steeper than 5 per cent. The advantages of this pavement are:—

(*a*) Ease of traction.
(*b*) Comparative noiselessness under traffic.
(*c*) Imperviousness to water.
(*d*) Ease of cleaning.
(*e*) Pleasing appearance to the eye.
(*f*) Suitability to all classes of traffic.
(*g*) No vibration or concussion in travelling over it.

The defects are:—

(*a*) Slipperiness under certain conditions of the atmosphere.

(*b*) Disintegration if excessively sprinkled or otherwise subjected to constant moisture (although asphaltum is impervious and insoluble in either fresh or salt water).

(*c*) Tendencies to become soft under traffic in extreme heat and to present a wavy surface, and under extreme cold it may crack and become friable.

(*d*) Unsuitability for steep grades.

Asphalt Macadam.—It is proposed to use this form of construction on streets where the traffic is not quite so heavy as would be on asphalt pavement, and with the same foundation course, viz., concrete. It takes the place of sheet asphalt on grades steeper than 5 per cent.

The most common type of asphalt macadam roadway is laid on a Telford base, this base consisting of stones about 8 inches thick, laid on edge. The course on top of the concrete base, or the Telford base, whichever is decided upon, is composed of stone from 1¼ inches to ⅜ of an inch, mixed with bitumen in its melted condition. From 17 to 20 gallons of bitumen will be used to each cubic yard of stone, thus covering completely each particle.*

This mixture is then laid on the concrete to a depth, after rolling, of not less than 3 inches. Before rolling, a grit course of clean stone screenings is spread over the surface in such quantity as will cover and fill the voids in the surface. The excess of this grit course is then removed and the road swept clean, and over the surface a squeegee coat of bitumen is applied, using about ½ gallon per square yard. Over this again is spread the excess of screenings which was previously removed, to correct the stickiness of the bitumen. The road is then well rolled, until the screenings are bonded with the bitumen of the squeegee coat.

Asphalt and Stone Blocks.—This refers to work on streets where street cars are running. Asphalt has already been dealt with, while, as formerly stated, it is considered necessary to have stone blocks for the full width of the track allowance, and 18 inches outside on both sides. Several of the streets at present have sheet asphalt or some other bituminous mixture in the track allowance with, in some cases, only one or two courses of blocks outside. This, it is contended, is poor construction, as with the continued vibration of the rails, the sheet asphalt soon becomes disintegrated and crumbles to pieces, causing holes adjoining the rails and consequent danger to vehicular traffic. While stone blocks are not perfect, owing to surface drainage difficulties, they are preferable to asphalt, and failures in the blocks can be easily and rapidly repaired.

Another form of construction in the track allowance is solid concrete. This has been used with considerable success in Montreal.

Asphalt Macadam and Stone Blocks.—This is practically the same form of construction as described for asphalt macadam and asphalt with stone blocks, it, of course, being understood that sheet asphalt macadam is introduced for vehicular traffic on a grade with a concrete base for heavy traffic and, as already described, with a Telford base for traffic of a somewhat lighter nature.

Concrete.—Concrete for roads is somewhat of a modern idea, but so far seems to have been very successful and with proper care, particularly in drainage, there is no apparent reason why construction of this nature should not be successful. It will be necessary to reinforce this concrete and also provide transverse expansion joints about 50 feet apart. The surface of the road might well be painted with some bituminous mixture, and afterwards sprinkled with sand, all tending to give a good surface.

Macadam Tar Painted.—This type of roadway will be built on the principles laid down by that well-known Scotchman, Thomas London Macadam, and not by some of the modernized versions of them. It is considered that many of the residential streets in the city, where traffic is light, should be macadamized. Where a foundation course is necessary a Telford base, as already described, should be put in. However, in numerous cases in the city it is not necessary to build a foundation course, some streets having had a good stone foundation course for years, in which cases all that is required is that this old foundation course be trimmed off to the proper convexity, then stone to pass through a 2-inch ring be laid to a depth of 5 inches. It should be then thoroughly blinded with gravel and a little clay, watered and thoroughly rolled. This is admittedly a cheap form of construction and suitable for light traffic in residential districts, and it is submitted that this form of construction is most suitable for a very large number of streets in the city of Ottawa.

The control and prevention of dust on this class of road is one which should have very serious and careful consideration, and particularly in view of the automobile traffic which in all likelihood will develop. Dust has always been a feature of macadam roads, being at the same time the result of use and a check upon excessive wear. Prior to the introduction of automobiles, dust was considered as nothing more or less than a nuisance; to-day, however, the existence of macadam roads depends upon the retention of the road dust formed by the wearing of the surface. It has been found from experience that the broad pneumatic tires of heavy automobiles driven at high speeds draw out by suction the small particles which bind the material of a macadamized road, with the result that the road soon disintegrates.

Various methods are in use for preventing or reducing dust, amongst which might be mentioned sprinkling with fresh or salt water, a mixture of water and calcium chloride, oil emulsion, and impregnating or surfacing with crude oils or coal tar products. The writer has tried all these methods and has come to the conclusion that good tar, properly applied, is the cheapest and best dust preventative and preservative of macadam roads, being both effective and durable. The quality of the tar is very important. If it is heated too much, and refined to too great a degree, it becomes brittle and makes black dust. If not sufficiently refined, and the light oils taken off, it will disintegrate.

Before tarring a road surface the weather should be warm, to be favorable; and the road thoroughly brushed and cleaned. The tar should be heated to its boiling point at convenient positions on the works, and should be applied as hot as possible, so that it may flow freely. Immediately on application the liquid tar should be brushed in so far as necessary to ensure regularity in the thickness of the coating.

The quantity of tar required will vary according to the physical conditions of the road, but generally, in the case of a road to be treated with tar for the first time, the quantity should be one gallon to coat from 5 to 7 superficial yards.

*The mixing will be done at the city's asphalt plant.

If the road must be opened for traffic before the tar has set hard, grit should be spread on the surface to prevent the tar from adhering to the wheels of the vehicles, but gritting should be dispensed with as long as possible, and the quantity of gritting material to be spread should be no more than sufficient to prevent the tar from adhering to the wheels. Stone chippings, crushed gravel, coarse sand, or other approved material (free from dust) not larger than will pass through a ¼-inch square mesh should be used for gritting, in quantity not exceeding 1 ton for 300 or 350 superficial yards, if grit is used, and 1 ton for 200 superficial yards if coarse sand is used.

Precautions should be taken to prevent liquid tar passing directly through drainage gratings or outlets.

For the safety of the public, precautions should be taken by lighting, watching and warning.

The question of tarring has been dwelt upon at considerable length, but it is one which is all-important, not only as a dust preventative, but in increasing the life of the road.

Macadam Tar Painted and Stone Blocks.—This construction is intended for residential districts in which street cars are running and ordinary vehicular traffic is light. Both forms of construction have already been described.

Macadam Tar Painted and Granitoid.—This is another form of construction for residential districts in which street cars are running. Granitoid is really a concrete roadway with a specially finished surface. The concrete above the foundation course is laid with a very strong mixture of cement with a ¾-inch top laid with cement and granite or marble screenings, the latter being absolutely free from dust. Particular attention has to be paid to the sub-drainage of the concrete, otherwise there is sure to be trouble and subsequent failure of the work.

This form of construction has been tried successfully in Montreal, Westmount and Maisonneuve.

Stone Blocks.—It is considered that stone blocks should be used on streets traversed by extra heavy traffic. The stone for block paving should be specially selected and tested, the requirements being a tough stone which at the same time will not become unduly slippery under horse traffic.

The difficulty with stone block, or, in fact, with any block paving, is the laying and jointing. The usual custom is to lay the blocks on a cushion of sand, but the opinion is expressed that this is more of a detriment to this type of paving than otherwise. If moisture could be kept out it would be useful, but as soon as the moisture gets in, the sand starts to run, leaving the blocks suspended in one place and heaved up in another. All this trouble can be greatly overcome by laying and jointing these blocks with a cement grout, but most important of all is ample subdrainage.

Tar Macadam.—Tar macadam is a comparatively new road material. As a material for footways it has long been used in different forms. In some of the northern towns of England it has been used for roads for some years past, but its increasing employment is mainly due to the development of the motor and cycle traffic, and to the attempts that are being made to cope with the "dust problem." Its superiority over ordinary macadam is generally acknowledged. Some of its advantages, in this respect, may be summed up as follows:—

(1) It is more unperishable. The metal being coated and partly permeated with a viscous coating of tar, the stone does not absorb water. The surface coat is finer than ordinary macadam, and has fewer voids in it, so that water does not penetrate so easily.

(2) It has a longer life. The tarry coating, besides preserving the stone from the influence of the weather, largely nullifies the attrition accruing in ordinary macadams, and the tar is a better binder than any of those employed. In general, the road is more homogeneous and elastic.

(3) It is practically noiseless.

(4) It preserves a smoother surface than ordinary macadam. The dust is reduced to a minimum so that the cost of scavenging and watering is practically avoided.

(5) The coat of maintenance as regards repairs is less.

Its disadvantage is that of a slightly greater initial cost, but this is compensated for by its longer life. One engineer has complained that the surface is apt to be slippery in frosty weather and others have urged that the surface will become soft and sticky under hot sun. In most cases it is mentioned as suitable for "light traffic," or traffic "not too heavy." From this it might be erroneously inferred that tar macadam is inferior to ordinary macadam as regards wear. Tar macadam will take heavier traffic than ordinary macadam, but that it can be substituted for the necessary pavements in the streets of large towns and cities is too much to suppose. Its chief purpose will be to supersede ordinary macadam in small country towns and villages, main country roads, and suburban and residential quarters of the larger towns and cities.

Stone.—The stone most recommended for tar macadam is limestone, but iron slag has been found equally good and is of greater strength. Many satisfactory roads have been made with a mixture of limestone and slag. Some of the igneous rocks have been tried, but as a rule, these are too compact for crystalline to absorb any appreciable proportion of the tar, which, therefore, remains as a surface coating that easily wears off. A few engineers have, however, employed igneous stone and have been satisfied with the results; so that the question is still open. Derbyshire dolomitized limestone, Kentish rag, and Scarborough grit stone, have been largely employed for tar macadam. Mr. Purnell Hooley, who has long studied and experimented with this material, is an advocate of iron slag, and he is the patentee of a specially prepared brand of tar macadam. The question of adding coke-breeze or other fine material to the topping coat is one in dispute. At Harrogate 12% of coke-breeze is invariably added, and the borough engineer finds the topping coat improved thereby.

Tar.—The tar requires very careful watching. As previously mentioned, the surface of tar macadam has in some instances become exceedingly sticky and troublesome in hot weather; in some cases so much so that pedestrians' boots have stuck to the road and had to be left there. This is due to (*a*) the stone used not being suitable; (*b*) the material not being properly prepared, and, (*c*) the tar being defective.

In nine cases out of ten, defects in tar macadam may be attributed to the tar. The tar produced by different works varies exceeding in quality. The most recent tar-extracting apparatus employed in gas works does not appear to produce such good tar as formerly, and the brand of coal used also has a bearing on the subject. Unfortunately, the difference between poor and good tar cannot at present be established by analysis; samples of both

appearing chemically the same. The advice given by one well-known engineer is to find a gas works producing good tar, and use only the tar produced there.

The tar macadam is laid on the roadway in three grades, over a good foundation, which is always shaped up to the proper convexity. The aggregate of the surface is composed of broken stone, obtained in the vicinity: 60% broken to a size of 2½ in.; about 30%, 2½ in. to 1¼ in.; and 10%, ¾ in. to ½ in., for closing up interstices. The last-mentioned size is kept separate and used during rolling operations. The tar macadam, after being spread and levelled, is rolled into a smooth surface but not rolled to the same extent as an ordinary water-bound macadam road. A 10-ton roller is used for this work, as better results are obtained than when a heavy roller is used. After the roadway has been open for several weeks, a coating of tar is applied to the surface of the road, and covered with stone chippings, not larger than will pass through a quarter-inch mesh.

Engineers differ considerably about the preparation of materials, and no standardization is at present possible. Heating the stone dries it, and renders it in a better condition to absorb tar. On the other hand, it is contended that artificial drying is detrimental, and also that it is better to dry the stone by storage under cover. It is doubtful whether the latter method can be effectual for, though the stone is preserved from actual wetting, it will, in wet and humid weather, absorb moisture from the air.

As to the necessity of boiling the tar, there should be little doubt. Tar varies very much in the amount of volatile matter present and careful boiling for 2 or 3 hours will render the consistency more stable and more tenacious. If the tar is poor a little pitch may be added to enrich it. The boiling, however, must never be carried too far or the residue will be brittle. Considerable care must be exercised with the boiling. In preference to boiling, some engineers store their tar for some months before use, and in this case it is kept in concrete or iron tanks, set below the ground level, and fitted with valves, etc., to permit the escape of volatile gas. The tar should, in this case, be drawn from the bottom of the tank, and a pump must, therefore, be fitted to effect removal under this condition.

General.—The estimate of $3,172,119.55 would appear at first sight to be an enormous expenditure, but a study of the details and close examination of the streets in the city will convince anyone of the vast amount of work that has to be done and it has to be remembered that good roads cannot be constructed without a heavy expenditure of money.

The opinion is expressed that the first work to be undertaken is the construction of roadways which form the main arteries or trunk roads in the city.

The report is concluded by a paragraph pointing out that proper maintenance is as important as good construction, but that it cannot reasonably be expected that the small amount of about $50,000 given annually for the maintenance of roads in Ottawa is anything like sufficient.

Maintenance consists in keeping a roadway as nearly as practicable in the same condition as it was when originally made. The repair of a roadway is the work rendered necessary to bring it up to its original condition after it has become deteriorated by neglect to maintain it. There is a wide distinction between the two operations; the former keeps the road always in good condition, while the latter makes it so only occasionally.

ELECTRIC IRON SMELTING.

By Jens Orten-Boving, M.I.Mech.E., London, England.

THE method of producing iron and steel by the use of electric current has lately received much and well-deserved attention in Canada. It may, therefore, be of some interest to learn some data regarding the recent experiences and developments in Sweden. Before doing so, the fact might be pointed out that there is no other country in the old world so like Canada as Sweden. Both are mainly agricultural countries with a relatively sparse population; both have an abundance of water power, forest and high-class iron ore; both have splendid transport facilities, i.e., rail, lake or canal, and the climate is marked by similar fluctuations of temperature and by the remarkably clear, invigorating atmospheric conditions.

During the last five years some very remarkable developments in the iron industry of Sweden have taken place by the introduction of electric reduction of iron ore, producing pig iron, and by electric refining of low-quality steel to high-grade steel.

This article will deal with the two processes separately, although in many plants the refining should be an integral link in converting the ore into fine steel by one continuous process.

Electric Reduction of Iron Ore.—The system which has met with real commercial success is that of Electro-Metals, Limited, which has been described on several occasions in various technical papers. Other methods have been tried repeatedly but they have all been abandoned and to-day the Electro-Metal furnaces are the only ones in use in Sweden. The following is a list of Swedish furnaces:—

Working now.	Number.	Power consumed per furnace.	Total power consumed.
Strömsnäs Jernwerks A. B.	1	3,000	3,000
Uddeholm A. B. Hagfors ..	3	3,400	10,200
Stora Kopparbergs Bergslag A. B. Domnarfvet.....	1	3,600	3,600
Building now.			
Strömsnäs Jernwerks A. B.	1	3,000	3,000
Nykroppa Jernwerk	2	3,400	6,800
	8		26,000 h.p.

These furnaces will produce approximately 80,000 tons of pig iron per annum. The Stora Kopparberg Co. are putting down 10 more furnaces, not included in the above.

There are, further, a great many installations contemplated and it is certain that wherever there is cheap water power the old blast furnaces will be replaced by electric producers. Generally speaking, it holds good that wherever one horse-power per annum can be produced cheaper than the cost of two tons of charcoal or coke (depending on what class of iron is to be produced) it is a commercially successful undertaking to substitute electric heat for carbon heat.

The operation of the electric reduction furnace is much simpler than that of a blast furnace and everybody who has been visiting the Swedish works returns impressed by the extreme simplicity of the affair. Fewer hands are required as well as less skill than for a blast

furnace. The prime costs for the electric plant are also lower.

The following tables give all the data required for calculating the cost of one ton of iron produced. For a plant of, say, three furnaces of each 3,000 h.p. capacity the following staff and labor would be required: 1 chief engineer, 1 assistant, 2 chemists, 3 foremen, 2 electricians, 10 men in each of 3 shifts.

Table I.

Continuous Run of One Furnace Belonging to Strömsnäs Jernwerks A. B. from Oct. 1, 1912, to Sept. 1, 1913.

Number of charges	26,549
Weight of ore used, tons	11,338
Weight of limestone, tons	907
Weight of charcoal, tons	2,700
Produced pig iron, tons	7,258.3
Weight of charcoal used per ton of pig iron, lbs.	830
Total number of hours when running normal, hours	7,957
Total power consumed kw. hour, kw. hour	15,291
Total power consumed per ton iron, kw. hour	2,107
Weight of pig iron produced per 1 horse-power year, tons	3.05
Weight of pig iron produced per 1 horse-power year, tons	4.14
Total consumption of electrodes, tons	28.42
Consumption of electrodes per ton of pig iron produced, lbs.	8.7

operation, in August No. 2 was running, and now No. 3 is ready for starting up.

"The plant was originally designed for two furnaces only of 3,000 h.p. capacity each (the power consumption is actually 3,400 h.p.). The furnaces are placed in the central bay; on one side all the electrical gear is placed, transformers, switches, regulators, etc., this part being entirely isolated from the metallurgical part. The power is generated 9½ miles away at Forshufvud which power station belongs to the company. The voltage is 12,000 on the line and is reduced to low pressure by the transformers and adjusted by the regulators to between 50 and 100 volts as required.

"The furnaces, as well as the whole of the plant, have been designed by the Electro-Metals Co. and are mainly following the lines of the well-known Trollhattan furnaces, although the various details naturally show modifications based upon the experience from Trollhattan. There are 6 electrodes, cylindrical in shape and arranged to be used continuously without waste by screwing the ends together.

"The pouring bay is conveniently fitted with an electric overhead traveller as well as trolley tracks for transporting iron and slag. The iron can either be poured to pig or conveyed in ladles to the Bessemer and open-hearth works. The slag is run into block moulds and makes excellent building stone.

"The crushing room is at the end of the furnace building. There are 3 crushers of the ordinary jaw type. There is a railway track outside and the daily requirements are supplied in the trucks so that there is no need

Table II.

Continuous Run of the Trollhattan Furnace for Three Three-month Periods from 1st October, 1912, to 30th June, 1913.

(This furnace was run by the Swedish Association of Iron Masters with a view to establishing the practical success of the system as well as to give the various members an opportunity of trying their various kinds of ore. Thus, in the table below different kinds of ore were used during the period indicated.)

Period.		1 Oct., 1912, to 31 Dec., 1912.	1 Jan., 1913, to 31 March, 1913.	1 April, 1913, to 30 June, 1913.
Number of charges		6,193	7,107	7,281
Kiruna A ore	Tons	1,047	223.3	799.8
Tvollavara ore	"	973.4	123.3	762.6
Klacka-Lerberg ore	"	885.6	1,453	1,426.5
Persberg ore	"	8.82	47.97	148.4
Total ore	"	2,914.8	3,047.6	3,137.4
Limestone	"	169.94	252.8	273.5
Charcoal	"	699	719	738
Pig iron produced	"	1,905.86	1,933.32	2,000.14
Charcoal per ton pig iron	Lbs.	825	835	830
Actual Working time	Hours	2,158.5	2,113.7	2,147
Consumed power kw. hours	Units	3,957,565	4,095,588	4,216,544
Consumed power per ton pig iron	"	2,076	2,118	2,108
Produced pig iron per kw. year	Tons	4.22	4.14	4.15
Produced pig iron per h.p. year	"	3.10	3.04	3.05
Consumption of electrodes, total	"	5.307	8.670	7.896
Consumption of electrodes per ton pig iron	Lbs.	6.2	10.0	8.8

Note—The ore from Kiruna and Tvollavara is of the highest quality obtainable in Sweden. It will be seen that the output of the furnace as well as the consumption of electrodes depends largely on the quality of the ore used.

At a meeting at Kristinehamn of the iron masters in the district last spring the following observations were made by the chief engineer of the Hagfors electric furnace plant after the first year's running:

"The work with the foundations of our plant was commenced at the middle of April, 1911; eleven months later, or the 15th of March, 1912, furnace No. 1 was in

for big storing bins. One of the crushers is fairly large with wide enough jaw space for the biggest lumps, and the ore passes from the crusher to the smaller ones, and thence by a bucket elevator up to a belt conveyer above the charging platform so that the raw material may be unloaded where required. There is a small ore store but this only contains some limited reserve amounts of the

various kinds of ores used. These are from Taberg, Finnmossen and Nordmark. The charcoal is transported from the stores by a ropeway.

"Up to now three different kinds of pig iron have been produced: (1) Pig iron for open-hearth treatment; (2) pig iron for Lancashire treatment; (3) pig iron for Bessemer treatment.

"The quality which is desired for the open-hearth pig is semi-spiegel and contains Si, 0.40-0.60%; Mn, 0.30-0.50%; P., 0.011-0.018%; S., 0.015%.

"It will be seen later on that it is more economical to produce pure spiegel iron in the electric furnace, and arrangements are being made to alter the open-hearth furnaces so as to use spiegel iron only.

"It has been assumed in various quarters that it would probably be difficult to maintain a constant product in an electric furnace. Experience shows, on the contrary, that a much more constant product is obtained from the electric furnace than from our old blast furnaces. One of the reasons for this fact is that there is such a large receiver or collecting basin in the lower part of the electric furnace that this collector acts as a regulator on the quality.

"The Lancashire pig needed is quite white and has the following analysis: Si, 0.20-0.30%; Mn, 0.20-0.30%; P., 0.011-018%; S., 0.015-0.020%.

"In the beginning there was a tendency for the sulphur to be unduly high but this was put right by making the slag more basic whenever the furnace was run for Lancashire pig.

Bessemer Pig.—"The analysis of the quality used is: Si, 1.00-1.40%; Mn, 2.50-3.00%; P., 0.015-0.019%; S., 0.005%.

"Excellent Bessemer has repeatedly been made of this pig. At first the result was not good, but it was soon found that we had to increase Si and Mn. It had been assumed that the amount ought to be as usual, but the reason for the higher content being required is probably that the temperature of the electro-Bessemer pig is lower than for ordinary Bessemer pig from blast furnaces.

"We intend, however, to re-arrange the receiver in our electric furnace with a view to increase the temperature. Our general experience points to the following results: It is cheaper to make spiegel than grey pig because: (1) More current can be put through the furnace; (2) the current consumption is lower; (3) thus the production is higher; (4) the electrode consumption is lower; (5) the repair costs are lower.

"It may further be stated that rich charges give better results than poorer. The quality of the pig is not influenced by the percentage of iron contents of the ore.

"The electrode consumption has been relatively high and this is influenced by the following conditions:—

"1. High power consumption (which, of course, increases if the charges are poor).

"2. Too lively gas circulation and too large a proportion of CO_2 in the gas. (Of course the carbon consumption is correspondingly lower).

"3. Too large electrodes for the load.

"Since the 15th of January we have used the gas from the furnaces as fuel under our open-hearth furnaces and I estimate the value of the gas at from 2 to 3 shillings per ton of pig iron produced.

"Finally, regarding the influence of the electric pig on the finished steel, our experience shows that the change tends to make better steel; this holds good both for Bessemer as well as soft and hard open-hearth steel."

The steel produced at Hagfors is of the highest quality and is mainly used for locomotive boiler tubes, piano wires and high-tension wires generally. Practically the whole of the output is exported.

In Sweden generally the electric reduction of iron ore is regarded as revolutionizing in this industry and elaborate preparations are being made for constructing mills of considerable capacity. Recent experiences have shown that larger electrodes can be used at the same time as the current intensity on the electrodes is increased. Larger furnaces will therefore be designed and some of those now projected will have a capacity 8,000 h.p. each.

It has been found that when using coke instead of charcoal it is advantageous to run on burnt lime, as otherwise the power consumption is too high, which largely depends on too much CO_2 being produced.

Refining Furnace.—The Electro-Metals refining furnace is designed for 2-phase current, although 3-phase may be used by suitable design of the transformers and coupling the connections on Scott's system. The furnace has been correctly and carefully described in the July 25th, 1913, number of the *Electrical Review*, as well as in the *Iron and Coal Trades Review* and various other publications. A number of these furnaces are now in operation in Sweden and in Sheffield, England, and the working results are highly satisfactory.

To run this type of refining furnace is extremely simple, everything being so well arranged and balanced that any steel melter who knows open-hearth work can take charge of the electric furnace. No special training or skill is required from an electrical point of view.

These furnaces give a marvellous product inasmuch as it is quite easy to produce a high-class steel from any ordinary scrap with the greatest ease. The ordinary steel smelter used to open-hearth work will not believe the results in the beginning, but once he has familiarized himself with the proper use of various slags to remove sulphur and phosphorus, as well as how to determine the carbon content or to add alloys, he will be loath to return to the open-hearth furnace which, indeed, is a very clumsy and incomplete apparatus compared with the electric refining furnace.

The process is equally suitable for high and low grade steel, for castings, drills, tool and quality steel of every kind and use.

In a country like Canada, where electric current may be produced cheaply from water power the resmelting and refining of ordinary cheap scrap in an electric furnace becomes a very attractive undertaking, and it is curious that it has not been started long ago.

The following figures, taken from an article published in the *Electrical Review* of July 25th, give the actual costs of production.

Working Costs.	Per ton steel £	s.	d.
Electrode consumption	0	4	0
Lining, roof, felting	0	6	0
Slag materials	0	2	6
Labor (assuming auto-regulation)	0	6	0
Tools	0	1	0
Electric energy, 825 kw. hours @ .6d.	2	1	3
	3	0	9

These are actual figures taken from the Works cost sheets and are obtained from a furnace of 2½ tons capacity, so, naturally the figures are considerably reduced in larger furnaces.

It should also be noted that a very high rate is paid for the electric energy, as this is obtained from the municipal supply and is generated by steam. In Canada, utilizing water power, the current could easily be supplied at 0.2d. per kw.hr. corresponding to a charge of £6 per horse-power year based on 300 days a year continuous full load; consequently, in using the above figures as a base to figure out cost of production in Canada it must be borne in mind that although the cost of labor would be undoubtedly higher, the cost of electric energy would be only one-third and the total cost, as shown by the above figures, would be in the neighborhood of £2 os. od. per ton.

If a new iron works were planned in Canada electric reducing and refining should be used throughout and it is certain that with judicious arrangements adapted to the special requirements of the country such an undertaking would pay handsomely and the quality obtained would be so high that it would exclude the importation of a good many standard products of iron and steel.

Anybody interested in these matters need only look up the government's statistics on import to compile a very long list of raw material and half finished goods which could and should be made in the country.

THE OXIDATION OF COAL AND OF THE PROCESS OF COMBUSTION.*

By Horace C. Porter.

IT is well known from the work of several investigators in European laboratories and from earlier work at the Bureau of Mines that all coals unite with oxygen more or less at ordinary temperatures. The action is at ordinary temperatures largely a simple addition, very little gaseous products of combustion being produced. There is, however, a development of heat by the simple addition of oxygen, and this heat development is the primary cause of spontaneous combustion.

As the temperature rises, the oxidation reactions increase rapidly in rate, and the simple-addition reaction becomes complicated with the development of water and oxides of carbon as products of the oxidation and with the production of water and of methane and other gases by destructive distillation.

Under whatever conditions coal burns, as for example on the fuel bed of a boiler furnace or in suspension as dust in the air of a mine, the earlier stages of oxidation proceeding at the lower temperatures have important bearing on the ease of ignition of the fuel and the degree of inflammability of its dust. In order to throw more light on the nature of the combustion reactions at successive stages and to determine how the various kinds of coal differ in their rates of reaction with oxygen, a laboratory study has been made of the oxidation of coal, at temperatures ranging from 80 deg. to 300 deg. C.

A series of experiments has been run with samples of different coals placed in atmospheres of pure oxygen at a pressure reduced so as to equal the average partial pressure of the oxygen in air. The rate of absorption of oxygen by the coal was determined by admitting pure oxygen at such a rate as to maintain constant pressure in the apparatus. Large differences in rate were found between different kinds of coal, and the comparative oxidation rates thus found conform in general to the known comparative degrees of inflammability of these coals.

At temperatures above 200 deg. C. the production of CO_2 and other gases causes a considerable error in an experimental method which does not remove these gases as they are formed. A rapid-stream method was, therefore, devised in which weighed samples of dry coal were heated at definite temperatures in a rapid stream of dry air for one hour, the change in weight of the coal being accurately determined as well as the amounts of H_2O, CO_2 and CO produced. From these data the total oxygen used and the oxygen fixed were calculated.

It was shown that the oxidation of coal consists in the earlier stages of the formation of an unknown complex of the coal substance with oxygen, and the more or less gradual dissociation of this complex as the temperature rises into water, CO_2 and CO. Below 200 deg. water is the chief product of this dissociation, the proportion of CO_2 in the products increasing as the temperature rises. Carbon monoxide is a primary product of the oxidation of coal at temperatures between 100 deg. and 300 deg. C. and possibly also outside of this range. Triangular diagrams representing the relationship of the three products H_2O, CO_2 and CO at different temperatures show interesting tendencies, e.g., toward constancy in ratio between CO_2 and CO within a certain temperature range.

The production of water by oxidation of coal at 100 deg. C. or lower is of interest in connection with the devising of methods for accurate moisture determination in coal. The direct production of CO at moderate temperatures is of interest in connection with mining operations and the storage of coal.

*An address delivered at the annual meeting of the American Chemical Society, Rochester, N.Y., Sept. 9-12, published by permission of the Director of the Bureau of Mines.

Returns made to the Bureau of Mines show that the metal output of Ontario for the first quarter of 1913 was as shown in the accompanying table:—

Product.	Unit.	Quantity.
Gold	Oz.	50,637
Silver	Oz.	7,264,559
Copper	Tons.	3,075
Nickel	Tons.	6,311
Iron ore	Tons.	15,389
Pig iron	Tons.	181,042
Cobalt and nickel oxides	Lb.	280,096

The principal gold producers are the Hollinger and Dome; but the McEnany and MacIntyre also contributed, as well as the Cordova in Hastings County, and the Canadian Exploration Company at Long Lake. The Foster-Tough mine at the new camp of Kirkland Lake is turning out some rich ore. The quantity of ore milled in all was 69,905 tons, the average yield of gold being thus a little under ¾ oz. per ton. The production of silver was nearly equal to that for the corresponding period of last year, being only some 74,485 oz. less. The mines of Cobalt proper furnished 7,253,595 oz.; South Lorrain, 198,381 oz.; Gowganda, 54,350 oz., and from gold bullion, 10,964 oz. Shipments amounted to 7,053 tons ore, 2,130 tons concentrates, and 1,926,160 oz. of bullion. Silver refineries in Ontario recovered 2,754,292 ounces. The Sudbury mines yielded 1,589 tons more of nickel and 538 tons more of copper than during the first three months of 1912. The producing companies are the Canadian Copper Company and the Mond Nickel Company, but a third company, which acquired the holdings of the Dominion Nickel-Copper Company, is actively preparing for production.

EXPERIMENT AT SHERBROOKE, QUE.

Professor Barnes, of McGill University, and Lieutenant Daw, a post-graduate student of the same institution, have studied the flood question at Sherbrooke, Que., and believe that a proposed scientific experiment will prove a solution to the problem. Every spring the country at Sherbrooke is flooded by the anchor ice in the rivers, which causes the pack ice to form and, thereby, holds back the water, which spreads over the low lying country to its great detriment.

Lieutenant Daw has been given permission from his commanding officer, Lieutenant-Colonel Harrison, of Montreal, to form a field corps of Canadian engineers. The matter has been submitted to head authorities by Colonel Harrison, and Lieutenant Daw has been informed that the authorization of his scheme is expected to be in orders within two months.

The services of forty-two engineers will be utilized, in conjunction with those of Professor Barnes, to relieve Sherbrooke from its annual floods. The scheme is that at a crucial moment, when the anchor ice is about to accumulate the pack, this troop will be summoned by alarm bombs from the armory to assemble post haste and proceed by motor, oar, or horse to the scene of danger, either in the night or day time. Arriving at the anchor ice field, they will drill the ice in a scientific manner, place gun cotton primers in the holes, attach electrical connection carrying leads to a safe point of observation, and after receiving the trumpet calls from up and down the river, on both sides, to the effect that the inhabitants within range of the explosion are out of danger, and have opened their windows to prevent them being broken by the dynamic and static shocks of the explosion, the mine will be fired.

Lieutenant Daw has received a request from the town of Richmond asking him to organize a corps on similar lines for that town's benefit; and also letters from the Minister of the Interior informing him that he is so interested in the matter that he has laid the scheme before the Ministers of Public Works and Militia.

If the scheme is successful, and those who advocate it are very confident that it will be, it may also be tried on the St. Lawrence River to prevent the floods on the South Shore, which also take place in the spring every year, through somewhat similar causes.

ARCH BRIDGE AT SASKATOON.

Though the contractors—the R. J. Lecky Company, of Regina—were delayed in getting their outfit on the ground, good progress has been made on the construction of the arch bridge over the Saskatchewan River from the intersection of 25th Street and Spadina Crescent on the west bank to the intersection of Clarence and Saskatchewan Streets on the east bank. The work was commenced on September 2nd, and already the excavation for five piers has been completed; and one pier, one retaining wall, and one pedestal, have been finished. Boring tests have been put down in all the excavations with a view to determining the nature of the foundation and all were found highly satisfactory.

Throughout the winter months, a force of 80 men will continue building operations; but in the spring this number will be greatly augmented. And by December 1, 1914, Saskatoon is to have an arch bridge unsurpassed by any like structure in Canada, being the largest reinforced concrete bridge in this country, and taking high rank among the great bridges of the North American continent. Its approximate cost is $400,000; and under the terms of the agreement entered into between the city and provincial government, the former is to pay one-third and the latter two-thirds of the cost of the structure.

The plans prepared through the instructions and under the direction of the highways commissioners, call for a bridge consisting of a series of arches with a floor on practically a 3 per cent. grade from east to west, in order to meet the rise on the university side of the river. The total width of the structure is to be 65 feet. Two 8-foot sidewalks are to be cantilevered from the roadway, while provision is made for two street car tracks and two 14-foot roadways, making ample room for each section.

The arches of 150 feet are notable as being longer in span than any in the Dominion of Canada. The total length of the bridge and the retaining walls at its approaches is to be about 1,490 feet. It consists of one arch of 25 feet span, one arch of 66 feet span, one arch of 92 feet span, one arch of 103 feet span, one arch of 136 feet span, four arches of 150 feet span, and one irregular arch of 94 feet span.

Special care was used in working out the design and the allowable stresses are considered most moderate. The variations of temperature cause the concrete to expand or contract, the bridge being designed for a temperature range from 50 degrees below Zero to 90 degrees above. In all probability this variation of temperature is larger than that contemplated for any other concrete bridge ever built.

The site selected presented various engineering difficulties. Chief among these was the elevation of the east side bank about fifty feet higher than on the west bank. During high water the river is 1,100 feet wide at this point. Special care also had to be exercised from an aesthetic standpoint, for the bridge will cross from a park on the east side to the University grounds on the opposite side of the river.

A new company has been formed to connect North and South Shields, Eng., by tunnel, through which an electric railway will run. A quarter million pounds sterling has been assured and the sanction of Parliament for the project is to be asked at the next session. At present communication across the mouth of the Tyne is by ferry only, and the service is frequently interrrupted by stormy weather. Liverpool and Birkenhead were successfully linked by tunnel some years ago.

A concrete hardening material now being introduced contains 95 per cent. iron dust or iron flour, which is mixed with cement for finishing the surface of concrete floors, says "Engineering News." From 15 to 25 lbs. of the material is mixed with 100 lbs. of the cement while dry, and one part of this mixture to two parts of sand makes the slush for the top coat, which varies from ½ to 1 in. in thickness. It is said to make a hard and durable floor, which is waterproof and not slippery. The hardening material is used also to make new concrete adhere to old concrete in repair work. This concrete hardener is made by the Globe Steel Company, of Mansfield, Ohio.

COAST TO COAST.

Mawer, Sask.—The steel of the Grand Trunk Pacific has now reached Mawer, a town staked out but three months ago, but now having a population of 450 people.

Calgary, Alta.—Two new street car lines have been put into operation at Calgary—e.g., the extensions to Bankview and Glengarry, in the south district, and to Capitol Hill on the north.

Guelph, Ont.—At the November meeting of the Light and Heat Commission, Manager Heeg reported that there had been 323 electric services and 10 power services installed during the past year, as well as 338 gas services. In addition to these, 37 electric street lights have been installed.

St. Marys, Ont.—At a meeting of the water, light and heat board, Superintendent Miller stated that from January 1st to October 31st the board had a net profit from the electric light department of $650. The waterworks department showed a deficit.

Montreal, Que.—The C.P.R., G.T.R., and C.N.R., all reported an increase in weekly earnings for the first week in December of this year over the corresponding week of 1912. The increase for the C.P.R. was $238,000; for the G.T.R., $10,102; and for the C.N.R., $15,100.

Brandon, Man.—The report on the street railway for the month of November shows that the returns for that month average $7.46 daily in excess of the month of October, although the cost of operating is practically the same, and although the number of miles operated is approximately 2,000 less.

Fredericton, N.B.—The inauguration ceremony in connection with the commencement of the operation of a regular train service on the new Gibson and Minto Railway was conducted by Sir Thomas Tait; while that in connection with the Southampton line was carried out under Manager Sherwood's management.

Vancouver, B.C.—Owing to the high price at whi .. water frontage and suitable sites for shipyards are held on the mainland and points on Vancouver Island, it has been stated with authority that it is improbable that the famous Yarrows Shipbuilding Company, of Scotland, will locate a site for a plant in British Columbia.

Vancouver, B.C.—A statement that the appropriation of $5,000,000 for Vancouver's harbor development includes the cost of the $4,000,000 government dock, has been contradicted. Neither is the cost of dredging False Creek included in the appropriation. The dock and dredging are being done under the supervision of the department of public works.

Calgary, Alta.—The surplus of the city of Calgary's municipal electric light department for ten months amounts to $40,000, according to figures that have just been compiled. The city buys power en bloc from a company which develops it at a hydro-electric plant on the Bow river, and also generates a greater quantity itself by means of a steam plant.

Peterborough, Ont.—The erection of the ornamental iron standards in connection with the Hydro-Electric street lighting system on Hunter and Simcoe Streets is progressing, and when these have been erected and the lamps placed, the downtown lighting system as originally proposed and outlined by Mr. Jeffery, engineer for the Hydro-Electric Commission of Ontario, will be complete.

Berlin, Ont.—Extensions to the Berlin waterworks system, costing $100,000, are practically completed. Water from nine artesian wells will be pumped by Hydro power instead of by steam plant. The new concrete stand pipe in North Ward, the largest on the continent, and the immense reservoir at the pumping station were filled some days ago, and will provide high pressure in case of fire.

Kaslo, B.C.—The arrival of the first locomotive at Kaslo over the new standard gauge railway line from Whitewater was celebrated by a smoking concert, attended by the municipal officials, prominent members of the board of trade, and citizens. Credit for the prompt completion of the line was given to W. P. Tierney, the Vancouver contractor, and to E. A. Sharpe, the C.P.R. engineer.

Montreal, Que.—According to the recent statement of J. McMillan, general superintendent of western lines, nearly 6,000 miles of wire and new lines have been constructed by the C.P.R.'s telegraph in the west this season. More exactly the figures are: 3,240 miles of copper wire, 1,420 miles of iron wire, 689 miles of railway equipped with train telephone despatching circuit, and 475 miles of telegraph along new railway and extension work still in progress, making a grand total of 5,824 miles of wire.

Montreal, Que.—The work on the western section of the Grand Trunk Pacific is being carried on in British Columbia, from Rose Lake to Hutton—217 miles; in Sasktachewan, the Prince Albert branch—36 miles,—the Moose Jaw Northwest branch—19 miles,—the Weyburn branch, 20 miles; in Manitoba, the Brandon branch—26 miles. This means that in a few months this line will be a continuous unit; and the company has ordered additional equipment so as to commence an efficient and standard service.

Nelson, B.C.—The receipts of the Nelson Street Railway show a gratifying increase of $107.40 for the month of November, 1913, over the corresponding month of last year and an increase during the first week of December of $55.25 over the same period of last year. For the month of November the receipts amounted to $1,200.45, while for November, 1912, they amounted to $1,003.25. The first week of December the earnings of the company were $368.00, and for the corresponding week last year the earnings amounted to $312.75.

Montreal, Que.—The Calgary Power Company, for the 11 months ending November 30th, showed satisfactory increases over the corresponding period last year. For 1912 the gross earnings were $178,486; for 1913, $213,672. For 1912 the net earnings were $145,583; for 1913, $171,318. The fourth unit at Bow Falls is now practically completed and everything will be ready to commence generating power from this additional unit early in December. By the installation of the fourth unit the capacity of this plant is increased to 19,000 h.p.

Ottawa, Ont.—An increase in traffic on Canadian canals amounting to more than four million tons for the navigation season of 1913, which officially closed on November 30th, over the total tonnage of traffic recorded for the corresponding period of 1912 is shown in the report issued by A. W. Campbell, Deputy Minister of Railways and Canals. The total tonnage through Canadian canals for the past navigation season was 51,319,426 tons. Last year the total was 46,952,605 tons. The figures for the 1913 year, therefore, show an increase of 4,366,821 tons.

St. John, N.B.—The Quebec Railway Company, which has recently filed its petition before the State Railway Commissioners at Augusta for permission to construct 111 miles of track from Washburn westward to the Canadian boundary line of Maine, will, according to President Arthur Gould, ultimately form a continuous electric line between the tidewater at St. John and Quebec. The Canadian Pacific and the Aroostook Valley roads would combine with the new line to form the continuous chain between the two cities. The section of the road between Andover, N.B., and Washburn has already been built and is in operation.

Victoria, B.C. Premier McBride has stated, in connection with President Wilson's recent message to Congress in

the United States concerning railway development in the north, that he believes the construction of a line of railway north and south through British Columbia providing access to the Atlin and the Yukon to be a national enterprise. He says that closely linked with such a possibility as the establishment of this line is the building of railways in Alaska and the eventual linking up of that district with the United States proper by means of steel running through the Yukon and province of British Columbia.

Fredericton, N.B.—Up to the month of December 72 miles of rails had been laid on the St. John Valley Railway, according to the report presented to the Provincial Government at the closing meeting of the December sessions. The estimates for work on the Valley Railway during the month of November amounted to about $100,000, while progress reports showed $142,000 of work done in October. Of the steel now laid, 25 miles is south of Fredericton and about an equal distance north and also south of Woodstock. Construction work will be carried along as much as practicable throughout the winter.

Toronto, Ont.—The construction of a new double circuit power line between Niagara Falls and the main transmission station at Dundas, the doubling of the present line between Dundas and St. Thomas by way of London, and the enlargement of half-a-dozen sub-stations, all to cope with the rapid expansion to the consumption of power, have been practically decided upon by the Ontario Hydro-Electric Commission. The construction of the Niagara Falls-Dundas line will necessitate the acquisition of a right-of-way and involve an expenditure of approximately half a million dollars; and the doubling of the Dundas-St. Thomas transmission line will mean another hundred thousand.

Ottawa, Ont.—It has been stated by Controller Nelson, of Ottawa, that this year over 5 miles of pavements have been laid at a total cost of $300,000, 13 miles of sidewalks at a cost of $70,000, and sidewalk repairs to the extent of practically two miles of new walks. However, Alderman McNeill has taken an active interest in traffic regulations this year, and states that next year Ottawa will have to devote more money and attention to roads. He claims that the money now allowed for maintenance is insufficient. There has been much repair needed which could not be undertaken this year, and holes in roadways should be repaired at once, not when they have become a menace to traffic.

Victoria, B.C.—Mr. Taylor, minister of public works, is reported as having declared that within the next year or two British Columbia will possess an up-to-date highway, extending from Kamloops to Tete Jaune Cache, and giving connection through to Edmonton. The provincial government has already established a good road for about 90 miles north of Kamloops along the north Thompson river, and it is to be extended later north to Tete Jaune Cache, where it will meet the highway built by the Grank Trunk Pacific contractors, east and west. It is probable that this road will be taken over by the province from Tete Jaune Cache to the provincial boundary line at Yellowhead pass; and already a fairly good railway contractors' road extends through the Rockies to the east along the Grand Trunk Pacific route to Edmonton.

Vancouver, B.C.—Ever since the new Coquitlam dam of the B.C.E.R. company was completed several months ago, water has been rising rapidly; and not long since poured for the first time over the spillway, proving the company's scheme to provide an adequate water supply for its power houses at Lake Buntzen to be a success. The water takes a drop of 73 feet from the top of the spillway to the bed of the river below. There is now stored behind the dam 8,000,000,000 cubic feet of water, or 50,000,000,000 imperial gallons. From Coquitlam Lake, as now enlarged, water is drawn off by means of the tunnel to the two power houses on the shore of the north arm of Burrard Inlet. The capacity of the spillway is three times the maximum flood into the lake and the dam has been constructed so that water will never pour over it.

Ottawa, Ont.—The proposed route of the All-Red Railway and Steamship Line, which is to seek incorporation at the next session of parliament, is from Cape St. Charles, on the coast of Labrador, north of Newfoundland, through northern Quebec to Winnipeg, and on to Dean Inlet, on the Pacific coast, running north, but parallel with the G.T.P., where it turns south to the coast. This route will reduce the time, it is claimed, between Winnipeg and Liverpool to four days. The route between the Atlantic coast and Winnipeg is through virgin country, which contains immense quantities of pulp. It is proposed to connect with the C.N.R. at Quebec. The time between New York and Liverpool by rail to Cape St. Charles, thence by steamer, will be reduced to three days and two nights. Owing to the shortening of the ocean trip it is thought very much traffic could be diverted from New York. As the road will follow the height of land, very little bridge building will be required.

Victoria, B.C.—The 50 arc light set and a spare transformer for the city light station are expected to arrive daily in the city, having been shipped from Peterboro. An installation of the lights on Ross Bay seawall driveway will be completed this month, the conduits having been put in when the street was paved some months ago. The "Park" type of fixed lights will be utilized, the light being attached to the standard, this rigid variety being considered the best, owing to the exposed position of Ross Bay. When this work is completed, the only portion of the waterfront from the city boundary to the outer wharf, unlit at night, will be the stretch of macadam across Beacon Hill Park. In order to rearrange the lodes for arc lighting, trunk connections are being installed through the city from Herald Street eastwards, and when the cables are in, the lode on circuits in the east and south-east portion of the city will be re-distributed. A number of new lights are being installed, and with the payment for the new equipment now on order, the loan of 1911 will about be used. City Electrician Hutchison believes that the future arc lighting extensions can be cared for out of revenue after the loan is expended.

Victoria, B.C.—Eight new bridges are now being constructed by the provincial board of works department, and three bridges are being renewed. Work on all of the structures is to be completed early next spring. Most important among those under construction is the bridge at Taghun, near Nelson, B.C., which will span the Kootenay river, and will cost about $90,000. It will comprise 3 steel spans with approaches, and will rest on steel cylinder piers filled with concrete. The bridge to be constructed across the North Thompson river at the mouth of the Barrier river, 40 miles north of Kamloops, will comprise one swing span and two fixed spans. Three bridges are being constructed across the Eagle river between Sicamous and Revelstoke; and two are being built over the Skeena river, one at Terrace, and the other at Smithers, this latter to have piled piers and Howe truss spans. The last of the eight new bridges is Clayton's bridge, to be built over the Bella Coola river. Those being renewed are one at Princeton, which will be a wooden truss structure on concrete piers, and will span the Tulameen river; one across the Okanagan river at Penticton, a swing-span bridge; and the third over Toby creek at Athalmar, in the Columbia district. Nothing definite has been done yet in connection with proceedings on the actual construction of the proposed Pit river bridge on the Dewdney trunk road.

Vancouver, B.C.—As far as the money available will allow, it is likely that the city will go ahead with the building of the causeway across Coal Harbor, and that the Park Board will move back the zoo and gradually improve the

surroundings of the harbor immediately. The work of building the causeway will be for the city works department, $155,000 having been appropriated for the preliminary expenses of the project. Ald. S. J. Crowe, chairman of the Civic Board of Works, declared recently that he was in favor of calling for tenders for the causeway immediately so that the city could go ahead with the work first thing in the spring, or as soon as money was available. Plans were passed some time ago by the Civic Bridges and Railways Committee, and they are said to have been drawn up with a view to conforming to the Mawson scheme. Chairman W. R. Owen, of the Park Board, said that the Board had asked for the approval of only the ground plan drawn up by Mr. T. H. Mawson, and that the work to be done, while gradual in effect, would conform to the general plan. In the meantime, the Park Board, he said, would trim up Coal Harbor and as soon as possible begin to fill in round the edges until the circular lake was formed. There was no intention in the plan of doing a great deal of expensive embankment work at once, but grassy slopes would likely be the scheme at first.

Montreal, Que.—Early in the morning of December 10th, at a point some 620 feet below the highest point of Mount Royal, the two headings of the Canadian Northern tunnel met almost exactly fifteen months after the first heading in the tunnel was commenced, and on the same day the first train ran through the tunnel from the west portal to the Dorchester Street shaft. Though the two heads started over three miles away from one another, when they were joined the grades were practically the same. Guests invited to make the first journey through the tunnel included Chief Justice Sir Charles Davidson, Acting Mayor Drummond, Controller Dupuis, Mr. Cowie, chief engineer of the Harbor Commission, J. E. Dalrymple, vice-persident of the Grand Trunk Railway, David McNicoll, vice-president of the C.P.R., Mr. Fairbairn, chief engineer of the C.P.R., Mr. Safford, chief engineer of the Grand Trunk Railway, Phelps Johnson, managing director of the Dominion Bridge Company, Prof. McLeod, secretary of the Canadian Society of Civil Engineers, G. H. Duggan, vice-president of the Dominion Bridge Company, and Professors Adams, Porter and Bancroft, of McGill University. This establishes a new record for deep tunnelling on the American continent and takes the record from the United States, while, with the exception of certain of the Swiss tunnels, where the headings are much smaller and the rocks softer, the achievement of the Canadian Northern engineers is a world's record.

PERSONAL.

W. D. L. HARVIE and M. A. REID have been elected public utilities commissioners for Lethbridge. ALEX. GRACE received the appointment of public works commissioner.

A. D. SMITH, for some time manager of the Western Electric Company at Fort William, Ont., has been appointed electrical inspector for that city, to assume duties January 1st.

J. K. SKAMMELL, District Engineer for the Department of Public Works at Fredericton, N.B., has been obliged to discontinue his services for the time being owing to severe accidental injury sustained recently

HON. ADAM BECK, Chairman of the Hydro-Electric Power Commission of Ontario, who was in New York last week in an advisory capacity respecting the feasibility of power development, sailed for England on the 13th instant.

T. H. HOGG, B.A.Sc., has been appointed to succeed Mr. C. H. Mitchell, C.E., as one of the representatives of the graduate body of the Faculty of Applied Science on the Senate of the University of Toronto, Mr. Mitchell having recently resigned.

TH. SEIDL, Manager and Chief Engineer of Messrs. Escher, Wyss & Company, Montreal, started on a short trip to Switzerland on the 16th December. Mr. Seidl expects to be back in Montreal on 20th January. During his absence Mr. Withers will be in charge of the office.

ARTHUR H. BLANCHARD, M. Can. Soc. C.E., professor in charge of the graduate course in highway engineering at Columbia University, on December 6th delivered an illustrated lecture on "Modern Developments in Highway Engineering" before the Drexel Institute of Philadelphia.

J. T. BRECKON, hydraulic engineer, Vancouver, has been recommended to take charge of Vancouver waterworks system under Mr. F. L. Fellowes, Supervising City Engineer. Mr. Breckon is a native of Oakville, Ont. He has had twenty-five years' experience in Canada and the United States in connection with waterworks, power plants, water supply and sewage disposal systems. Since September, 1912, he has been in charge of the design and construction of the waterworks system for the Associated Cement Company at Bamberton, B.C.

BACK COPIES WANTED.

One of our subscribers, anxious to bind his copies of *The Canadian Engineer*, is minus the following issues: Feb. 19th, 1909; May 4th, 1911; May 11th, 1911; May 18th, 1911; May 25th, 1911; June 1st, 1911, and would be glad to pay 25 cents per copy for any of them. Will subscribers who happen to have these numbers, and who do not care to keep them, kindly send them in to this office, and we will see to it that they are put into the hands of the party interested?

MANITOBA BRANCH CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the annual meeting of the Canadian Society of Civil Engineers, held in Winnipeg on the 4th instant, Professor E. Brydone-Jack was elected chairman for the ensuing year, with Mr. G. E. Bell as Secretary-Treasurer. It will be remembered that Professor Brydone-Jack was secretary last year, while Mr. J. G. LeGrand was chairman. The new secretary may be communicated with at Box 2918, Winnipeg.

It is reported that on Dec. 2nd a mechanical section of the Canadian Society of Civil Engineers, Manitoba Branch, was organized. Mr. A. C. Frith was chosen chairman of this section; Mr. R. R. Neild, vice-chairman, and Mr. J. F. Tracey, secretary. The executive committee consists of Messrs. J. W. Dorsey, S. S. Kennedy, T. L. Roberts, W. J. Gilmore, W. Jardine, and R. Milne. The next meeting of the section will be held on the first Monday in January.

COMING MEETINGS.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—Seventh Annual Convention will be held at Great Northern Hotel, Chicago, December 29th to 31st. Secretary, I. W. Dickerson, Urbana, Ill.

MINING AND METALLURGICAL SOCIETY OF AMERICA.—Annual Meeting will be held in New York City, January 13th, 1914. Secretary, W. R. Ingalls, 505 Pearl Street, New York.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20939—December 2—Amending Order No. 10568, February 26th, 1910, to provide that crossing of Plymouth Road be protected by day and night watchmen; cost of maintaining gates be apportioned: 15 per cent. by town of Welland, 10 per cent. by Tp. Crowland, and remainder by M.C.R.R. Co.

20940—December 3—Approving location C.P.R. Swift Current North Westerly Branch from point in Sec. 16-23-20, W. 3 M., at mileage 111.17, to point in Sec. 12-5-3, W. 4 M., at mileage 134.38, and authorizing construction of said branch across 23 highways.

20941—December 5—Approving location C.P.R. Bassano Easterly Branch Line from point on East Boundary of N.E. ¼ Sec. 13-24-1, W. 4 M., at mileage 118.39 to point in Sec. 6-26-21, W. 3 M., at mileage 180.20. And authorizing construction of said line across 63 highways.

20942—December 1—Extending until July 1st, 1914, time for approval of C.P.R. tolls between points in Canada west of and including Sudbury, Ont., to and from points west of Sudbury, from, and to points east thereof, and east of and including Windsor, Ont., also included in said tariff; during such period C.P.R. is allowed to charge tolls it was authorized to charge under Acts 7-8, Edw. VII., Chapter 61.

20943—December 2—Authorizing, temporarily, until June 1st, 1914, C.L. and W. to operate trains over crossing of Oshawa Electric Ry., at mileage 158.85, at Prospect St., town of Oshawa, Ont., subject to condition that crossing be protected by flagman appointed and maintained by and at expense of Ry. Co.

20944—December 3—Approving location C.P.R. station at Willon, S.E. ¼ Sec. 10-14-28, W. P. M., Man., at mileage 26.5, on Virden-McAuley Branch.

20945—December 2—Authorizing C.P.R. to construct spur on parcel of land leased from Government, lying northeasterly of right-of-way of C.P.R. main line, and Dog Lake, in Tp. 46, Dist. Algoma, Ont., at mileage 58.8, Lake Superior Division.

20946—December 1—Extending, until July 1st, 1914, time limited by Sec. 4, Ch. 61, of Acts 7-8 Ed. VII., and extended until December 1st, 1913, by Order No. 19423, dated May 30th, 1913, for approval of G.N.W. Tel. Co.'s tolls between points in Canada west of North Bay, also to and from points west of North Bay and to points east thereof, and east of and including Windsor, Ont., also included in said tariff, during such period G.N.W. is allowed to charge tolls it was authorized to charge under Acts 7-8, Ed. VII., Ch. 61.

20947—December 1—Extending, until July 1st, 1914, time for approval of Can. Nor. Tel. Co.'s tolls for the transmission of telegraph messages between points in Canada; during such period C.N. Tel. Co. is allowed to charge tolls it was authorized to charge under Acts 7-8 Ed. VII., Ch. 61.

20948—December 3—Authorizing Can. Nor. Western Ry. Co. to construct across and connect with tracks of City Industrial Spurs in city of Medicine Hat, Alberta.

20949—December 2—Authorizing C.N.R. to construct spur for the Scott Fruit Co., city of Regina, Saskatchewan.

20950—December 1—Extending, until July 1st, 1914, time for approval of White Pass and Yukon Route tolls for transmission of telegraph messages between points in Canada; during such period company is allowed to charge tolls it was authorized to charge under Acts 7-8, Ed. VII., Chapter 61.

20951—December 1—Extending, until July 1st, 1914, time for approval of G.T.P. Tel. Co.'s tolls for transmission of telegraph messages between points in Canada, with exception of tolls of Co. between its local offices, on its Ottawa Division, in Provinces of Ontario and Quebec, and between them and Swanton, Vt., approved by Order No. 11153, dated July 12th, 1910; during such period Tel. Co. is allowed to charge tolls it was authorized to charge under Acts 7-8, Ed. VII., Chapter 61.

20952—December 4—Authorizing G.T.P. Ry. to construct Government Road Diversion across main line in S.W. ¼ Sec. 35-52-1, W. 5 M., at mileage 818-6 west of Winnipeg, Dist. North Alta., Alta.

20953—December 5—Authorizing C.P.R. to construct siding at Melba, across highway between N.W. ¼ Sec. 18-17-3, W. 3 M., and N.E. ¼ Sec. 13-17-4, W. 3 M., at mileage 41.9 from Moose Jaw, Sask.

20954—December 5—Relieving C.P.R. from providing further protection at crossing of First Avenue, village of Souris, Man., at mileage 16.6 on Estevan Subdivision, ¼ mile west of Souris Station.

20955—November 24—Directing that crossing at Broadway Street, town of Yorkton, Sask., be protected by a watchman, appointed by C.P.R., from 8.30 a.m. to 8 p.m., except during grain shipping season, when such crossing be protected night and day; wages of watchman be borne 60 per cent. by Ry. Co., and 40 per cent. by town of Yorkton.

20956—December 5—Extending, until May 15th, 1914, time within which C.P.R. complete spur for Canadian Metal Shelter Company, Winnipeg, Man., authorized under Order No. 19325.

20957—December 5—Authorizing C.P.R. to construct, by means of grade crossings, an additional track (double track) of main line, Sask. Division, Swift Current Subdivision, across five highways—M. 40. 8, N.W. ¼ Sec., 17-17-3, W. 3 M.; 2. M. 43 7, Sec. 23 and 26-17-4, W. 3 M.; 50.3, Secs. 25 and 26-17-5, W. 3 M.; 4. 51.3, Secs. 26 and 27-17-5, W. 3 M.; and 5, mileage 66.69, Secs. 22 and 21-17-7, W. 3 M., Ernfold, Sask.

20958—December 5—Amending Order No. 20502, by striking out figures "15" wherever they occur in recital and operative parts of Order and inserting in their place and stead figures "14," so as to make Order read, "and across Sec. 27, Tp. 18, R. 14, W. 2 M."

20959—December 5—Authorizing C.P.R. to use and operate Bridge No. 613 on Teeswater Subdivision, Ont. Division.

20960—December 3—Authorizing G.T.P. Branch Lines Company, to construct spur for Hamilton Brothers, village of Fort Qu'Appelle, Sask.

20961—December 4—Approving plan "B," dated November 25th, 1913, filed by G.T.R., and showing location of transfer track, town of Port Hope, Ont.

20962—December 3—Directing that, within 60 days from date of this Order, G.T.R., install automatic electric bell at crossing of highway, between Cons. 6 and 7, Tp. Otonabee, ½ mile west of Keane Station, Ont., 20 per cent. cost of installing bell paid out of Ry. Grade Crossing Fund, remainder by Ry. Company.

20963—December 5—Authorizing G.T.P. Branch Lines Company to operate trains over crossing of C.N.R., Maryfield Branch in N.W. ¼, Sec. 9-5-6, W. 2 M., Dist. Assiniboia, Sask., without their being brought to a stop.

20964—December 4—Directing that G.T.R., within 60 days from date of this Order, install improved type of automatic bell at crossing of public road west of Ste. Justine Station, Que.; 20 per cent. of cost of installing said bell be paid out of Railway Grade Crossing Fund, remainder by Ry. Company.

20965—December 4—Extending, for a period of 1 year from December 1st, 1913, Order No. 12723, dated December 6th, 1910, subject to condition that crossing be protected by gates, to be erected and operated by and at expense of applicant company (C.N.O.R.).

20966—December 9—Substituing plan No. 53515 as revised to December 5th, 1913, for plans approved under Order No. 20827, dated November 14th, 1913. 2. Openings be left in said bridge between piers 11 and 12 and piers 15 and 16, as shown on plan marked Plan "A."

20967—December 10—Approving proposed Supplement No. 2 to Canadian Freight Classification No. 16, as finally revised and submitted for approval by G. C. Ransom, Chairman, Can. Freight Association, by his letter dated Montreal, December 6th, 1913, effective not later than January 20th, 1913.

20968—December 6—Authorizing G.T.P. Ry. to construct highway between Secs. 32 and 33-51-20, W. 4 M., Alta., across its main line at mileage 763.7, west of Winnipeg.

20969—December 5—Approving revised location G.T.P. Ry. main line from East Line of Lot 5337 to West Line of Lot 5336, Cariboo District, B.C. Also approving location of station in Lot 5336, mileage 95, Yellowhead Pass West, B.C.

20970—December 6—Authorizing C.P.R. to reconstruct Bridge No. 2.0, Montreal Terminals, Eastern Division.

20971—December 10—Amending Order No. 20775, dated November 6th, 1913, by striking out figure "8" after words "Lot No.," in seventh line of operative part of Order, and substituting therefore figure "5."

20972—October 31—Establishing collection and delivery limits of Express Companies in Edmonton, Alta.: And rescinding Orders Nos. 14987 and 15759, dated respectively 11th September, 1911., and 8th January, 1912.

20973—December 4—Establishing collection and delivery limits of Express Companies in city of Levis, Que.

20974—December 9—Authorizing city of Edmonton, Alta., to operate its Electric Street Ry., over G.T.P. Ry., at 27th Street, pending installation of half-interlocking plant required to be installed under Order No. 20793, subject to and upon conditions that crossing be protected by flagmen, appointed and maintained by and at expense of city; cars of city be stopped 100 feet from diamond; trains of G.T.P. Ry. to approach crossing under control, prepared to stop if electric railway is making crossing.

20975—December 9—Extending, until April 1st, 1914, time within which G.T.R. install gates at crossing of Wallace Avenue, Toronto, Ont.

20976—December 9—Authorizing Edmonton, Dunvegan and B.C. Ry. to construct bridge across Athabasca River, mileage 131, west of Edmonton, Alta.

20977—December 9—Authorizing. Esquimalt and Nanaimo Ry. to consruct across Campbell Street, Nanaimo, to serve Nanaimo Pressed Brick and Terra Cotta Company.

20978—November 27—Authorizing C.L.O. and W. Ry. (C.P.R.) to operate trains, temporarily, until June 1st, 1914, over crossing of Toronto and Eastern Ry., at junction of Scugog and Wellington Streets, town of Bowmanville, mileage 149.2 from Glen Tay.

20979—December 9—Authorizing C.P.R. to construct spur for Imperial Oil Co., Limited, Montreal, Que.

20980—December 3—Approving and authorizing clearances as shown on plan of C.P.R. siding for Imperial Oil Company, Calgary, Alta., subject to condition that men keep off sides of cars while operating said siding.

20981—December 9—Extending, until April 1st, 1914, time within which G.T.R. commence construction of subway at crossing of Thompson Rd., Tp. Bertie, and directing work be completed within 4 months from that date; pending completion of subway, G.T.R. employ day and night watchmen at said crossing; wages of watchmen be paid—15 per cent. by P.M.R.R. Co., 30 per cent. by M.C.R.R., 47½ per cent. by G.T.R. and 7½ per cent. by Tp. Bertie. Rescinding Order No. 20921, dated November 20th, 1913.

20982—December 6—Authorizing G.T.R. to construct siding into premises of Frontenac Wall and Tile Company, part Lot 5, Con. west of Great Cataraqui River, Tp. Kingston, Co. Frontenac, Ont.

20983—December 9—Directing C.N.R. to dig a ditch 3 feet wide by 3 feet deep, from west end of British America Elevator, to connect with old ditch at east switch, to bridge just east of road allowance, Engelfeld, Sask. Ry. Co. grade driveway and aproaches to elevator and loading platform along south side of station grounds, and grade team-track driveway for distance of 300 feet from west side of Engelfeld Milling Company's building, work to be done by August 1st, 1914.

20984—December 10—Amending Order No. 20905, November 25th, 1913, by substituting words "tracks of the G.T.P. Branch Lines Company," for words "G.T.P. Railway," where they occur in Order.

20985—December 9—Authorizing C.P.R. to open for traffic its Virden McAuley Branch from mileage 13.5 to 36.0, Man.: Provided speed of trains be limited to rate not exceeding 20 miles an hour.

20986—December 10—Approving location C.N.O.R. station grounds at Coniston, Tp. Neelon, District Nipissing, Ont., at mileage 257 from Toronto.

20987—December 10—Approving location C.P.R. station at Broadacres, Sask., on S.W. ¼, Sec. 32-35-21, W. 3 M.; and rescinding Order No. 18915, dated April 14th, 1913, in so far as it approves location of station in Sec. 6-37-21, W. 3 M.

20988—December 10—Establishing collection and delivery limits of Express Companies in town of New Liskeard, Ont.

20989—December 9—Authorizing C.P.R. to construct proposed wye at Tregarva, Sask. Division, Colonsay Subdivision, across Railway Avenue Lane in Block 2 and Gregg Avenue, Tregarva, Sask.

20990—December 9—Authorizing C.P.R. to reconstruct Bridge No. 49.8 over Salmon River, Orford Subdivision, Eastern Division, near Kingsbury, Que.

20991—December 9—Authorizing C.P.R. to construct, at grade, Kootenay Central Ry., across four (4) highways in Lots 5033 and 4596 (Provincial Government Survey), East Kootenay District, B.C.

20992—December 10—Authorizing city of Fort William, Ont., to cross, at level, with its double track line of Street Ry., on Frederica Street, the tracks of G.T.P. Ry., where same cross Frederica Street, city of Fort William. Question of apportionment of cost of installation and maintenance of half-interlocking plant is reserved.

20993—December 9—Directing that C.N.R. divert road allowance from a point north of Ry., to farm crossing, thence to road allowance in Sec. 12-19-24, Man. Mun. provide necessary right-of-way upon payment by Ry. Co. of $200.

20994—December 9—Authorizing G.T.R. to construct spur across Montreal Street and the Port Arthur and Fort William Electric Street Ry., at West Fort William, Ont., for Canadian Car and Foundry Co., Limited.

20995—December 9—Approving plan showing details of superstructure of C.L.O. and W. Ry. (C.P.R.) bridge at Simcoe Street, town of Oshawa.

20996—December 12—Directing that crossing of tracks of Confederation Construction Company over G.T.R., be approved and authorized, for construction purposes only, subject to certain conditions. Temporary crossing be protected by an interlocking plant and derails be installed to satisfaction of Engineer of G.T.R.; Applicant Co., bear and pay entire cost of construction, maintenance and operation of crossing.

20997—December 11—Authorizing C.P.R. to open for traffic double track from mileage 76.8 to 84.2 on Moose Jaw Subdivision.

20998—December 11—Authorizing C.P.R. to open for traffic double track from Notman, mileage 95.1 to mileage 99.4, on Swift Current Subdivision.

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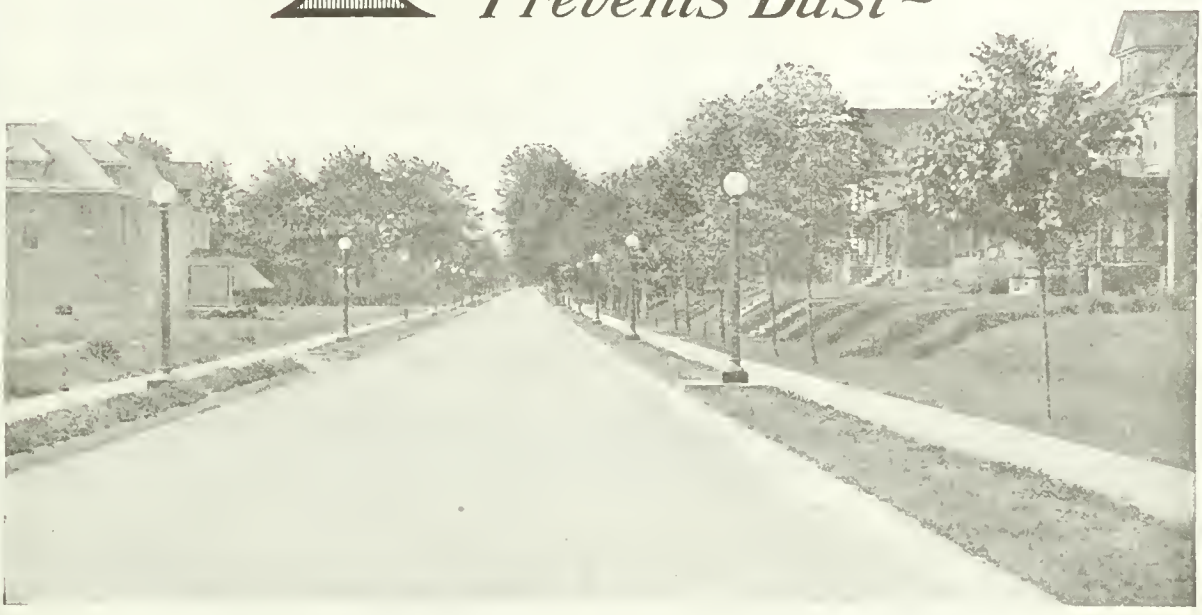

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Beloeil Village, P.Q., wharf	Jan. 5.	Dec. 11.	82
Calgary, Alta., machinery, etc.	Dec. 31	Nov. 13.	88
Charlottetown, P.E.I., dredging	Dec. 23.	Dec. 11.	82
Grand Mechins, Que., extension to wharf	Dec. 22.	Dec. 4.	80
North Toronto, Ont., waterproofing of subways	Dec. 27.	Dec. 11.	86
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., coaling plants, etc.	Jan. 7.	Nov. 13.	86
Ottawa, Ont., ice-breaker	Jan. 8.	Nov. 27.	84
Ottawa, Ont., dam on French River	Dec. 29.	Dec. 11.	86
Ottawa, Ont., steel pipes	Feb. 3.	Dec. 11.	88
Quebec, Que., heating, etc., in Post Office building	Jan. 8.	Dec. 11.	80
Rimouski, Que., wharves and dredging	Dec. 22.	Dec. 4.	80
Toronto, Ont., mechanical filtration plant	Jan. 20.	Nov. 27.	88
Vancouver, B.C., pavements	Dec. 23.	Dec. 11.	80
Winnipeg, Man., water supply		Oct. 16.	86
Yorkton, Sask., electric machinery	Dec. 22.	Nov. 13.	86

RAILWAYS—STEAM AND ELECTRIC.

Aylmer, Ont.—The proposition of the London and Lake Erie Traction Company, to extend their road to Aylmer and Port Burwell was discussed at a meeting held recently in Aylmer, when representatives of the road met the representatives of the municipalities interested. The company's offer was placed before the meeting by Vice-President E. R. Wood. Mr. Wood considered that Aylmer should guarantee $20,000 per mile in bonds as her fair share, or $50,000 for the 2½ miles of line proposed, the guarantors to have the whole road as security. Mr. Wood stated also that the municipality of Port Burwell could be incorporated in the agreement, or any reasonable proposition would be considered by the company. The municipalities will consider the company's offer.

Barrie, Ont.—At a special meeting of the town council a provisional agreement with the Toronto, Barrie and Orillia Electric Railway Company was adopted and a by-law prepared for submission to the qualified ratepayers on January 5 to authorize a railway. The company gets a 25-year franchise and a fixed assessment of $15,000 for general taxation.

Calgary, Alta.—The C.N.R. has given notice through its subsidiary organization, the Calgary and Edmonton Railway Company, that at the next session of Parliament it will apply for permission to construct the following lines of railway:—From a point on the Macleod branch in township 19, 20 or 21, in a westerly direction to a point on the south branch of Sheep Creek, in range 4, west of 5th meridian, Alberta; from a point on the line described in paragraph (a) to a point on the north branch of Sheep Creek in range 2, 3 or 4, west of 5th meridian; from a point on the line described in paragraph (a) to a point on Trap Creek, west of 5th meridian The proposed line will go right through the heart of the new oil district.

Edmonton, Alta.—Private advices from London are that financial arrangements have been completed in England to build the Alberta, Peace River and Eastern Railway, from Hudson's Hope to the Pacific Ocean, 2,300 miles, by way of Edmonton and Peace River Crossing, with a branch line to Fort McMurray. The promoters of the railroad claim it will be the shortest transcontinental line on the North American continent. Surveyors have been over the proposed line between Edmonton and the Peace River country and it is announced that everything is in readiness to begin work.

Edmonton, Alta.—The construction of a line of railway from Edmonton to Alaska, was a proposition submitted to the Board of Trade, recently. The proposition met with approval, and it was resolved to have a committe appointed as soon as possible, with a view to pressing the further consideration of the matter upon the Dominion Government and with the ultimate intention of having the Government confer with the Government of the United States.

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Edmonton, Alta.—The construction of a line of railway from Edmonton to Alaska is a proposition submitted to the Board of Trade by Mr. W. A. Griesbach. As he outlined it, the proposition met with approval, and it was resolved to have a committee appointed as soon as possible to press the further consideration of the matter upon the Dominion Government and with the ultimate intention of having the Government confer with the Government of the United States.

Fort William, Ont.—Details are completed for the building as rapidly as possible the last link of the Duluth and Minnesota Railway, which will connect the two lake ports, Fort William and Duluth. According to Engineer H. J. Hare, who is in charge of the construction, contractors will start at both ends of the connecting link early next spring, and the line will be rushed to completion. One hundred and twenty miles of the road have already been built from Duluth. Only 80 miles remain to be completed.

Guelph, Ont.—At the banquet held recently at Guelph of men from the city and neighboring counties, towns and villages, interested in the project of a radial to be operated by the Hydro-Electric Commission, it was resolved that the meeting representing some 25 municipalities of the counties of Wellington, Grey and Simcoe, urge upon the Hon. Adam Beck and his colleagues that they give these municipalities assistance in compiling all the necessary information as to cost of construction and operation, method of financing and most suitable location of said line, so that it may serve the best interests of the people of the district. And in return they guarantee that their earnest co-operation and support in the building up of such a Hydro electric radial system as shall bring the greatest development, progress and prosperity to the whole province of Ontario. In replying to the resolution, the Hon. Mr. Beck stated that the engineers of his department would, as soon as possible, go over the proposed routes. They would probably submit two or three plans, having regard to the feasibility of construction, and the number of people to be served.

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BOOKLETS ON REQUEST

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Hamilton, Ont.—C. W. Bell, solicitor for the Webb Incline, has announced that the company will begin at once upon the work of constructing a new incline, as ordered by the Ontario Railway Board.

Moose Jaw, Sask.—The G.T.R. and the C.N.R. have entered into arrangements for the erection of a Union Station and for the joint use of extensive terminal facilities at Moose Jaw. In the agreement the C.N.R. has secured running rights over the G.T.R. between Moose Jaw and Regina, which gives this city direct C.N.R. connection with Winnipeg and Fort William. The C.N.R. intends to construct a line from Moose Jaw running southwestward between Lakes Johnston and Chaplin to connect with the Midale extension running in the direction of Lethbridge, the expectation being that the connection will be made south of Maple Creek; and also a line connecting the city with Chamberlain on the Regina-Saskatoon branch, affording direct connection with Prince Albert by way of Saskatoon.

Montreal, Que.—The announcement is reported from headquarters that Mr. J. D. McArthur, railway contractor, Winnipeg, is interested in a railway project which aims to build in Saskatchewan a road from Regina southeasterly to the eastern boundary of the province; then northwesterly to townships 27, and thence northerly to Saskatoon—a local railway, for the convenience of the new settlers, which is to start with a capital of $1,000,000.

Ottawa, Ont.—The Canadian Northern Railway will ask Parliament for extension of time to build the following lines: Regina southwesterly to international boundary; Battleford westerly to the head waters of Brazeau River; Regina northerly to Humboldt, thence to Pas Mission, and from a point on the line between Humboldt and South Saskatchewan River northeasterly to crossing of South Saskatchewan River by company's Prince Albert branch; from Calgary westerly to Cochrane, Exshaw and Banff and from Cochrane northerly to intersect the company's line near Pigeon Lake; from Cochrane southerly to Nanton.

Ottawa, Ont.—The Canadian Northern Ontario Railway asks for extension of time to build the following lines:—(a) from its authorized line between Port Arthur and Sudbury, near the head of Long Lake, northerly and westerly to connect with the National Transcontinental Railway east to Lake Nipigon; (b) from its authorized line between Ottawa and North Bay, near the township of Chisholm, southeasterly to the Central Ontario Railway at or between Bancroft and Whitney; (c) also the line Port Dover to Kincardine.

Petrolea, Ont.—A rumor is circulated that the Merchant's Mutual Line and other lake package transportation freight companies are interested in plans for a railway route through Petrolea to Corunna, with radials to Courtright, Brigden, Arkona and Sarnia. The project is backed by London and Petrolea capitalists, and options for the right of way have already been secured on front farms in Moore township. Hydro-Electric is the proposed motive power, and it is figured that the amount of freight handled at once will more than compensate for the operation and equipment of the proposed road.

Port Arthur, Ont.—A by-law to raise the sum of $238,000 by way of debentures for the purpose of further improving and extending the street railway system of the city, will be submitted to ratepayers on January 5th next.

St. John, N.B.—The Hon. H. F. McLeod stated while here that the Valley Railway will cross the St. John River at The Mistake or Oak Point. At The Mistake, a diamond drill has gone down 200 feet into clear mud, without striking a bottom suitable for a bridge foundation. The railway will cross the St. John and the Kennebeccasis and connect with the Intercolonial at a point near Rothesay and thence over the I.C.R. to the Courtenay Bay district.

Toronto, Ont.—When in the city, Mr. J. Rose, an engineer who accompanied the survey party for much of the length of the new G.T.P. line between Calumet and a point near Belle River, which will make a short link with the main line from Montreal, stated that the preliminary survey of this 170 miles had been completed, and that it is expected that the new line of the Northern Railway between these two points will be commenced next spring, directly the bonds have been guaranteed.

Vancouver, B.C.—Recently Mr. J. J. Woods outlined the proposal of the promoters of a motorbus service in Vancouver before the civic finance committee. The final decision of the committee was that Mr. Woods draft an agreement setting forth just what was wanted from the city and how it was proposed to conduct the proposed service. This will be ready for the next meeting of the committee and if it is decided to recommend the granting of a franchise it will be submitted to the ratepayers in the form of a plebiscite, the expenses of which the promoters are prepared to defray.

Winnipeg, Man.—Tenders will be received up till December 29th, for the supply and delivery of 250,000 railway ties and 3,000 telephone poles. Plans and specifications may be obtained from the Office of the Commission for the Greater Winnipeg Water District, Winnipeg, Man. Signed, S. H. Reynolds, Chairman of Commissioners.

Winnipeg, Man.—Application will be made at the present session of the legislature for an act to incorporate a railway, with powers to construct railways and operate the same from a point at or near Fort Churchill to a point at or near the Hudson Bay Railway at Kettle Rapids, in the province of Manitoba, and all other powers and rights incident thereto.

GARBAGE, SEWAGE AND WATER.

Cedarvale, Ont.—A special meeting of the Cedarvale Ratepayer's Association is to consider the immediate need of a better water supply in the district.

Chatham, Ont.—The Hon. Adam Beck, at a recent mass meeting of Chatham ratepayers strongly advised the support of the by-law which will be submitted in January, to authorize the purchase by the city of the gas and electric light plant of the Chatham Gas Company in connection with the Hydro-Electric system in the city, the purchase price being $410,000.

Edmonton, Alta.—City Engineer Latorne reporting on the water and sewerage accommodation necessary in connection with the new city schools, states that it would cost approximately $12,700 to construct the permanent sewer for the H. Allan Gray School, as a long stretch of 36-inch and 24-inch intersecting sewer would be necessary; but an 8-inch temporary sewer along Westminster from the school to Namayo would cost about $2,300. The Bennett school can be taken care of with a sewer at a cost of $1,350. For the John A. McDougall School the engineer reports that the natural outlet is the 4-foot sewer now being constructed on Fifth Street. The additional permanent construction required to carry the sewerage from this school to this sewer would cost about $12,500, but a temporary sewer could be carried to the same point for about $4,620.

Hamilton, Ont.—The civic board of control has received a letter from the Fire Underwriters' Association to the effect that if Hamilton is to continue to pump water by electricity, it should duplicate its pumping equipment and obtain a supply of power independent of the Hydro-Electric power which is now being used.

Ottawa, Ont.—The waterworks committee has decided to have the city engineer spend $1,600 on completing the wall between the two aqueducts.

Peterborough, Ont.—The Trent Valley Water Conservation Association has been organized and the matter of conserving the waters of the district will be taken up with the Government.

Port Arthur, Ont.—Among other by-laws to be submitted to the ratepayers on January 5th, is one to provide for laying additional water mains and making extensions to the waterworks system, the cost to be covered by the issue of debentures for $202,167.

Regina, Sask.—When the city commissioners report on a cheap power scheme, they will recommend the adoption of the Coste-McCauley or Georgeson propositions for natural gas in preference to development of the Estevan coal fields for power purposes. Because of the high freight charges, they consider the latter too costly for success.

St. Catharines, Ont.—The Ontario Board of Health has directed the city of St. Catharines to establish a filtering system in connection with its waterworks, a mechanical filtration of the gravity type preferred, using storage period of two hours after administration of chemical.

Sydney, N.S.—The Dominion Steel Company are preparing to install a new heating furnace in their rolling mill de-

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Welland, Ont.—Before the Niagara District Medical Association at the Welland Club, Dr. J. W. McCullough of Toronto, P.H.O., affirmed that the Government is investigating and making surveys for the laying of a pipe line from Port Colborne all along the canal to supply fresh lake water.

Winnipeg, Man.—The Winnipeg ratepayers have passed a by-law for the expenditure of $85,000 on an incinerator to be located in the district of Elmwood.

LIGHT, HEAT AND POWER.

Camrose, Alta.—Tenders will be received till December 22nd for plumbing, heating and ventilation for the Normal School at Camrose, Alta. Plans and specifications may be obtained from the Department of Public Works, Calgary. John Stocks, Deputy Minister.

Chatham, Ont.—The city council has dealt with the four by-laws to be submitted to ratepayers, among which are one to enable the council to sell debentures to raise funds for the hydro scheme, and one for the purchase of the Chatham Gas Company.

Fort William, Ont.—A by-law is advertised to be submitted at the coming civic elections to raise $115,500 by way of debentures for the purpose of taking care of the cost of improvements and extensions made and to be made to the electric light system at Fort William.

Hamilton, Ont.—A by-law will be submitted at the coming elections in Hamilton for the issue of debentures for $335,000 for the completion of the Hydro-Electric system in Hamilton.

Havelock, Ont.—It is understood that the Havelock council has decided to accept the suggestions of the Hydro-Electric Commission, and will embody them in a by-law to be passed on by the council and submitted to a vote at the January elections.

London, Ont.—A by-law is to be submitted to voters at the municipal elections to grant the right to Greene-Swift, Limited, to lay and maintain in certain streets in the city of London, pipes for the conducting of steam to supply heat to the inhabitants of the municipality.

Moose Jaw, Sask.—The city council has endorsed the proposal of William Georgeson and his associates to supply natural gas to Moose Jaw and has passed a resolution placing on record its approval of the project and recommending that the council of 1914 ratify the same.

+ **Nepawa, Man.**—Orders have been placed for the following apparatus for the town of Neepawa by their consulting engineers, W. E. Skinner, Limited, with the GOLDIE AND McCULLOCH COMPANY of Galt, Ont., for two 72 x 18 return tubular boilers and one 12 x 19 x 8 vertical compound condensing engine operating at 450 r.p.m.; and with the CANADIAN GENERAL ELECTRIC COMPANY for one a.t.b. 16, 150 k.v.a., 450 r.p.m., 2,400 volt, 3 phase, 60 cycle, A.C. generator.

+ **Ottawa, Ont.**—A contract has been awarded by the Cabinet Council to the ELECTRICAL REPAIR AND SUPPLY COMPANY for $990 for electric installation in a public building at Coaticook, Que.

Ottawa, Ont.—The city council has decided to leave the matter of the proposal regarding a municipal gas plant to next year's council, when there will be greater time for consideration.

Port Arthur, Ont.—A by-law to authorize extensions and improvements to the electrical power system and to issue debentures for $55,000 to cover the cost thereof, will be submitted to ratepayers on January 5th.

Vancouver, B.C.—A reorganization of the Ocean Falls Company in an amalgamation of Pacific Coast paper interests, that will put the Ocean Falls pulp plant in active operation again, and in addition mean the building of a $3,000,000 paper mill, is now in process of settlement, according to advices received in the city from London. It is proposed to form an amalgamation of the Powell River Pulp and Paper Company, the Crown Paper Company of Portland, the Quatsino Sound Pulp Company and the Ocean Falls Company, thus consolidating the Ocean Falls Company with the three largest pulp and paper properties on the Pacific Coast.

Victoria, B.C.—The civic authorities have been asked by the engineering firm of Du Cane, Dutcher and Company, to consult with the company's representatives for the purpose of arranging a 30-year franchise for a steam-heating plant in Victoria, which will utilize the waste material from lumber industries to generate heat and electricity for the supply of down-town office blocks. The council has appointed a committee to confer with the representatives of the company.

Wallaceburg, Ont.—At the January elections, a by-law will be submitted in Wallaceburg to secure authority for the purchase of the plant of the Wallaceburg Gas Company.

Welland, Ont.—At the next elections, there will be submitted to voters a by-law to grant the right to lay and maintain pipes for conducting natural or fuel gas or oil across and along the public highways in the township of Wainfleet, in the county of Welland, and to supply to the corporation of the inhabitants of the municipality or any of them natural or fuel gas or oil.

Winnipeg, Man.—The city of Winnipeg Light and Power Department are building a 12,000 volt transmission line between their substation and the G.T.P. shops in Transcona. The town's interest in this matter, as well as others of an electrical nature, are taken care of by W. E. Skinner, Limited, their consulting engineers.

Winnipeg, Man.—By a large majority, the Winnipeg ratepayers have approved the by-law granting $1,000,000 to the distribution section of the City Light and Power Department.

BRIDGES, ROADS AND PAVEMENTS.

Bow City, Alta.—The farmers of the adjoining country and the citizens are uniting to petition the Government for a bridge over the Bow River at this centre.

Calgary, Alta.—The city council has passed clause 4 in the proposed agreement between the city and the International Milling Company which stipulates that no work will be started upon the construction of 4th street subway, until the provincial legislature has ratified the whole agreement. This will probably delay the construction until the summer of 1915.

Galt, Ont.—Farmers who travel the East River road have circulated a petition to be presented to the Railway Board asking that the L.E. and N. Railway be forced to construct a subway at its intersection with the River road.

Montreal, Que.—The municipalities of Pike River, Stanbridge Station, Stanbridge East and Bedford, are urging upon the Government the urgency for the immediate construction of the Government highway starting from the King Edward road at Lacolle, in the county of St. Johns, through the counties of Missisquoi and Brome, as far as Knowlton, ultimately to connect with the Government highway from Sherbrooke to Derby Line.

Newcastle, N.B.—The Intercolonial authorities have decided to erect a bridge over the Miramichi between Chelmsford and Millerton, and surveyors are now at work taking the soundings of the proposed site.

New Westminster, B.C.—It is likely that work on the paving of Columbia Street in front of the penitentiary will be commenced this year. The distance to be paved is some 2,500 feet, and the Dominion Government is expected to pay $45,000, which is a good part of the total cost.

New Westminster, B.C.—The Navigation Committee of the New Westminster Board of Trade want the level of the new Government Pitt River Bridge raised ten feet above what is called for in the present plans. This would necessitate the lengthening of the apertures. A meeting of provincial authorities will consider the matter further.

Ottawa, Ont.—A report is to submitted to the board of control in which City Engineer Archibald Currie says that to put the various roads in Ottawa in good condition would require an expenditure of $3,172,119. In his report Mr. Currie gives a list of the various streets and the pavement proposed. He suggests 10 kinds of pavement and says that 84.32 miles of roadway would be involved—in other words, 445,258 lineal feet or 1,511,361 square yards. Mr. Currie recommends that

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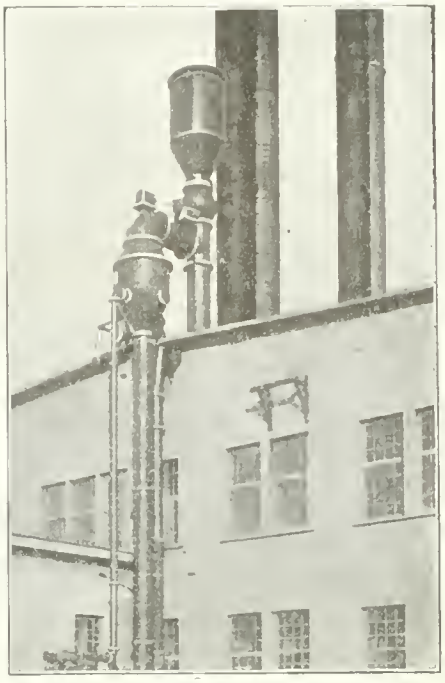

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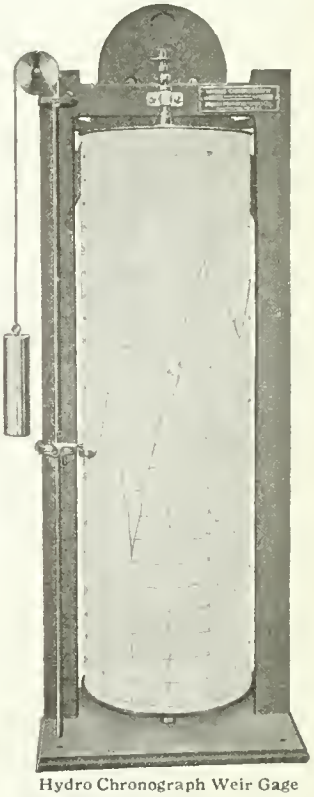

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the question of roadways in Ottawa be taken up very seriously as the present state of affairs is far from satisfactory.

Ottawa, Ont.—An agreement has been finally reached between the city Board of Trade and the county counsel respecting the building of a temporary bridge over the Rideau River at Billings Bridge. The terms were that the county would agree to the erection of a temporary bridge leaving to arbitration the division of cost from the south bank to the island; and that if it was proved that the county were also liable for a division of the cost of the part from the island to the north shore that the division of cost would be decided by arbitration. The agreement is to be ratified by the county council.

Peterborough, Ont.—The city council has decided to submit a by-law to the people at the January elections to provide for the construction of a $78,000 bridge from Dalhousie Street to Maria Street across the Otonabee River.

Saskatoon, Sask.—Up to date, no tender has been received for the rehabilitation of Long Hill from any of the firms asked to give an estimate on the work. The city commissioners believe that it would cost about $100,000. However, the question of using this money in the erection of a new bridge, which would solve the problem, is being raised and will be discussed by council.

Toronto, Ont.—Plans for the superstructure of the Bloor Street viaduct are being prepared and tenders will be called for early in the spring. A combination of problems have to be solved to make the viaduct accommodate the variety of traffic.

Toronto, Ont.—The new Gerrard Street bridge will cost between $182,000 and $198,000 more than the $200,000 which has been appropriated for it by the city, according to a report from the Works Department to the board of control.

Vancouver, B.C.—Tenders will be received up till December 23rd for the construction of certain asphaltic mixture and wood block pavements. Plans and specifications may be obtained from the City Engineer, City Hall, Vancouver, B.C. Signed, Wm. McQueen, City Clerk.

Vancouver, B.C.—At the last meeting of the Point Grey municipal council, it was decided that the intersections of Twenty-Seventh Avenue and Connaught Drive with Oak Street should be macadamized so as to make a better access from Oak Street to Braemar School.

Victoria, B.C.—A dual approach to the proposed Johnson Street Bridge, one from Johnson Street and another through property offered by the E. and N. Railway, connecting the bridge with Cormorant Street, was the proposition favored by the city council, which has again considered plans submitted by City Engineer Rust. The Government has declared its adhesion to the Johnson Street approach alone, but the council, in approving of the dual approach, expressed the hope that, at another conference with the Government, the city's choice will be approved. The engineers of the city and Government will be asked to get together with a view, if possible, to estimating the cost of the proposed structure so that a by-law may be submitted to the ratepayers at the forthcoming civic election; but first the location of the bridge must be fixed definitely.

INDUSTRIAL WORKS.

Bridgeburg, Ont.—It is rumoured that the M.C.R. will unite with the C.N.R. in the construction of a tunnel beneath the Niagara River, unless immediate steps are taken to double the International Bridge.

Cobalt, Ont.—Representatives of the Cobalt Lake Mining Company appeared before Mining Commissioner T. E. Godson recently to ask for a permit to drain Cobalt Lake. They wish to quarry in the bottom of the lake, the reason being that it would save miners from danger in tunnels.

Edmonton, Alta.—The city commissioners have concurred with the recommendations of City Engineer Latornel to leave the dredging of the channel across the river to his department to be done by day labor, rather than by contract.

Goderich, Ont.—The following recommendation is one of several made by the coroner's jury in the inquest at Goderich into the death of Thomas Stone, of the freighter 'John A. McGean': "We strongly recommend and believe that the government should without delay and at any cost complete and equip Goderich Harbor as a real harbor of refuge: first, by fully completing the breakwater now begun; second, by installing up-to-date lights and a fog signal at the entrance of the breakwall; third, by dredging to the necessary depth the outside basin formed by the breakwall so that ships may have some sea room after the stress of entering to manoeuvre and steady themselves before trying to enter the piers."

Megantic, P.Q.—Tenders will be received up till January 5th for the construction of a concrete dam. Plans and specifications may be obtained from the Clerk of the town of Megantic, County of Lake Megantic, P.Q. Signed, Joseph Roy, Clerk.

Ottawa, Ont.—Since tenders for a dam on French River have been called, it is expected that the Hon. Robert Rogers will shortly announce the appointment of a commission to inquire into the commercial feasibility of the canal project.

Ottawa, Ont.—Notice is given that the time for the reception of tenders for the construction of wharves at Victoria Harbor, B.C., has been extended to January 8th, 1914. Signed, R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Plans are being prepared by the Government for a new elevator at Calgary, and tenders will be invited early in the year. The capacity will be 2,500,000 bushels.

Sydney, N.S.—The Board of Trade terminal wharf committee is reported to be making great progress with their work in connection with that feature. The committee has already made an exhaustive study of the situation and is now preparing its report and other documents which will be submitted to the board.

Toronto, Ont.—The Harbor Commissioners have approved plans and specifications for improvements to be made at the mouth of the Don River and the construction of a lift bridge at Cherry Street. The work is to commence next April, and will be done by the Hargor Board by day labor, costing in the neighborhood of $294,000. At the mouth of the river, a permanent channel 125 feet in length is to be constructed to connect the Don and the bay. Also permanent concrete docks and every facility for shipping will be constructed. The lift bridge across the channel at Cherry Street will be of the "scissors" type, and will be built especially for highway and street railway traffic. The contract for this part of the work has not yet been let.

Vancouver, B.C.—A big, well-known cold storage company will build before spring a salting plant on Langara Island to handle all varieties of fish. Wharves and other necessities will also be built.

Vancouver, B.C.—The civic Board of Trade has passed a resolution to the effect "that the Vancouver Board of Trade, following its previous recommendation and resolution regarding the desirability of the Kitsilano and other Indian reserves bordering on the harbor being developed in the interests of harbor improvements under the authorization of the Vancouver Board of Harbor Commissioners, endorses the efforts of our member, Mr. H. Stevens, towards this end, believing this matter to be of supreme public importance and requiring the urgent attention of the government; and that this resolution be telegraphed to Rt. Hon. R. L. Borden."

MISCELLANEOUS.

Chatham, Ont.—The city has defeated the by-law to provide for the raising of $25,000 for the purchase of three acres in the western part of the city, and bordering on the industrial spur, for factory sites.

Fort William, Ont.—A by-law to issue debentures for $30,000 with which to purchase and equip a rock quarry and to run an electric tramway to the site, will be submitted to the voters of Fort William at the January election. The members of the council had been considering a proposition submitted by the Mount McKay and Kakabeka Falls Railway Company to purchase that company's road, park and quarry.

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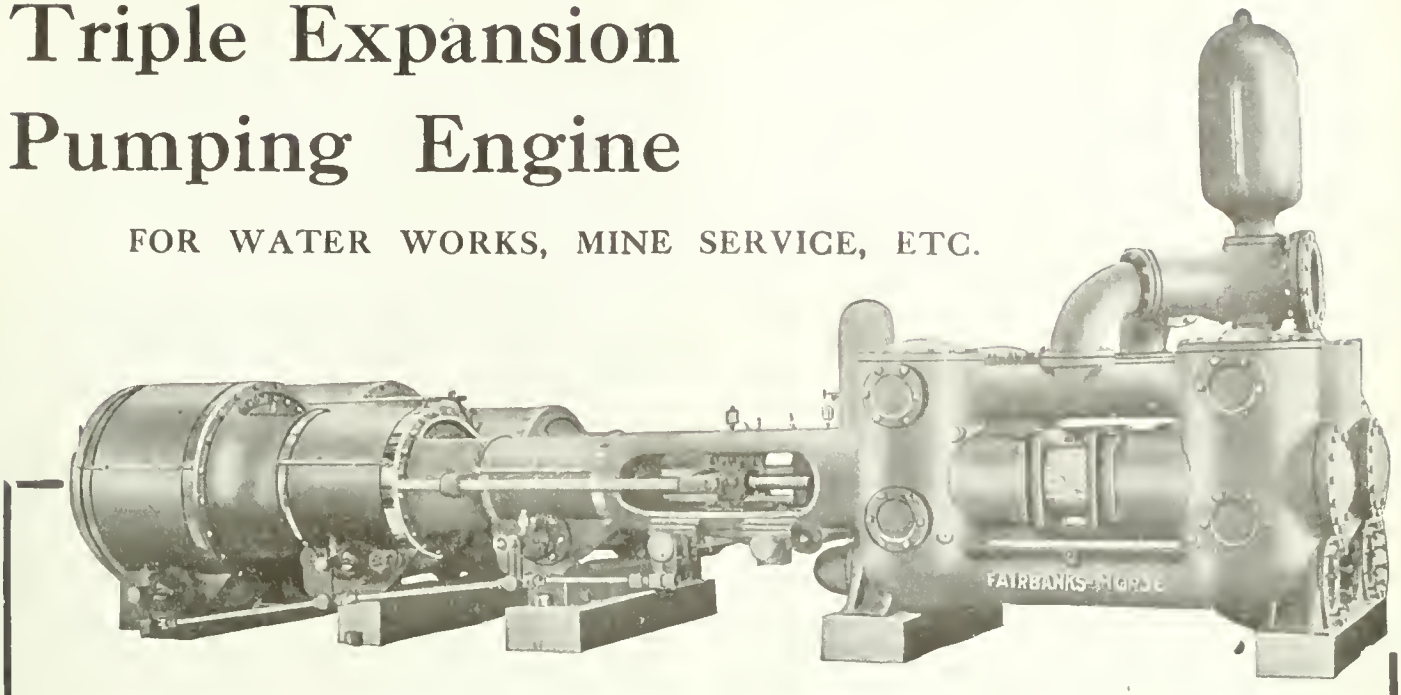

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the report that was to have been submitted by a special committee of the council, is not as yet on hand.

Fort William, Ont.—There will be submitted to ratepayers at the January elections a by-law to raise the sum of $125,000 by way of debentures for the purpose of further improving and extending the telephone system of the city.

Ottawa, Ont.—Tenders will be received up till January 7th for the purchase of the Canadian Government's patrol boats, "Hudson," "Davies," "Number One" and "Number Two." Persons desiring to examine the boats should communicate with R. Hockin, Inspector of Fisheries, Pictou, N.S., with Joseph Prescott, Fisheries Officer, Bay Verte, N.B., and with J. F. Calder, Fishery Officer, Campobello, N.B. Signed, C. Stanton, Esq., Acting Deputy Minister of Marine and Fisheries, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received up till January 15th for 10 knots of gutta-percha cable with 4 conductors, and 14 knots of gutta-percha cable with 2 conductors, to be delivered at Halifax, N.S. or St. John, N.B., May 1, 1914. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. R. C. Desrochers, Secretary.

Sarnia, Ont.—Word has been received in Port Huron that a resolution has been passed authorizing the Secretary of War to go ahead with a survey of the St. Clair River on the American side, from a point near the tunnel to the mouth of Black River.

St. John, N.B.—On his arrival at St. John, Sir William Mackenzie confirmed the report that his company is contemplating the construction of two additional steamers for the Atlantic route.

Vancouver, B.C.—The Vancouver Board of Trade has endorsed the resolution passed by the Quebec Board of Trade asking the Dominion Government for a subsidy for a line of steamers between Eastern Canada and the Pacific Coast.

+—Victoria, B.C.—The contract has been let by the Empire Lumber Company, of New York, to E. R. DOE, of Victoria, B.C., for a booming ground and a 1,000-foot unloading trestle at Osborne Bay, to cost $20,000.

+—Victoria, B.C.—The contract has been let by the Empire Lumber Company, of New York, to GEORGE McDONALD for the construction of a 100 h.p. tug, to be built at Cowchan Bay.

Victoria, B.C.—The Pacific Coast Steamship Company's steamer "City of Seattle," of the Alaska fleet, is now at the yard of the Seattle Construction and Drydock Company, having new boilers installed. These boilers are of the Scotch marine type, 13 feet diameter by 13 feet 10½ inches long, aggregating a total heating surface of 4,280 square feet. Each boiler is equipped with three Morison suspension furnaces. In addition to the installation of new boilers, the owners intend to have the entire superstructure from stem to stern reconstructed of steel. This contract will be awarded at an early date.

Winnipeg, Man.—Tenders will be received up till December 26th for the construction of an icebreaker and navigation fender at the Louise Bridge. Plans and specifications may be obtained from the City Engineer, 223 James Avenue, Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control.

CURRENT NEWS.

Brandon, Man.—The balanced gates to be placed at the First Street crossing of the C.N.R., by order of the requirements of the Board of Railway Commissioners, are ready and awaiting installation.

Brandon, Man.—The wiring work for the street railway is practically completed for this year.

Calgary, Alta.—According to figures compiled by oil men of this city, contracts have already been let for the drilling of no less than 16 wells in the Okotoks and Aldersyde oil fields. Adding the three wells which are now being drilled to this number, the total is brought up to 19. These contracts call for the commencement of drilling operations either this winter or early next spring.

Fort William, Ont.—Work is progressing rapidly on the stub street railway lines from the main line to the garbage collecting stations on Walsh and Young Streets. The branches are standard double track and each is 1,600 feet long. Collecting stations and the lines connecting them with the main system will be in readiness to handle garbage as soon as the incinerator plant is completed. This construction is going ahead rapidly, and it is predicted that it will be completed in about three weeks. Specially made street cars, in which garbage will be conveyed from the collecting stations to the burning plant, arrived several weeks ago.

Fort William, Ont.—As a result of a decision unanimously arrived at by the city council, the Canadian Iron Corporation, Limited, which had contemplated shutting down for the winter, will operate a couple of months or more longer. This has been affected through the execution of the city's order for cast-iron pipe ranging in size from 18-inch to 8-inch, and amounting to 1,600 tons, at a cost of about $72,000.

Fort William, Ont.—Until two large bridges have been completed, track laying on the C.N.R. east of Port Arthur cannot proceed and a gap of nine miles remains unfinished. It is expected that the bridge at mile 244 will be finished before Christmas, and that track will then be laid to the second one at mile 253, which will likely be completed about the same time that steel will have reached it. From Port Arthur to mile 200 the track is all ballasted, while beyond mile 200 it has been given one lift of ballast. All stations, section houses and water tanks up to mile 200 have either been completed or are under construction. Next summer considerable finishing work will have to be done, but the bulk of the work is over. Grading is very heavy with considerable rock cutting, but the low grades and curvatures, decided upon at first, have been adhered to. The line between Sudbury and Oba is practically completed and the gap is between Port Arthur and Oba.

Levis, Que.—Mr. Davie, of Geo. T. Davie and Son, who have a shipbuilding and drydock plant at Levis, has announced that his firm was preparing to tender for the construction of the mammoth ice-breaker that the Canadian Government will have built next year. The Canadian Vickers Company are also tendering. The contract will be awarded early in January.

London, Ont.—At the first meeting of the commission recently appointed to take charge of the affairs of the electrified London and Port Stanley Railway, Hon. Adam Beck was given the chairmanship of the commission and Mr. Philip Pocock, who is now chairman of the Water Commission of London, was made vice-chairman; Alderman William Spittal, secretary pro tem. Colonel Lamb, of Windsor, representing the Dominion Public Works Department, was present and produced plans for a warehouse, which is to be built at Port Stanley wharfs. The Government, he announced, will also replace the old east dock with a new one and will widen the channel during the coming season.

London, Ont.—Owing to good weather, Bain and Ross, the contractors on the new Wharncliffe Road bridge, are making progress and will soon have the abutments completed to allow the Hamilton Bridge Company to go ahead with the steel work, which can be done in winter months.

Montreal, Que.—The C.P.R. new line between Glen Tay and Agincourt, making the double track between Montreal and Toronto, is expected to open for freight toward the close of the present month. Passenger trains will be running over it next spring. It is very free from grades, and all the work in the connection is of the most massive and permanent character.

Montreal, Que.—The engineers in charge report good progress on the Montreal and Southern Counties Railway line. From Marieville to St. Cesaire, the roadbed is complete, the bonding, the poles and brackets and all equipment is in position, and the overhead wire is being strung. A fine new station is being erected at Rougemont, which is about half-way between Marieville and St. Cesaire. The bridge over the Yamaska River east of St. Cesaire, being built by Mr. John Ross, is well under way, and will doubtless be completed in the early spring. Already the coffer dams are nearing completion, and a great deal of concrete has been put in position.

Newcastle, N.B.—Work at the new wireless station is proceeding rapidly. The six wooden towers, each 300 feet high, have now been completed and about 60 feet of the central steel tower, which will be 500 feet high have been erected. The power house and offices are also well advanced:

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and if given favorable weather, the station should be completed early in the New Year.

Newport, B.C.—A recent heavy gale at Newport broke the dyke and flooded the town. In addition, a portion of the Government wharf was carried away; and it is now impossible for vessels to approach. it.

Ottawa, Ont.—Mayor Ellis, representing the municipal electric commission, states that under the new contract with the Hydro-Electric Commission, the city will save $10,000 on the cost of electricity. The Hydro-Electric Commission's engineers are of opinion that until there is a much larger market for power in Ottawa and its vicinity that at present it would not be economical in any event to develop the Chats Falls. However, it is the intention of the Hydro-Electric Power Commission to go on with the acquisition of the Chats Falls so that they can be held and developed whenever there is a sufficient market for the power to enable the development to be made at a price better than that at which it can be purchased.

Ottawa, Ont.—Dr. P. J. Maloney, of Cornwall, provincial officer of health for Eastern Ontario, has declared that the city incinerator inadequate for present needs, and that it must be either enlarged, improved or some other method used to prevent the city from creating a nuisance by the manner in which the garbage is disposed of.

Peterborough, Ont.—The offer of the Peterborough Light and Power Company to supply power to the municipality to operate the magnetic arc lights, was approved by both the Hydro-Electric Commission and the civic authorities; and a feed wire capable of supplying an unlimited quantity of power has been connected with the rectifiers of the municipal substation. It is estimated that about 70 h.p. is necessary; and on December 33rd it is expected the power will be turned on and the streets lighted.

Peterborough, Ont.—The contractors engaged in the work of constructing the new C.P.R. bridge across the Otonabee River expect to have the structure completed by Christmas. The middle span, which will be a swing section, will not be erected until next fall. This is due to the fact that a swing bridge was not demanded until the plans for a stationary bridge had been completed. It is understood that the company will construct what is known as a bob-tailed swing, which will provide for a 37-foot channel.

Quebec, Que.—It is said that the Federal Government has acquired the old Quebec Gas Works from the Q.R.L.H. and P. Company, at a cost of $750,000. The Government will utilize part of the property purchased in connection with its scheme for improving the St. Charles River and part in connection with the plans for the proposed union passenger station.

Regina, Sask.—It is expected to have the paving of the west side of the new Broad Street subway completed before Christmas and the subway opened for traffic.

South Vancouver, B.C.—The purchase of a 75 h.p. electric motor for the waterworks department, at a cost of $742, was authorized by the recent meeting of the municipal council.

Toronto, Ont.—The Hydro-Electric Commission has reduced the cost of power in the following municipalities, thus: —Hamilton, from $16 to $15 per horsepower; Dundas, $16 to $15; Caledonia, $29.10 to $24; London, $24 to $23; Guelph, $22 to $21; Preston, $21.50 to $21; Galt, $22 to $21.50; Waterloo, $23.50 to $22.50; Berlin, $22.50 to $21.50; Baden, $37 to $32; St. Thomas, $29 to $28; Port Credit, $31 to $28.

Vancouver, B.C.—Sir Richard McBride has stated that, though more than 2,000 miles of new railway construction is being undertaken in British Columbia, no company under agreement with the Government has so far asked for a day's extension of time, and it is not expected that any company will approach the Government for an extension.

Victoria, B.C.—Work on the completion of the paving of Douglas Street is being carried ahead as rapidly as the uncertain weather conditions will permit, and it is expected will be almost completed by the end of the present week. When this paving is finished the city street work for the year will be practically completed, and, so far as paving is concerned, no more will be done until next year.

Victoria, B.C.—Work on the repair of the sewer on Oxford Street is being rushed by the city engineer. Owing to the nature of the ground, a large number of piles will be driven to support the sewer when relaid. Some of these piles have had to be driven down 29 feet before touching firm foundation. While the city has appropriated $8,000 for the work, it is a certainty that before the whole job is completed it will cost several times that figure.

Victoria, B.C.—Work has been commenced on the northwest sewer at Macaulay Point, being the first place in which the sewer has been commenced in the limits of Esquimalt municipality.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received:—2249.—A South African importer wishes to be put in touch with Canadian manufacturers of shovels. 2250.—Samples and prices are asked for by a South African importer in Canadian-made fencing wire. 2266.—An East London general merchant would like prices and samples of wire. 2292.—Samples and quotations on barbed wire are asked for by a Durban firm. 2305.—A South African firm requests samples on cards and quotations for Canadian-made wire, barbed and plain. 2307.—Catalogues and prices are requested by Durban firms on Canadian manufactured tools. 2308.—Catalogues and quotations on axes, are requested by a Durban firm.

The names of the firms making these inquiries, with their addresses, can be obtained upon application to: "The Inquiries Branch, the Department of Trade and Commerce, Ottawa," or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary and Chambre de Commerce du District du Montreal.

The following inquiries relating to Canadian trade have been received:—

2172.—Samples and prices of wire are asked for by a South African firm of importers. 2190.—Inquiries are made by a South African firm of importers for catalognes and prices on Canadian-made shovels. 2229.—A Yorkshire manufacturing company is in the market for amber mica, and would be glad to receive samples and quotations from Canadian producers. 2231.—An important London firm of mineral brokers are looking for further supplies of molybdenum, chrome ore, wolfram and tin ores and are open to consider offers of regular shipments of these ores from Canadian producers. 2232.—A firm in Hamburg, Germany, who handle mica, invites offers and quotations from Canadian shippers. 2234.—A firm in Bordeaux, France, having extensive connections in steel and iron industry wishes to get into touch with producers of above-mentioned iron ores. 2235.—An agent in Paris with connections in coal and steel trade desires to be put in touch with producers of molybdenum iron ore.

The names of the firms making these inquiries, with their addresses, can be obtained upon application to:—"The Inquiries Branch, the Department of Trade and Commerce, Ottawa, or the Secretary of the Canadian Manufacturers' Association, Toronto, or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary and Chambre de Commerce du District du Montreal."

NEW INCORPORATIONS.

New Westminster, B.C.—Marsh-Hutton-Powers Company, Limited, $250,000.

Montreal, Que.—Home Construction Company, Limited, $50,000. T. B. Gould, T. J. Coonan, C. Thomas.

Winnipeg, Man.—Goldfield Mining Company, Limited, $1,500,000. H. A. McDonald, D. A. Duff, G. J. Brimson.

Toronto, Ont.—Canadian Elevator Equipment Company, Limited, $100,000. G. H. Sedgewick, D. McArthur, R. Forsyth.

Hepworth, Ont.—The Hepworth Silica Pressed Brick Company, Limited. $125,000. J. Douglas, F. Campbell, J. E. Campbell.

MEXICAN EAGLE ASPHALT

TRADE MARK

East Main Street, Hamilton, paved with Mexican Eagle Asphalt

MEXICAN EAGLE ASPHALT is specially adapted to the Canadian climate, as it is not susceptible to changes in temperature and will not mark in the hottest weather. Dow and Smith, Consulting Paving Engineers, say: "This is a very high quality of asphalt."

EVERY BARREL of our asphalt is guaranteed to be uniform and according to analysis. This is the guarantee of our principals, the Mexican Eagle Oil Co., Limited, a company that has over twenty-five million dollars working capital.

Our asphalt in not dependent on the whims of nature. It is refined by the most accurate scientific processes from excellent asphaltic materials. That is why it is much less affected by extremes of cold or heat than is California, Trinidad, Bermudez or any other asphalt on the market. It is a favorite for its high purity, cementing value and ductility.

We can also supply different grades of Mexican Asphalt for asphalt fillers, road binders, roofing asphalts, wooden water pipe coatings, waterproofings, etc. Also Durazzo Sicilian Rock Mastic Asphalt for sidewalks.

Samples, prices, analyses, etc., on request

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned, and endorsed, "Tender for Dam on French River, South Channel, Ont.," will be received at this office until 4.00 p.m., on Monday, December 29, 1913, for the construction of a Dam across the South Channel of the French River, at head of Big Chaudiere Falls.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of the District Engineers, Confederation Life Building, Toronto, Ontario; Post Office Building, Montreal, and on application to the Postmaster of North Bay, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 5, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—51842.

CITY OF OTTAWA, DOMINION OF CANADA.

TENDERS FOR STEEL PIPES.

Sealed tenders in duplicate addressed one copy to the City Clerk, City of Ottawa, Canada, and the other to Sir Alex. Binnie, Son and Deacon, St. Stephens House, Westminster, London, England, and endorsed, "Tenders for steel pipes," will be received until 4 p.m. on Tuesday, the 3rd day of February, 1914, for about forty-two miles of steel pipe, fifty-four inches internal diameter, about thirty-two miles of steel pipe, fifty-eight inches internal diameter, and about eleven miles of steel pipe, fifty-one inches internal diameter.

Forms of tender and specification may be obtained from Sir Alex. Binnie, Son and Deacon, St. Stephens House, Victoria Embankment, London, S.W., or from the City Engineer of Ottawa, Canada, on and after the fifteenth, on receipt by them of a cheque to the value of five hundred dollars, made out to the City Treasurer of the City of Ottawa, Canada, which sum will be returned on receipt of a bona fide tender.

The lowest or any tender is not necessarily accepted.

No tenders will be considered except from actual manufacturers capable of supplying the whole of the pipes within a period of two and a half years from the date of acceptance of the tender.

SIR ALEX. BINNIE, SON & DEACON,
Engineers in Chief,
St. Stephens House,
Westminster, London.

Dated December 4th, 1914.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Submarine Cables," will be received at this office until 4 p.m., on Thursday, the 15th January, 1914, for 10 knots of gutta-percha cable with 4 conductors and 14 knots of gutta-percha cable with 2 conductors to be delivered at Halifax., N.S., or St. John, N.B., by the 1st of May.

Specification and forms of tender can be obtained on application to the office of the General Superintendent of the Government Telegraph Service at the Department of Public Works, Ottawa.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 9, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—51974.

EXTENSION OF TIME.

Notice is hereby given that the time for the reception of tenders for the construction of wharfs at Victoria Harbor, B.C., is extended to Thursday, January 8, 1914.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 9, 1913.

NEW INCORPORATIONS.

Saskatoon, Sask.—Northern Brick and Supply Co., Limited, $150,000. Argue, Limited, $20,000.

Sherbrooke, Que.—Two Miles Falls Water Power Co., $500,000. I. L. Lafleur, J. E. Roberge, O. E. Dorais.

Windsor, Ont.—Moloney Electric Company of Canada, Limited, $300,000. R. W. Hart, A. Chenier, P. Stokes.

Kingsville, Ont.—The Champion Brick and Tile Co., Limited, $75,000. D. Wigle, R. M. Wright, G. Pearse.

Collingwood, Ont.—The W. A. Tom Construction Co., Limited, $45,000. J. T. Loftus, W. H. Ford, A. I. Naftel.

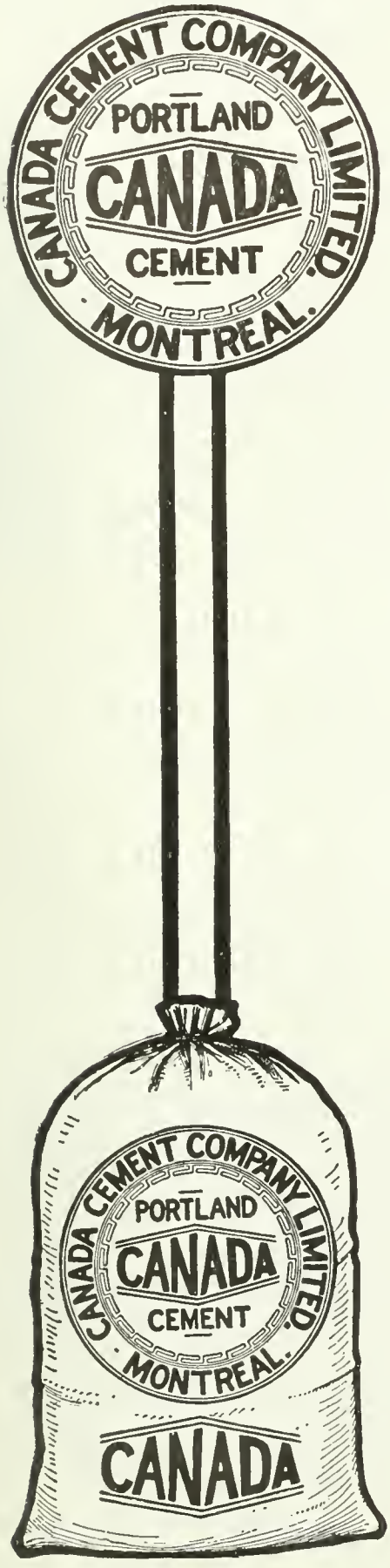
Mount Dennis, Ont.—The John A. Marshall Brick Co., Limited, $40,000. J. G. Marshall, B. B. Hunter, T. Goddard

Sainte Edwidge, Que.—Compagnie Electrique de Sainte Edwidge, Limited, $20,000. A. Comptois, E. Berard, N. Masson.

Toronto, Ont.—Cleary Mines, Limited, $1,000,000. W. H. Garvey, J. A. Rowland, D. H. Stewart. White Falls Lumber Co., Limited, $40,000. J. Lauder, J. Spears, N. Sommerville.

Montreal, Que.—Brick and Construction Products Co. of Montreal, Limited, $600,000. P. Taschereau, T. Rinfret, N. Z. Cordeau. Transcontinental Construction Co., Limited, $50,000. W. J. White, A. W. P. Buchanan, T. S. Owens.

PERMANENCE—



an ideal that is now attainable

THE superiority of concrete over all other materials for the building of permanent structures is now generally admitted.

The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

CANADA CEMENT COMPANY

Limited

MONTREAL

Sales Offices at

MONTREAL TORONTO WINNIPEG CALGARY

Second-Hand Machinery

Advertisements under this heading three cents per word per insertion, if not "displayed." Minimum 50 cents per insertion.

Contractors' Machinery For Sale Or Rent

We have in stock the following second-hand equipment for immediate delivery.

Send for details and prices.

1—8"x 10"x 8" steam driven air compressor.
1—6" x 5" x 7" steam driven air compressor.
1—9" x 10" double cylinder, belt driven ai compressor.
1—No. 3 Ransome concrete mixer.
1—No. 2 Ransome concrete mixer.
18—concrete carts.
1—7"x10" dble. cyl., dble. drum steam hoist.
1—6½" x 8" double cylinder, single drum steam hoist.
1—5"x6" dble. cyl. single drum steam hoist.
1—6" belt driven centrifugal pump.
1—5" belt driven centrifugal pump.
1—60 H.P. firebox boiler on wheels

H. W PETRIE, LIMITED
General Machinery Dealers. TORONTO, Ont.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

PATENT NOTICE.—Anyone desiring to obtain the invention covered by Canadian Patent No. 138770 granted on February 27th, 1912, to S. K. Bohlin and E. M. Edstrom, of Goteborg, Sweden, for Photographic Plate Holder, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh and Co., 53 Queen Street, Ottawa, Canada. Russel S. Smart, resident.

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.

Ontario Land Surveyor to act as Corporation Surveyor for the City of Port Arthur.

Applications will be received by the undersigned up to January 20th, 1914.

Applicants should state experience and salary expected.

L. M. JONES,
City Engineer.

ENGINEERING COMPANY manufacturing Engines and Boilers, requires General Manager. Salary, $7,500 per annum. Apply stating age and full experience to Box 194, *The Canadian Engineer*, Montreal.

CHIEF ENGINEER.—Good opportunity is offered to an experienced engineer to connect with an established Consulting, Engineering and Construction Corporation based on co-operative plan; offices in Cleveland, Detroit, Buffalo and New York City. The position requires a man to take complete charge of the Mechanical, Electrical and Civil Engineering Departments. Highest references and $1,500 investment required. Contract with salary, commission and expenses guaranteed. Address Box 196, *The Canadian Engineer*, Toronto.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

DRAUGHTSMAN desires employment, engineering, surveying, architectural, Montreal reference; fifty dollars. Special lettering and tracing, diplomas. W. J. Collins, 129 Bleury Street, Montreal.

MONTREAL MARKET LETTER.

Montreal, December 10th.

The heads of both the Dominion Steel Corporation and the Nova Scotia Steel and Coal Company were in Montreal during last week, and this naturally attracted more than usual attention to the iron and steel situation. Mr. Plummer was here to attend the meeting of the directors of the Dominion Steel Corporation, this meeting being the regular quarterly dividend meeting. Previous to the meeting the report reached the Street that the dividend would either be passed or cut, and consequently there took place a marked decline in the stock of the corporation. The dividend, however, was declared as usual. An interview given out by Mr. Plummer was to the effect that the various plants of the corporation were now in an advanced state of perfection, and that hereafter it would not be necessary to make application for more capital for a couple of years to come. The wire rod mill was closed down and the rail mill was running, though there were not as many orders on hand as a year ago. Mr. Plummer thought that the railways would shortly begin to give out further orders for supplies.

President R. E. Harris of the Scotia Company was here last week for a couple of days. The stock of that company also showed an easier disposition and declined a couple of points. It is not knowed what caused the weakness in the stock, inasmuch as there was every reason to believe that the company was earning its dividend, although this company would naturally be subjected to the same general conditions as the Dominion Steel Corporation; and it is only natural to suppose that the falling off in trade activity and the tendency of prices to decline would have a considerable effect upon the profits.

There was nothing new in the way of price changes or trade developments. Buying was dull all the way round. Some of the car companies, it was claimed, had quite a few orders on hand, but assuming this report to be true, it, in reality, did not affect the general situation, for the reason that it is well known that orders for cars are not being given out as they were a year ago, and that unless railways soon begin to give out new orders, the car works will show marked falling off in activity before a great length of time.

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—

Canada.—Frederick Hansen, engines; Mario W. Tebyrica, railroad ties and beds; Olof Soderlund and Teofron Boberg, evaporating, distilling and similar installations; Nils Testrup and Thos. Rigby, production of wet carbonizing briquettes; George C. Adams, throttling devices for pipes, tubes and pumps; George J. Ogden, electric switches.

United States.—James M. Wilson, rotary pumps and motors.

Newfoundland.—Callendars Cable and Construction Co., supports for electrical conductors.

ONE OF OUR RECENT BRIDGE CONTRACTS

CONSTRUCTED IN NINE MONTHS

Substructure of a 930 ft. Double Track Railroad Bridge—Under very difficult conditions, these piers were carried to a maximum depth of 50 ft. below water level, by pneumatic caissons and open cofferdams.

THE FOUNDATION COMPANY

MONTREAL LIMITED VANCOUVER

MARKET CONDITIONS

Montreal, December 15th, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1 40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜ in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3 45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3 15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25 lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength per 100 fuses:—4-ft. wires, $3; double strength, $3 50; 6-ft. wires, $3.54, and double. $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4 30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21 25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 56 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per font. Laths: Quotations per 1,000 laths, at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions, as laths, X, $2 10; XX, $2.40 XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady:—¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22 50; 1½-inch $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57 50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch $1.08.

Toronto, December 17th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¾-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch, $8.50 to $9; 2¼-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11 50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $16 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c per ton of 2,000 lbs., either 1-inch, 10c., 2-inch or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for gond Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10-case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 54c. per hundred for each 2-in. wire additional. Single strength, $3 per hundred, advance 54c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40 60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1912.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships, in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1.60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 9 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2 75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3,40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price 45 to 50c., lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excelle demand. We quote very firm at $6 to $6.50 per cwt.

Winnipeg, December 16th, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¾ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow, $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3 16-in., $10; ¼, $7.25; 5-16, $5.85; ⅜, $5; 7.16, $4.75; ½, $4.50, 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¼c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20 $4; 18 $3.95; 16, $3.90. Queen's Head, 28, $4.80; 26, $4.70; 24, $4.80 22, $4.30; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 28-gauge American $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch, $2.40; ⅜-inch, $2.55; ½-inch, $3.25; ¾-inch, $4; 1-inch, $5.75; 1¼-inch, $7 80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in. $3.35 base; machinery, $3 base; share; $4.50 base; share crucible, $5.50; cast share steel, $7.50; tire cast, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

Volume 25 Toronto, Dec. 25, 1913

Contents of this issue on page 903

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

BRIDGE CONSTRUCTION AT NEWCASTLE, N.B.

DESCRIPTION OF THE FOUNDATION WORK OF THE MIRAMICHI RIVER HIGHWAY BRIDGE — BUILT ON TWO ABUTMENTS AND FIVE PIERS OVER 1400 FOOT CHANNEL—OPEN CAISSON DREDGING METHOD USED

By C. A. WENTWORTH

AN interesting piece of bridge foundation work is being built for a highway bridge across the Miramichi River at Newcastle, N.B. Newcastle is situated about thirty miles from the mouth of

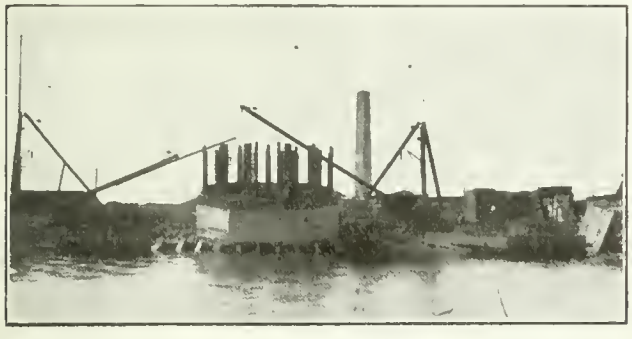


Fig. 1.—Pivot Pier Caisson Ready for Launching.

the river and is a growing town of 3,000 inhabitants. Across the river is the town of Nelson, and six miles below, on the Nelson side, is Chatham, whose population is slightly larger than that of Newcastle.

The river varies from three miles wide near the mouth to about one-half mile wide at Newcastle. The

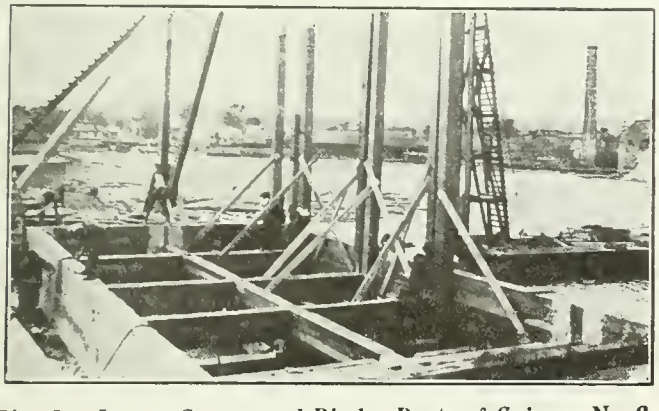


Fig. 2.—Lower Course and Binder Posts of Caisson No. 2.

nearest highway bridge to the mouth of the river is at Indiantown, over forty miles from the mouth and about fifteen mines from Newcastle.

Four to five months in the winter the river can he used as a highway, as the ice is usually 30 in. to 36 in. thick; and for a slightly longer time in the summer ferry boats cross the river at both Newcastle and Chatham, but for a month or more in the fall and spring there is no way of crossing. The important lumber and manufacturing interests all along the river made the construction of a bridge a necessity to accommodate the important interests of the people in this section of New Brunswick.

After careful examination by diamond drill borings, the location was decided upon opposite Newcastle and about one mile downstream from the confluence of the southwest branch with the northwest branch of the Miramichi River.

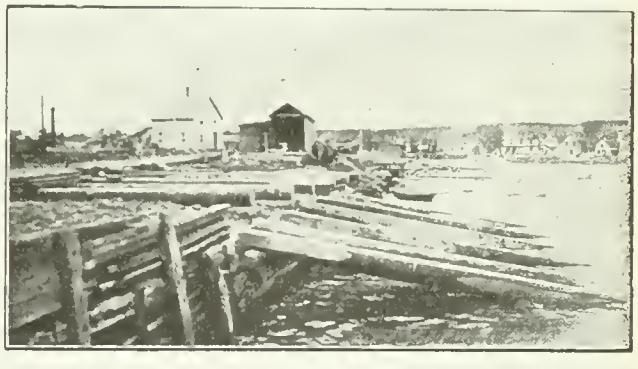


Fig. 3.—Launching Ways.

The water in this river is from thirty to forty-five feet or more in depth, and there is a tidal variation at Newcastle of about six feet, with a maximum of ten feet. The current varies with the tide from three miles per hour upstream on the flood tide to nearly six miles per hour downstream on the ebb tides.

The river bottom consists of fine sand and mud, twenty to thirty feet deep overlying harder strata of sand and clay, and sand and gravel, carrying artesian water. This bottom produced unusual foundation difficulties to contend with, there being no ledge rock on which to rest the piers, except at the Nelson abutment.

The design finally adopted for the bridge calls for four spans of 278 feet, and a draw span with an opening of 115 feet on either side of the draw. The approaches are each about 700 feet long and are composed of rock-

filled slope walls with an earth core, the rock fill protecting the earth from erosion by the waves and ice.

There are two abutments and five piers, each founded on piles, and built of concrete from the bottom to a point seven feet below mean tide. From this point to high tide level they are composed of cut granite masonry backed with concrete, and above high tide level of freestone backed with concrete.

Fig. 4.—Guide Frame for Caisson No. 1.

The abutments presented no unusual features. They were both built in open cofferdams, which were made by driving wooden sheet piling around a built-up framework of 12-in. by 12-in. yellow pine timbers, which formed the braces and wales of the cofferdam. As soon as the sheet piling was completed the cofferdams were pumped out and excavation made to ledge at a depth of twenty-eight feet at the Nelson abutment, and to a hard clay and sand strata at a depth of sixteen feet in the Newcastle abutment. The piles for the latter abutment were then driven with a drop hammer; using an extension lead pile driver; and the concrete of both abutments was placed in dry space.

The five piers presented the most interesting and difficult work. They vary from 56 feet to 69 feet in height and are being built in water from 35 to 48 feet deep.

The plan of construction adopted for these piers was the "Open Caisson Dredging Method." Caissons were framed up of yellow pine timber, twenty-six feet wide (except the pivot pier caisson) and of the height required for each pier. The two largest caissons were 63 feet 6 inches high. The pivot pier caisson was octagonal in shape, 42 feet across and 59 feet 6 inches high. The pivot pier caisson ready for launching is shown in Fig. 1.

All of the caissons were framed up on shore to a height of twelve feet around the first set of binder posts, which in the largest caissons were 31 feet high. The outside walls of this portion were built solid of 12-in. by 12-in. timbers and braced by one longitudinal and four lateral sets of timbers framed into the sides and bolted solidly at the intersections and to the binder posts. The bracing timber was placed in vertical rows so that the caissons were divided into ten pockets, four of which served later for dredging and six of them for loading with sand for sinking. The lower courses and part of the posts of one of the rectangular caissons is shown in Fig. 2.

The launchingways, illustrated in Fig. 3, were built of heavy timbers 30 feet long, laid horizontally and resting at their centre on a 12-in. by 12-in. rocker timber 54 feet long.

The caissons were built on these timbers in a level position and, when ready for launching, the caisson and supporting timbers were tilted on the rocker timber. This brought them in line with another set of timbers leading on the same slope into the water, and the caissons were launched by sliding on these timbers. No cradle or falsework was used and no difficulty was experienced with this method of launching. (Two hours were sufficient to tip and launch the caissons and thirty minutes after launching a caisson the launchingways were ready to start construction of the succeeding caisson).

Pontoons were secured in four of the pockets of each caisson before launching to float it in a level position when launched and hold it at an elevation in the water convenient for working. All of the caissons were lauched sideways as the water was only about six feet deep at high tide where the launchingways were constructed.

After launching, the caissons were tied up at a dock where building up continued until the caissons drew 23 feet of water, the total depth available, and then towed to their final site. They were then built up in place to their finished height, the caissons in every case drawing enough water to rest on bottom before being completed.

The strong current in both directions required special means of holding the caissons in place, the pressure against them being over 50,000 lbs. on the ebb tide at times. A guide frame composed of thirty-two piles, sixteen of which were batter piles, bolted to the other sixteen

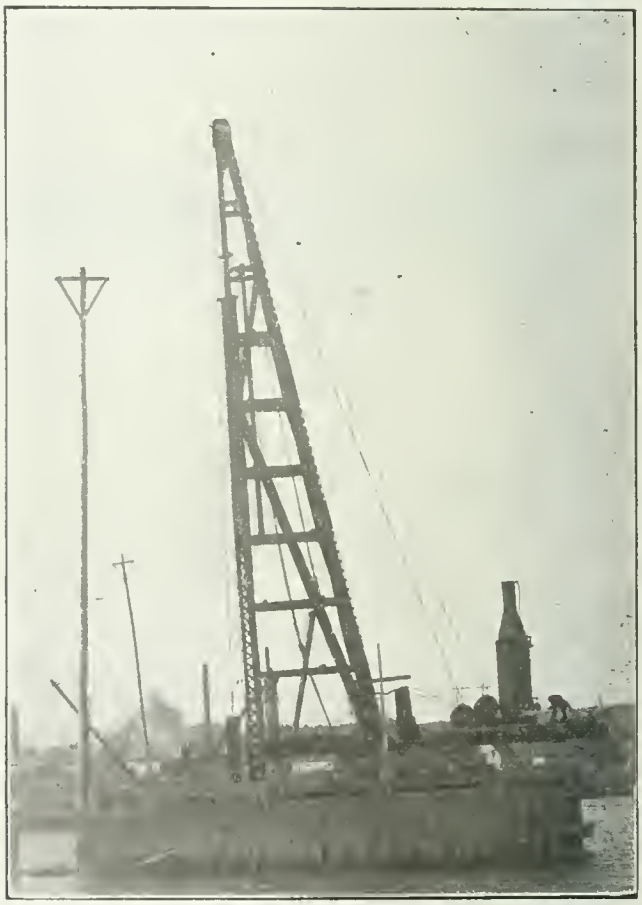


Fig. 5.—Pile Driver.

vertical piles, was driven to from three sides of a rectangle the upstream side being left open, as shown in Fig. 4. These piles were capped and braced in position. Chinese anchors, made by filling timber cribs 16 feet square with 40 tons of rock, were previously constructed and sunk about 400 feet upstream and downstream from the caissons. Each caisson was secured to four of these

anchors by means of 1 1/4-in. galvanized iron cables with double wire rope blocks and tackles so as to adjust it in position and hold it against the current.

The caissons were sunk through the mud and sand by dredging in four of the pockets with a clamshell bucket. False bottoms were placed in the other six pockets, sixteen feet above the cutting edge, and these pockets were weighted with sand while the dredging was going on. For one hundred years the Miramichi River has been a lumbering centre and many of the logs have become waterlogged and sunk. Many of these, sometimes twenty feet deep in the mud, were encountered in sinking the caissons, and were either taken out by the clamshell bucket or had to be cut off by a diver. High-power jets were also used by a diver under the cutting edge of one caisson to sink it through a strata of clay. In addition to the sand pocket method of weighting, pig iron was also used. All of the caissons have now been sunk and the maximum variation of any caisson is 15 ins. from the actual to the located centre line.

The hard strata of sand, clay and gravel on which the caissons rest might be sufficient support for the piers, but it was considered advisable not to rely on this, but to use a pile support. The heads of the piles had to be driven to a depth of over 60 feet below the top of the caissons in some cases. A sixty-five-foot extension lead pile driver was built and provided with a steel tube which worked in these leads. The piles were placed in this tube and driven by a 5,100-pound drop hammer working through the water. The piles were cut to length and driven until their heads were at the cut-off grade with a few exceptions. These were cut off by a diver. The pile driver was mounted on a turntable, the leads and engine turning on conical rollers on a circular track secured to a bed frame. A 2½-in. steel king bolt fastened the sills to the turntable. With this driver it was possible to reach every part of a caisson, while the weight of the driver, tube and hammer, amounting to over 25 tons, was supported along the centre line of the caisson. This pile driver is shown in Fig. 5. When the piles were driven in one caisson the pile driver was rolled on a scow and floated to the succeeding caisson.

After completing the pile driving, 12 feet of concrete was placed, entirely filling the bottom of the caissons. This concrete was put in with a bottom dump bucket working through the water. When the concrete had set the caissons were pumped out and the pier shafts constructed in dry space. Rail grillages were set vertically in the under-water concrete by a diver while the concrete was being placed and after pumping out, additional rails are connected to these by splice bars to reinforce the pier shafts. A view of the work four months after starting is shown in Fig. 6. The work was begun the latter part of May, 1913, and will be completed early in the coming winter.

The Hon. John Morrissy is Chief Commissioner of Public Works; A. R. Wetmore is Provincial Engineer, and A. R. Sprenger is Resident Engineer. The Foundation Company, Limited, are the contractors, and C. A. Wentworth is superintendent.

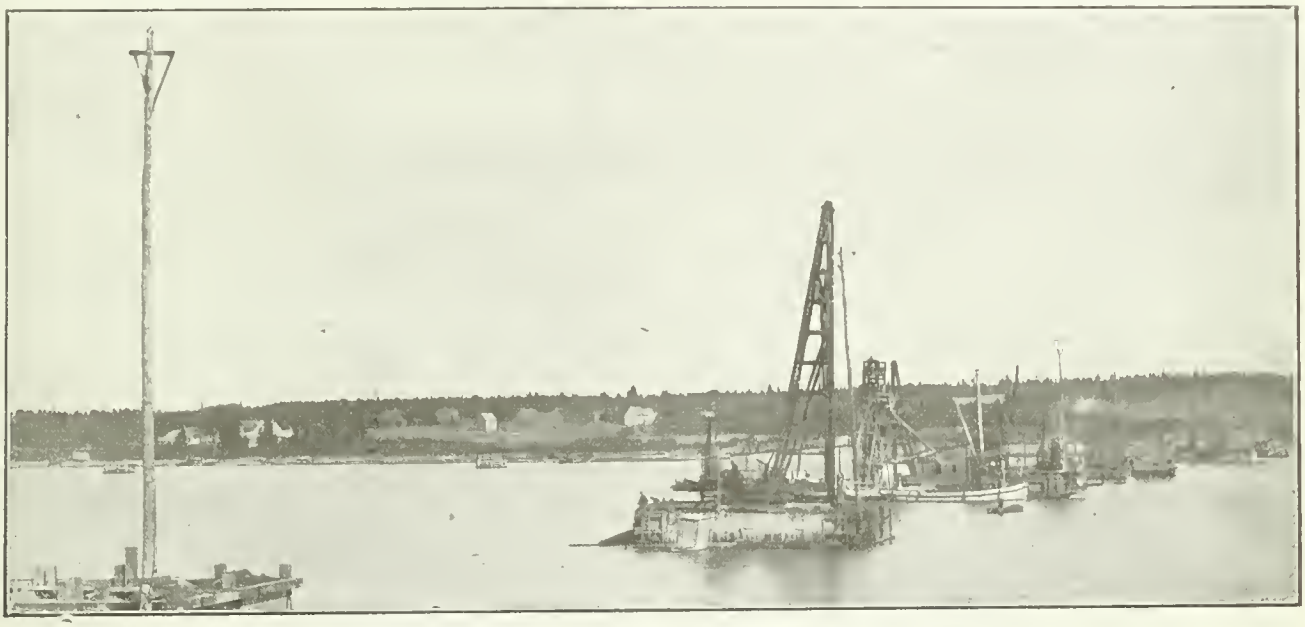


Fig. 6.—General View Four Months After Beginning Work.

The new harbor at Emden, Germany, which has taken three years to build, was opened recently with a good deal of ceremony. The sea sluice of the Emden harbor is the largest in the world; it is 260 meters long, 40 wide and 13 deep. Sixteen torpedo boats can pass through simultaneously within 15 minutes.

The Governor of New York, after consultation with the commissioner of highways, the attorney-general and the commissioner of efficiency and economy, has decided that hereafter asphalt shall be bought on open specifications and not under separate specifications for natural and oil asphalts, as was proposed by the consulting board of highway engineers. Full details have not yet been prepared, but it has been announced by the Governor that "it has been decided to have the specifications so drawn that every suitable asphalt known can be used, but to insert the conditions that every contractor must guarantee the road he builds for at least three, and possibly five years. This will do away with the asphalt scandal. This provision will give every asphalt dealer in the world who has an asphalt which he will guarantee for five years an equal chance with every other asphalt man for the business of New York State."

EFFECT OF HEAT TREATMENT ON THE STRENGTH AND DUCTILITY OF ELECTRIC FURNACE STEELS.

AN article written by T. R. Loudon, B.A.Sc., and descriptive of a Canadian electric steel furnace, appeared in October 23rd issue of *The Canadian Engineer*, and the general layout of the plant of the Moffat-Irving Steel Works, Limited, was included.

Since the appearance of the above article Mr. Loudon has conducted some experiments on the tensile strength of various carbon steels made in this furnace. The main idea followed out was to determine the strength of the steel as used in an ordinary steel casting, and then by heat treatment, to refine the grain size and note the effect on the strength and ductility.

The test bars were cast in rectangular form, and were then turned down to the standard shape for the tensile test of metal used in steel castings. Two such test pieces were made from each heat. One of these test bars was then placed in an annealing furnace and the grain size heat refined, care being taken to reach the desirable temperature for the various carbon contents.

The specimen bars were then tested in a Riehlé machine in the ordinary manner with the following results:

It is quite noticeable that in every case the tensile ultimate strength has been raised by heat refining the grain. The elastic limit, however, has been lowered but, as would be expected, the elongation results show a very great increase in ductility. The metal examined under the microscope shows evidence of being very sound, and, as intimated in the former article, the wearing qualities of this electric furnace steel are greater than mere physical tests would indicate.

		Natural specimen			Heat refined		
Heat.	Carbon.	Elastic limit.	Ultimate strength.	Per cent. Elongation in 2 ins.	Elastic limit.	Ultimate strength.	Per cent. Elongation in 2 ins.
167	.23	53,300	68,950	12.5	52,200	72,100	26.25
168	.18	47,500	63,900	15	46,300	66,850	25
171	.31	56,000	82,800	12.5	53,000	84,500	22.5
175	.12	49,200	53,700	17.5	47,050	57,450	35
178	.23	52,500	68,750	13.75	53,600	70,500	27.5
181	.35	53,300	84,600	10	53,950	88,400	20
184	.21	59,450	80,050	15	59,200	81,500	22.5
187	.29	49,950	74,850	15	50,500	76,650	30

ELEVATORS: THEIR USES AND ABUSES.*

By B. C. Van Emon.

AN elevator may be termed an ingenious mechanical device, invented and designed by man to overcome nature's imperative law, the law of gravitation. The overcoming of gravitation by the use of an elevator is by no means modern, for, many ages ago, history has shown that man had equipped a clumsy hand-power contrivance, whereby, with the use of considerable human energy, a greater weight was overcome by a lesser energy; but modern equipment, invention and devices place the elevator in a mechanical class entirely by itself. The towering buildings of modern construction, these massive structures of many stories, are rendered possible, practical and economically advantageous, only through the installation of the modern elevator, which, by its convenience in carrying passengers and freight to a higher or lower elevation and its accommodations for a practically unlimited number of passengers, increases property a hundredfold in its initial value.

Like most modern inventions, which many centuries ago were in crude construction, the completion and almost perfection of the elevator has been an achievement left for the present century. Thus, again, like the perfection of all other wonders which now seem to us so commonplace, the practical completion of the elevator has been a matter of slow evolution.

The combined mechanical genius of many elevator engineers has given to the public various types of elevator construction, of which a list is herewith presented:

Elevators may be divided into the following classes: Handpower elevators; belt or power-driven elevators; steam elevators; hydraulic elevators; pneumatic elevators; electric elevators; each of these being divided into classes by governing conditions.

Handpower Elevator.—This is the oldest elevator known, patented in the year 1846. When used for handling freight in buildings the machinery is generally located overhead and consists of a long wooden drum, with a large gear wheel attached to the end; this wheel engages with a smaller pinion driven by a large "bull" wheel, or wheel upon which a rope is placed, leading from the lower floor through the several floors of the building over this "bull" wheel; this rope is spliced and is made continuous. By pulling this rope the countershaft is made to revolve and drives the small pinion; this engages the large gear wheel which turns the drum upon which the rope is attached to the car, and in this manner lifts the freight. The sizes of these hand-power elevators, under this condition, vary, according to the work to be done, and are built for capacities of 4,000-pound or 5,000-pound loads at a very slow speed.

The next type of hand-power elevator commonly used is for sidewalk elevators, this type dating from 1858. The gearing or hoisting mechanism is generally built on an iron frame, and consists of gear wheels, ratchets and brakes. These frames are sometimes built of wood, with

*Read before the Technical Society of the Pacific Coast, July 18, 1913.

the gearing mounted as upon the iron frames, and are used for raising and lowering merchandise from basement to sidewalk level.

Double Belt Worm-Gear Elevator.—Another type of elevator commonly used for handling freight, is driven with belts from the main line shaft in the building to pulleys on the worm shaft of the belt elevator. These are double belted, one belt traveling in one direction, the other, a cross belt, traveling in the opposite direction; and by the use of a pull rope placed conveniently in the well hole, by means of a mechanical device, these belts are shifted on and off the tight pulley on the worm shaft, giving the operator control of the direction of the elevator. When the rope is pulled to the neutral position, the belts are both off of the tight pulley and run on the loose ones. This same movement sets the brake on the tight pulleys and holds the car when fully loaded. The worm gear mechanism is enclosed in a cast-iron casing and filled with oil, and on the worm wheel shaft is placed a winding drum of sufficient size to accommodate the hoisting cables, these cables being carried up through the hatchway over a sheave on top of the elevator shaft, and down to the car. On the opposite side of the drum are ropes passing upward through the building over another set of sheaves, that are attached to a counterweight, balancing the car and part of the load, this arrangement giving the best results. These worm-gear machines were built in sizes as high as 6,000-pound loads and were considered very large elevators in the early elevator days. However, even with the great advancement made in the elevator industry, a belt elevator is rarely built to exceed a capacity of 6,000 pounds even at the present day.

Later, the belt elevator was operated by an electric motor with a single belt running to the drive pulley, or tight pulley on the worm shaft. This electric motor was started and stopped by an electric switch which reversed the current in the motor, and gave it the direction required, thus eliminating one belt and giving a direct drive from the motor power to the elevator, and when the elevator was not in operation no power was being consumed. This was practically the next step in the elevator advancement.

Steam-Driven Elevator.—About the period these belt-driven elevators were first used, there was also a steam-driven elevator, operated by steam direct to an engine, of the reversing type, somewhat like the "Brotherhood engine" used on steamboats to control the rudder. These steam-driven elevators were operated by a pull rope with a pilot valve on the engine almost in the same manner in which the steamboat operated its controlling mechanism with the rudders. The first of these engines were direct-geared to a drum, with suitable rope connections over sheaves overhead to the car and counterweights. Latterly, these steam engines were geared to worm-geared machines.

Hydraulic Elevator.—This elevator was developed about this time, and consists of a large cylinder with a piston and a piston rod running through a stuffing box properly packed, and on the end of the piston rod are fastened several wire ropes wound around a very small drum, securely fastened to a shaft, upon which is keyed a very large drum. This was what was termed, at that time, a "pull-back machine," and was run generally from the city water pressure or city hydrants. This was controlled by hydraulic valves for admitting water into the cylinder, and also discharging it into sewers. These elevators were quite commonly used about 1880 and 1890, at which time the electric elevator came into general use.

Plunger or Hydraulic Ram Elevator.—About 1882, the first plunger or hydraulic ram elevator, as it is termed, came into use. This plunger elevator consists of a piece of steel or iron pipe, which is turned true and smooth on the outside and operated through a stuffing box, which is securely fastened to the top of a piece of pipe of a larger diameter in which the smaller is enclosed. By admitting water on the top end of the larger pipe, in which the smaller pipe is placed, the water pressure will cause the smaller pipe to pass through the stuffing box and propel the car in either direction when the control valve is opened, thus allowing the water to escape into the sewer. Plunger or ram elevators are set into the ground, a hole being bored of sufficient size and depth according to the travel and height of the building in which the elevator is to be operated.

At the present time, plunger elevators are built for almost any travel up to 300 or 400 ft., and the water pressure applied is in ratio to the height of the building; in some instances, the water pressure required being 700 pounds per sq. in., varying, of course, according to the size of the ram and the conditions under which it operates. The writer will not enter into technicalities to the extent of figuring out accurately just what the strains are, and what the tension on the ram would be, under certain conditions, but it is a well-known fact that in tall buildings where the ram or plunger elevators are used, when the ram or plunger is a certain distance out of the stuffing box it comes under a pull instead of a push, and, in many cases, and almost universally in high buildings, it is necessary for the manufacturer to put a couple of wire ropes inside of the ram or plunger pipe the full distance, these being securely fastened at both ends very taut to hold the compression of the ram, so that when the stress or pull is put on the car after reaching a certain height it will not separate or pull apart at the joints, these joints being necessary in the plunger to keep it water-tight, and also assist in overcoming the strain which is placed on the pipe. This, it will be readily understood, becomes a strain or pull on the plunger after it has reached a certain distance from the ground or level at which the stuffing box is placed, caused by the increasing counterweight, this being necessary to overcome weight of the car and plunger, the same being generally made of steel pipe of a thickness sufficient to withstand the water pressure admitted in the larger pipe, around which the water is encased, which presses against the smaller or finished turned plunger which travels up and down the well hole. The plunger elevator is now being very successfully operated in tall buildings; the only drawback being the immense weight which constitutes the elevator equipment, also the time element necessary in starting, stopping and reversing this enormous weight in a given time. The stress upon the ram or plunger pipe, casing, control valves and other parts, is very great, as the water pressure is very high. An elevator equipment in a building of 300 ft. travel consists of the ram or plunger, the car with its counterweights, necessary to properly balance the car, and plunger which must be very heavy; and it seems to the writer that the time element is very necessary in starting, stopping, and reversing this elevator; whereas an electric elevator made very light can be started, stopped and reversed much quicker, and, unquestionably, can run at any speed desired.

Admitting the plunger elevator for tall buildings to be very expensive, it being necessary to bore a hole in the ground equal to, if not a little more than, the total

height of the travel of the car, it is a fact that the turning of the steel plunger or ram, the fitting together of the same, with the outside casing necessary to contain the high water pressure, the stuffing box at the top of the outside casing, with all its pumping apparatus and controlling apparatus, the necessary variable counterweights and all their accessories, must entail more expense than any direct electric elevator. Conceding that the starting and stopping of the Hydraulic elevator are much easier and more gradual, the actual running conditions of both are the same, and, so far as safety is concerned, the electric elevator is conceded by experts to be safer than the plunger type. In high buildings the electric elevator requires less for repairs, is less expensive to operate and costs less for installation.

The efficiency of the plunger elevator depends entirely upon its construction, and to make it efficient it is necessary to properly counterweight the same, so that as the plunger leaves the ground floor, and it comes out of its stuffing box, it pushes the car up; the counterweight in coming down must be so constructed that it will increase in weight equal to the same amount of the weight of the plunger coming out of the stuffing box. For example, suppose one foot of plunger should weigh 25 lb., every foot of counterweight that passes over the overhead sheave must weigh an equal amount, and it is readily understood that in tall buildings when the elevator reaches a certain point in its travel it becomes a pull upon the ram by the amount of counterweight that has passed over the sheave, and that the remaining part of the ram from this point in the shaft down to the stuffing box is holding back to this point over the counterweight, so that as the elevator ascends beyond this given point there becomes a strain upon the ram instead of a push. As before stated, to insure safety there must extend the whole length of the ram, and on the inside, a wire rope drawn very taut to make sure that the ram will not separate at one of the joints and allow the elevator car with its load to go crashing through the roof, which actually occurred with fatal results in an eastern city some years ago.

In the use of safety devices for the car it is necessary to have them so arranged that they will operate in either direction, because the safety devices must work in the reverse direction after the ram is placed under a strain by being out of the casing a certain required distance.

There is also another type of plunger elevator where the plunger is not placed in the ground, but is at one side of the well hole. This type is worked under somewhat the same conditions heretofore mentioned. In this type of plunger elevator, the weight of the plunger must equal the car plus the load. This plunger is held up by the pressure of the water, and when the load is lifted, the pressure of the water is released from the cylinder under this plunger, thus allowing the water to escape, and the excessive weight of the plunger over the weight of the car through its multiplication of ropes and sheaves will lift the car. When the car descends, it is necessary to produce a pressure in the cylinder great enough to lift this ram or plunger and allow the car to descend. Ordinarily, this type of elevator was a multiplication of "two to one" or "three to one" in the rope connections, and all of the work is accomplished through wire ropes connected to the car, over sheaves, placed overhead in the hatch. This type of elevator has the reverse features of the plunger elevator when the plunger elevator is a certain distance out of the ground, that is, the safety devices on this elevator operate in the opposite direction to those on an ordinary electric elevator, for if the cylinder which holds the water should break or a pipe should give way, allowing the water to discharge freely from the cylinder, the plunger would drop very rapidly, and the elevator would attain excessive speed in going up, and might result in an accident. These safety devices must operate in case the ropes should break, and prevent the car from falling, and they must be operative in both directions.

This type of elevator is very successfully operated at high speeds, can be started and stopped very quickly, and comes nearer the action of a direct electric elevator for high buildings than any other hydraulic elevator.

Horizontal Multiple-Sheave Elevator.—This type is generally placed in the basement of a building on the floor and consists of a large cylinder with a piston, a connecting rod and a set of multiple sheaves travelling on a crosshead mounted on a track. On the other end of the cylinder is also placed a set of sheaves, equal to the number which travel with the piston and connecting rod, and as the water is admitted into the cylinder between the head and the plunger it moves the plunger out, thus pushing the plunger and sheaves upon the ropes passing around these sheaves—the other end of these ropes being attached to the cylinder—and thus lifts the car. In this type of elevator, the car is counterweighted to within a point wherein the weight of the car will overcome the water in the cylinder, and when the valve is open to lower the car the weight of the car must be sufficient to push the water out of the cylinder into the tank where it is again pumped under pressure. This latter is the most universal type of hydraulic elevator used for passenger service in high-class buildings, as the starting and stopping of this elevator is very gradual and accomplished without shock or jar, and it may be handled successfully at very high speeds.

Direct-Connected Electric Elevators.—There are several types of direct-connected electric elevators, one consisting of the worm gear with drums attached and ropes fastened to the winding drums; another, the direct-connected worm-gear elevators with traction sheaves around which the rope is passed several times and run over an idler sheave, where one end of the rope is fastened to a counterweight, and the other end to the car. This worm-gear traction elevator is now coming into general use.

Another type of traction elevator is the "one to one" type, with the traction sheave securely fastened to the rotating shaft of the armature and the idler sheave directly over or underneath same, depending upon the position and condition under which the elevator is to operate. The ropes pass around these sheaves the same as in the worm-gear traction type of elevator. This type of elevator is capable of an unlimited speed, while the worm-gear traction drive elevator is somewhat limited in speed.

Again referring to the worm-gear elevators with their winding drums and ropes securely fastened thereto, it should be said that they are generally made in two types, one of a single worm and worm wheel, and the other, a double worm and two worm wheels.

The double-worm machines consist essentially of two worms in an oil-tight casing, one of which is made right hand, the other left hand. The two worm wheels in which these worms engage are made right and left hand to fit, and they are so arranged that, in most cases, the two worm wheels constitute a gear wheel, as well as a worm wheel, being meshed together, thus constituting a three-point connection between the right-hand worm and the

left-hand worm and the two worm wheels which are gear wheels, thus giving the double-worm elevator its superior working qualities and strength over the single worm, because it has double the amount of contact or wearing surface between the worm and the wheel, thus allowing the use of a much larger motor and doing much heavier duty than can be done with a single worm, since there is a limit to the amount of work that a worm will do under a given load and speed. This double-worm elevator, or tandem worn-gear elevator (as it is commonly known), is only used for high-duty purposes, that is, where it is high speed with ordinary heavy loads for passenger service.

In some instances these worms are cut a double pitch, these being two worms of the right hand and two worms of the left hand, thus giving what is termed four points of contact for driving the worm wheel upon which is fastened the winding drum, around which the cables are wound. These worms are always made of a very high grade of steel, and the worm wheel also is made of the best grade of phosphor bronze, thus giving the best metals known for heavy friction at high speeds. These worms are operated, in some cases, up as high as 1,400 rev. per min. and are giving excellent service at that speed. They are all enclosed in an oil bath with a special oil for the purpose, and when doing very heavy duty become quite warm at times.

With all of the worm-gear elevators it is generally conceded that, if properly constructed, the efficiency is about 50 per cent., and in instances less than that; so that in placing the electric motor for an elevator of a given duty, it is necessary to put on a motor having a capacity not less than 50 per cent. greater than the theoretical work to be performed, and in many cases as much as 75 per cent. greater capacity. It is also necessary to have a motor which will do at least 50 per cent. excess duty for a few moments in starting the load and getting under headway in a given time. It is now the rule for manufacturers of motors for elevator purposes, to build them for what is termed "intermittent duty," so that they will stand an excessive over-load for a few moments and also operate at their normal horse-power and carry the load for the time required. These motors are now built especially for this purpose with large extra shafts, extra strong windings, and other features necessary to meet the severe conditions under which an elevator motor is to operate.

Controlling devices for these motors are also built by manufacturers who make a specialty of that class of work, and who have made an exhaustive study of the duties required for controlling apparatus. The advance made in the last few years in such apparatus is very marked, as the elevator controllers at the present time are much more durable than in former years, are simpler, more efficient, less liable to breakage and are somewhat cheaper, owing to the large number now being built.

There has also been developed within the past few years the full magnet control for alternating-current elevators. These controllers are built in all sizes.

The difficulty in the past has been that the laminations for the working parts of the solenoids or the magnets required to operate the switches have made too much noise, and in operation would heat, and the constant expansion and contraction of the laminated parts loosened them and broke them down completely. But these A.C. solenoids and magnets are now so constructed that they do not heat and the noise is at a minimum, thus giving excellent service in operating the switches. No doubt in time there will be a marked improvement in the A.C. controlling mechanism for elevators. They are also well developed for the full automatic control elevators such as are used in apartment houses, and their cost is but very little more than for the D.C. apparatus to do the same duty.

During the past few years the A.C. motor for freight purposes has made marked progress and is giving good service without interruption.

Within the last year or so an A.C. motor has been introduced for elevator purposes which can be thrown directly across the line using a reversible switch. These motors are very simple. They have an enormous starting torque, from two to three times their normal running torque with about the same overload of current necessary to produce this torque. This makes the A.C. motor very valuable for small freight elevators. These motors are now built so that they run very quietly and are very flexible in starting.

In the larger motors, for heavy freight duty and also for passenger service, what is termed the "slip ring armature resistance type motor" is used, operating with practically the same device that operates a direct-current motor, and the resistance in the armature is cut out in several steps by a control magnet, operating cut-out contacts, for cutting out or short-circuiting the armature resistance as the motor comes up to speed, thus giving it from two to three times its starting torque and holding the same until the armature resistance is completely cut out. This development in the A.C. motor has been very beneficial to the elevator manufacturer, since prevailing current supply is now alternating, and it is only a question of time when the direct current will become obsolete.

The first electric motors for power came into use in 1886 and 1887. These electric motors were operated from the old constant-current arc-light machines, viz., 9.6 amperes of constant current where the voltage varied according to the load placed upon the electric motor. These motors were controlled by shifting the brushes on the commutator, and were, at that time, the only known electric power which gave commercial satisfaction. A great many of these motors were built in San Francisco from 1886 to 1890. The old constant-current motors were built up to 15 h.p. and as high as 20 h.p., this latter being considered a large motor. They were belted to countershafts for driving pumps for pumping water into a tank on the roof, or in a steel compression tank under air pressure, where the water under pressure was used to operate the elevator, it being discharged from the elevator into a surge tank and then repumped under the pressure required to operate the elevator.

About 1890 appeared the constant potential motor which is now in use, that is where the voltage is kept constant and the amperes vary according to the work to be done, and wherein the motor does not require a governor to operate the brushes to control the speed, but where the brushes of the motor are fixed, the speed depending upon the adjustable relations. These motors were much cheaper than the old constant-current motor and gave better results. About this time all of the controlling devices necessary to start and stop the electric motor which operated the pump were also perfected. Some of the apparatus is in use at the present time, giving fairly good service.

In 1891, the writer patented a direct connected electric elevator. This was a tandem-geared, or double-worm machine with a right- and left-hand worm and a right- and left-hand worm wheel. This worm wheel consisted

of two gear wheels spirally cut on about the angle and pitch of the worm, and the worm wheel was hobbed out of the centre sufficiently to make a proper contact between the worm and the worm wheel. These worm wheels were made of common cast iron accurately machined, and the right- and left-hand worms were made of phosphor bronze securely keyed to the worm shaft. Upon the end of the worm shaft an electric motor was installed, designed and built by the writer. Also all of the controlling mechanism was operated mechanically by reversing switches with springs, lever and dash pot which cut out the armature resistance as the motor came up to speed. This elevator was sold to the Keil estate and placed in their building at 770 Mission Street, occupied by Hulse-Bradford Company. The elevator did good service up to the time of the great fire of 1906.

About this time the writer patented a larger elevator of this same type, the motor and control however being of a different type from the above. This elevator was placed in the Old Cliff House about 1892 and did good service until it was destroyed by fire. This installation was first operated from 110-volt circuit of direct current, and was later changed or rewound for a 220-volt circuit. When the electric railway was built to the Cliff House, it was changed to 500 volts.

The single-worm elevator was then developed by the writer, who later patented several devices for controlling elevators, and after much study and experience these devices were brought up to satisfactory efficiency.

Since 1900 the development in electrically controlled elevators has been very marked, and the writer predicts that the advancement in the next thirteen years will be equally as great.

About 1898 or 1900, the eastern manufacturers realized the importance of the demand for electric motors and electric controllers for elevator purposes, and they made a study in detail of elevator equipment, viz., the making of motors especially for this purpose, also a controlling apparatus made for controlling freight and passenger elevators electrically driven. The constant usage of these motors and controllers has exposed their weaker points, and they have now reached a point of efficiency where they are commercially a great success, also being economical and practical in their operation.

Within the last few years, in the electric motor especially, there has developed what we term the "interpole motor," which has eliminated the commutator trouble originally had with reversible motors under heavy duty with varying loads.

The writer wishes to state a few facts regarding the care, maintenance and abuses of elevators. We are aware of the many advantages to be gained by good elevator service in buildings equipped with the modern elevators of the present day.

Good Service.—It is not enough that the owners get from the manufacturers a first-class machine; they must do their part, employing good, reliable, intelligent men, who are capable of understanding the importance of keeping all parts well cleaned and properly oiled, and who understand making adjustments when required, thus in many instances lessening the liability of accidents and reducing the up-keep of the machinery very materially; and the writer would ask the consideration of owners and the public for the elevator manufacturer. who is the man who is blamed for all the mishaps, accidents and unsatisfactory results, while as a matter of fact these conditions in many instances are caused by lack of care and attention on the part of the owner or, more often, the tenant. Then again, many troubles can be traced to the architects or engineers, who, when planning the buildings, fail to make the proper allowance of space for elevators; also, conditions are many times disadvantageous, such as poor light, etc.; and many other conditions obtain, all detrimental to a successful installation of what is conceded to be a most complicated mechanical contrivance.

In many instances, the owners of buildings consider their responsibility ended with the payment of the manufacturer's bill, forgetting that only by eternal viligance and care can any machinery give good service; elevators are certainly no exception to this rule.

An elevator doing heavy duty in a building is a very essential part of the building, and when the elevator is out of commission the expenses of the building are just as great, without any results. Owners should realize that elevators should be taken care of by men experienced in elevator mechanism.

The writer will give the following illustration to make his meaning plain. Not long ago he was called to a rooming house to figure on putting in a new commutator on a motor which had been running for several years. The motor and controlling devices were placed under a stairway leading from a back entrance into a basement; part of the elevator machinery being in one room, a partition under the stairway brought part of it in another room. The controlling devices were so close to the wall as to render it absolutely impossible to reach one side at all. In this room were four barrels full of inflammable matter, one of which was placed directly against part of the controller. It would have been easy for a spark from the controller to have dropped into this barrel. Undoubtedly this would have set fire to it, thus endangering the whole building. Around the machinery, the oil was ½ in. thick. Old rags, boards and shavings covered the floor. This elevator was in the care of a Japanese, who could neither speak nor understand English, consequently it was impossible to make him comprehend that the elevator must be kept clean. Doubtless these conditions exist in many other cases in this city.

The writer suggests that, when owners and architects of buildings decide upon the elevator equipment required to meet the conditions under which the building is being built, it would facilitate matters to employ an elevator expert, who as an expert should be qualified to give them information valuable to insure good results, inasmuch as it is very material that the elevator manufacturer should understand the details, viz., how many entrances there are to the car, how the overhead supports should be constructed, what room and provisions are to be made for the semi-automatic gates, whether or not a freight elevator is required, and also the conditions required for fire hoods and fire doors, and much other necessary information. All of this is required to make a successful installation, and conduces to the owner's benefit, insures satisfactory results to the lesee of the building, and last, but not least, is of great assistance to the elevator manufacturer in helping him to thoroughly understand just what is required.

You will understand that the elevator contractor, in bidding upon the installation of an elevator, in most instances only receives a few of the actual conditions under which the elevator must give service, such as the load, speed, travel and size of car, etc. This is only a part of the information he should have. In order to bid intelligently, he should know every gate, fire door, and many other conditions with which he should be thoroughly in touch in order to insure a good installation.

The writer knows of several instances where the architect has designed a concrete well-hole, or a brick well-hole, without any recesses on the inside for gates; these shafts, being constructed for fireproof purposes, must necessarily have a roller drop fire door on the outside, this door completely covering the entrance. The gates must be put outside in the room beyond this roller door and the contractor is obliged to drill through the walls to put connections through, so as automatically to trip the the gate when the car leaves the floor. Gates installed this way are invariably unsatisfactory. The writer suggests that when architects or engineers require bids for elevators it would be advisable to have a complete drawing made of gates, doors, automatic locks, safety devices and other things necessary, so that it may be determined how they should go into the elevator installation, these drawings accompanying the specifications of the material to be used. Then the bidder has full knowledge of what is required and is able to bid intelligently, while without this knowledge the elevator contractor is compelled to use his own judgment, and in many instances it is at variance with the ideas of the architect and owner and often leads to confusion and dissatisfaction to all parties concerned. Hence, the writer's reason for suggesting the services of a competent elevator engineer to make the lay-outs and specifications for the bidder.

A good, efficient elevator installation is of vital importance to all concerned in the elevator equipment of a building, and in order to obtain this the architect and contractor must work together to this end and for their mutual advantage, the architect giving the contractor all necessary data, etc., and the contractor, upon the other hand, assisting the architect by giving him the benefit of the knowledge of actual experience.

SASKATOON'S WATER AND DISTRIBUTION SYSTEM.

OWING to the expenditure of much money and effort on the Saskatoon water supply and distribution system, a deficit of $23,802.01, shown last year, has been converted into a considerable profit. This has been effected by rigid economy and extensive repairs and reconstruction. Some of the improvements carried out at the pumping house during the year were the removal of 3 return tubular boilers and of the brick chimney; the remodelling of the old boiler room and the division of the same into two; the utilizing of the space previously occupied by the boilers for the generator room; the rearrangement of the entire steam piping and the erection of two new feed water lines, one from the injector to the boilers, and the other from the feed pump to the boilers; the transference of a 500 k.w. reciprocating unit from the power house, and its erection in the pumping plant, together with the exciter, the condenser, and the air pump; the complete rearrangement of the steam and exhaust steam piping, and the placing of the same beneath the floor in the steam pump room. Other changes in the building itself are the raising of the roof 5 feet and the making of it fireproof; the placing of a new concrete floor in the pump well; and the removal of two 100-h.p. domestic pumps and one 50-h.p. booster pump from the steam pump room to permanent positions in the new pump room, and the connection of the delivery pipes made to the city mains.

This rearrangement of the pumping plant has been undertaken, with the result that the city can now pump its entire water supply with electrically driven centrifugal pumps. The present capacity of the pumps is 4,000,000 gallons per day with a nominal pressure of 60 pounds in the mains. In case of fire the pressure can be instantly raised by means of a booster pump to 100 pounds. The capacity of the pumps is sufficient to meet present demands, the average daily consumption being about 1,800,000 gallons. Provision has been made so that additional pumps can be added without enlarging the building, which would provide a daily supply of 12,000,000 gallons, sufficient for a city of 180,000 population, on the present basis.

The filtration plant has caused the least concern on the part of this year's council, having given almost complete satisfaction.

Further improvement is arranged for, in order to eliminate complaints made last winter with reference to the delivery of water to householders who are not supplied from the city mains. Small vertical boilers will be installed at several standpipe stations for heating the water and thawing out the delivery tanks. This will effect a saving of $20 a month for the city on each standpipe.

The economic effect of the works carried out at the pumping plant is shown by the following figures: in May the output was 59,119,060 gallons and the operating cost was $6,079.10, or 10.28 cents per 1,000 gallons; in October the output was 51,556,000 gallons and the operating cost was $3,686.79, or 7.15 cents per 1,000 gallons; showing a decrease of 30.4 per cent.

The waterworks department proposes, however, by carrying out further improvements to acquire still greater gain for the city, and anticipates a surplus in 1914 of $10,000. This will be chiefly effected by the reduction in the cost of fuel, which will result from the doing away with the stand-by at the pumping station in case of breakdown—e.g., the keeping up of steam on one of the boilers, which is prepared at any time to propel a reciprocating engine, drive a generator, and run horizontal steam pumps,— and the substitution of a separate stand-by and the installation of a duplicate main from the power house to the pumping station. This, alone, it is expected will decrease by $14,000 a year the waterworks expenditure.

That sawdust and other mill waste can be profitably manufactured into briquettes for fuel is evident from the fact that a large lumber company in British Columbia is erecting a $50,000 plant, which will have a daily output of about 30 tons of such briquettes. They will sell for about five dollars a ton at the mill.

The quantity of coal required to produce a ton of coke is much less than was required formerly. The average gain in 1912 compared with ten years ago is probably at least 160 pounds. It is doubtful if in the earlier years the actual yield of coal in coke exceeded 60 per cent., whereas in 1912 it was 67 per cent., according to the United States Geological Survey. This gain is largely due to the increase in the production of by-product coke, in which the yield of coke from a ton of coal is very much higher than in making beehive coke. In Illinois, Indiana, Massachusetts, Michigan, New Jersey, New York and Wisconsin, where coke is made exclusively in by-product plants, the yield varies from 69.6 per cent. in Wisconsin to 81.8 per cent. in Indiana, whereas in the States where beehive practice prevails the yield in 1912 varied from 50 per cent. in Georgia to 66.5 per cent. in Pennsylvania.

PROTRACTING RAILWAY TRAVERSES BY THE METHOD OF CO-ORDINATES.

By J. A. Macdonald, Ottawa, Ont.

IT has been repeatedly shown by various writers, that when the distance measured on a sphere is a portion of a rhumb line, whether direct or oblique, or when it coincides with a parallel of latitude, when it crosses a meridian obliquely, and forms equal angles with them, all the corresponding amounts of latitude and departure, and the distance itself, may be accurately represented by the three sides of a right-angled triangle. As the length of lines to which we apply latitudes and departures are, when compared with the vast length of a great circle of the earth, extremely small, the error arising from considering the distances measured, and the difference of latitude and departure corresponding thereto as three sides of a right-angled triangle, is trifling.

A Knowledge of Plane Trigonometry Required.—Such surveys as are conducted under the rules of plane trigonometry may be all classed as having for their object either to obtain an accurate plan of a limited portion of country with a view to the calculation of its area, or its suitability for a railroad, by obtaining representations of the varying features of the surface, such as the extent of mountains, woods, lakes, rivers, roads, towns, villages, coast lines, or any other details of country through which it may be required to run a railroad.

An acquaintance with the higher branches of mathematics is necessary for those who are entrusted with surveys of any kind, railway and otherwise, though a wonderful degree of perfection is frequently obtained by practice and with only a limited knowledge of the rules of plane trigonometry. It is for the assistance of the labors of those so equipped that the following notes may be applied in practice, assuming that the reader is acquainted with the use of the transit or the surveyor's compass, and the chain.

Mapping of a Railway Line.—The method of plotting the survey of a line of road, or mapping by traverse, is a *modified application of protraction by co-ordinates*, for in a road survey the lines generally lie on one side of the meridian, though not necessarily so. Table I. contains an extract from a survey, by the writer, of a line of road in the North-West provinces, made in the year 1906, and will serve to illustrate the application to this method. The second column refers to the angles of deflection taken with the transit; the third, to the true bearings, either astronomical or magnetic, as calculated from the deflection angles, registered on the limb of the transit, and so on.

Fig. I. (sketch-plan) contains a few of the first stations protracted on a definite scale. The stations are plotted in the following manner: Draw any line (Fig. I.) to represent the meridian, and assume any point upon the line for the first station of the survey; mark a point upon the meridian, "O." The position of this meridian on the plan, and of this first station, will depend upon the general direction of the line to be surveyed.

Station.	Def. Angle.	Bearing.	Distance.	Lat. N.	Lat. S.	Dep. E.	Dep. W.	Total Lat.	Total Dep.	Offsets.
0	31° 40′	N. 25° 30′ E.	1910	1724	....	822	....	0	0	
1	73° 20′	N. 47° 50′ W.	910	612	....	....	674	1724	822	
2	61° 15′	N. 13° 25′ E.	1420	1381	....	329	....	2336	148	
3	47° 00′	N. 60° 25′ E.	2000	987	....	1739	....	3717	477	
4	21° 10′	N. 39° 15′ E.	1500	1161	....	949	....	4704	2216	
5	40° 00′	N. 0° 45′ W.	1420	1419	....	....	18.6	5865	3165	
6	43° 30′	N. 42° 45′ E.	1205	875	....	818	....	7284	3146	
						4657	692.6	8159	3964	
						692.6 subt.				
Totals				8159		3964				

The first station being marked "O," or 0 + 00, where the transit was first set up, and the bearings having been taken from the back-sight of a connecting line, N. 57° 10′ E., the instrument is then put in the meridian

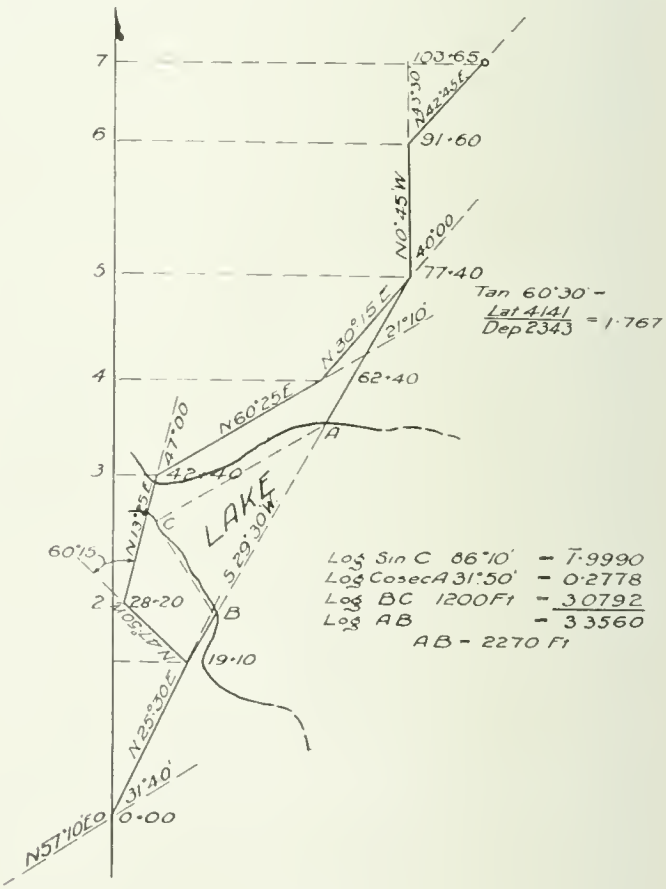


Fig. 1.

by turning 57° 10′ back to zero, with a suitable scale. Mark a point N. from Station 0, 1,724 ft., being the first entry, and opposite to the number 1 in the plotting column, Total Latitude, of the table, and number the point 1′. From 1′ on a line perpendicular to the meridian

mark a point 822 ft., being the first entry, and also opposite to the number 1 in the plotting column, Total Departures (10th column), and this point will be Station 1 (19 + 10). Again, from Station 0 in a direction N. 2,342 ft. mark a point and number it 2′, and from 2′ on a line perpendicular to the meridian set up the point E. of the meridian 148 ft., which will be Station 2 (28 + 20). Proceed in a similar manner for the remaining stations, taking all the values successively from the plotting columns, under the head of Total Latitude and Total Departures (9th and 10th cols.), and laying them off as above from Station 0. Draw lines connecting the stations 0, 1, 2, 3, etc., which will represent the measured or station lines of the survey, from which distant objects are filled in by intersection, and near ones by offsets in the usual way.

By the use of a parallel ruler (a pair of set-squares answers quite as well) all the points of a series may be defined at once. When the scale is laid along the meridian all the points, 1′, 2′, 3′, 4′, 5′ 6′, etc., may be pricked off at once from the figures opposite to these numbers in the 9th column of the table. For the Departures (next column) it will be necessary to draw a line, precisely perpendicular to the meridian at Station 0, then with the parallel ruler draw lines parallel to the first one through the latitude points, 1′, 2′, 3′, etc. Now, place the scale on those several perpendiculars and measure the departures (column 10) opposite to their numbers, and make a fine point. These points are then connected by lines joining each, and represent the distances between stations. It will be seen that the column distance is not used in plotting. This column is only used to obtain the latitudes and departures of the several courses.

In protracting each piece of work it will be found advantageous to fix the extreme points first before filling in the intermediates. Great facility is also afforded thus for reducing, enlarging, or transferring maps of single lines of road where the bearing of the line is considerable. The differences of latitudes and departures in the columns entered against the several stations serve to determine the relative geographical position of those stations with reference to the first, or any other station in the series.

Obtaining a True Bearing.—The lake shown in the plan was first crossed at its narrow part, involving several sharp curves. It was thought that the lake might be boldly crossed in as nearly as possible a direct line at Station 5, 77 + 40. It was decided to back-run a line, directly across the lake to Station 1, 19 + 10, to strike this station as nearly as possible.

The latitude and departure from 19 + 10 (Station 1) to 77 + 40 (Station 5) is found as in Table II. :—

	Lat.	Dep.
Station (1)	0	0
" (2)	+ 612	— 674
" (3)	+ 1933	— 345
" (4)	+ 2980	+ 1394
" (5)	+ 4141	+ 2343

The latitude is 4,141 and the departure 2,343. Dividing the one by the other we get the tangent. Then orienting the transit at 270 degrees, due west, and turning the angle, 60° 30′ we run the line, S. 29° 30 W., back across the lake. If everything is right, should strike the hub at 19 + 40 (Station 1).

Triangulating.—It will be necessary to triangulate across the lake. Though rather wide for a "sight," this may readily be done. The transit-man, on approaching the bank of the lake, drives a hub, and, having taken his back-sight, sets his instrument in the same direction forward, and signals to his flagman, on the opposite bank of the lake, who, on getting the line, drives his hub there, at B.

The transit-man must now choose a point somewhere on the edge of the lake to the west, unobstructed by trees, if possible. Such a point can usually be secured without much cutting on a lake. A flagman must be there to get a point, and, on reading the angle on this point, C, moves his transit there and sets up. Taking a back-sight with transit set at zero, the first triangulation point, A, he reads the angle to B, and then proceeds to measure the distance, C B, for a base. He has secured two angles, A and C, and the base, C B, and calculates the distance, A B, before proceeding further. The calculation of this triangle is shown on the plan, as well as the triangle, shown dotted, and the lettering of the three angles, A, B and C. Taking the log. of sin. C, 86° 10′, the cos. of A, 31° 50′,

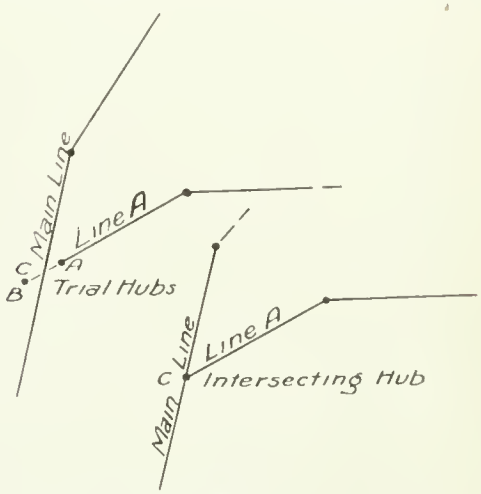


Fig. 2.—Showing Method of Intersecting.

and the log. of a′, 1,200 ft., we get the distance A B. Then taking a back-sight from B to A, the line is projected forward to the hub at Station 19 + 10.

In all these operations we have used no protractor nor angle-measure. We depend entirely on our sines and cosines, or latitudes and departures. It may be mentioned that this method is used in all important new lines of railway. Engineers prefer plotting by deflecture angles, as it involves no mathematics, and it is quick and simple, but open to many errors.

Intersecting.—In running a railway line it is usually necessary to run several lines through some portions of the country in order to get a line that is satisfactory to the surveyor. These several lines are tied to the main or first line in almost every case. We come to a lake, perhaps, and are undecided (if the lake is a large one) which bank of the lake to run or line along. If the country is wooded, as a good deal of country is in Canada still, the better side will not be known until we run a line on both. When the farther end of the lake is reached we tie one line to the other. In many cases we shall have to intersect, particularly if we are running through thick woods. In a clear, level country we can easily see the hub of the main line, and bear on it. Intersecting is rather bothersome, but the refinement of every action required to make a true intersection has its merits.

Fig. 2 shows a line, A, intersecting on the main line, the first operation and the completion. On reaching the line already run, i.e., the "main line," the flagman, after

ranging the line, just arrived at, sets for a point about a foot *from* the line, at A. Here, at A, he drives a temporary hub and drives a nail in the point. Immediately on the far side of the line, and also about a foot from it, he drives another temporary hub, B. The transit-man now comes along and sets up on the nearest hub of the main line or line to be crossed or tied to, as need be. Getting a back-sight, he looks ahead to get a hub exactly in line, and also precisely in line with the two temporary hubs, A and B. The picketman approximates the position of this hub and drives it, at C. With a straightedge or piece of the chain stretched across the nail-points of the two temporary hubs, he marks a line on the centre hub, C, in range, of course, with line A. Now, the picket signals the transit-man for a point on this pencil-line on the centre or permanent hub, C, and when he gets that point he drives the nail. This nail in hub C is then precisely in line with the position of line A, and also in line with the position of the main line. It is exactly at the intersection of the two lines. If the transit is now set up

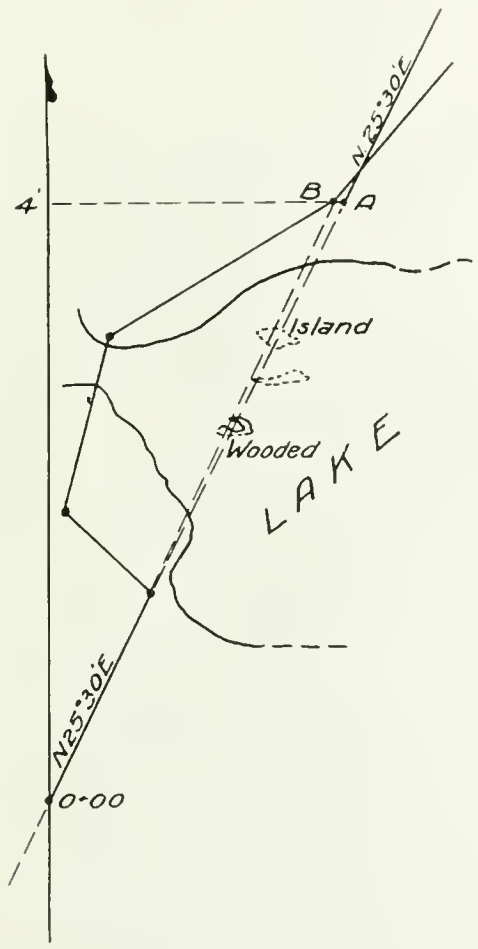


Fig. 3.

on the intersecting hub, C (the hubs A and B being pulled up) and the bearing of the line "A" taken, then orienting the transit on the main line, and noting the deflection angle, he gets the bearing of the line he has just struck —the main line in this case. If he ran that line himself, he will know its bearing and can make comparison. The lines may not close in bearings—may possibly be ten, twenty or forty minutes out, and will not connect or tie on the plot, but that is another story.

When One Cannot Sight Across the Lake.—Frequently it is impossible to sight across the lake on account of its being too wide, or on account of islands covered with bush intervening. This is a peculiar case, but in some surveys may arise frequently. For example, there were islands in this lake, already referred to, on the line of sight of our first bearing, N. 25° 30′ E., and we could not sight across, as shown in Fig. 3. In such cases we proceed in the same way around the lake by a traverse to B (Fig. 3), which is the same point as Station 4′ (62 + 40), (Fig. 1). On reaching the point B (Fig. 3), that is, Station 62 + 40, which has a bearing of N. 60° 25′ E., we judge we are approximately near the line, if produced from the first bearing across the lake. We then get our latitude and departures to determine our exact position.

By looking over the table, we find in column 9 that this point has a latitude of 4,704, and a departure of 2,216, which gives a tangent of 25° 12′. In other words, the bearing of B (Fig. 3), or Station 62 + 40 (Fig. 1), from 0 + 00 (starting point) is N. 25° 12′ E.; that is, B (Fig. 3) bears N. 25° 12′ E. from 0 + 00. But the bearing we want is N. 25° 30′ E. Looking up our table of latitudes, the latitude of B is 4,704. This sum multiplied by the natural tangent of 25° 30′, which is 4,770, gives the desired departure, viz., 2,243, which is the departure of point, A. We have already ascertained the departure of point B, and the difference between A and B is 27 ft. In order to get on the line we must increase our departure 27 ft. We now set the transit up at B (Fig. 3), or Station 62 + 40 (Fig. 1), and measure exactly 27 ft. due east, when we are in the direct line of our first bearing. A hub is driven here, of course. We now set up at A, take our bearing, N. 25° 30 E., when we proceed in a direct line, at A (Fig. 1). From the starting point, 0 + 00, to A, is easily calculated, being, as we know, the latitude and departure, and the angle 25° 30′.

Lat. 4,704 ÷ nat. cos. 25° 30 = radius, equals distance from starting point, 0 + 00 to A = 5,214. It is by this method, or a modification of it, we locate the line on the projected preliminary plan. No up-to-date surveyor projects a railway location by deflection angles with the aid of a protractor. On first-class roads the protractor is barred. All bearings of both preliminary and location are projected upon the map or plan by the method of co-ordinates, latitudes and departures; sines, cosines and tangents.

Canal statistics for the season, which is now practically closed, exceed all previous records. Up to the present time 46,428,283 tons of freight have passed through the canals, an increase of 4,845,171 tons. Of this, the Soo canal is credited with an increase of 3,384,713 tons, the Welland 729,-713 tons, and the St. Lawrence canals 851,569 tons.

It is announced that the first Canadian Roads Congress, a national convention arising out of the needs of all the provinces for better highway facilities, is planned to be held in Montreal during the coming winter. The federal and provincial governments are co-operating with the Automobile Club of Canada, as well as the local and foreign road associations, boards of trade, municipal and county councils and societies in general, to make the congress of great value to the good roads movement.

Another Alaskan railroad to open the natural resources of the territory is proposed in a bill Chairman Houston, of the Territories Committee, has favorably reported to the House. The road, to be built by the Government and either leased or Government operated, would run from the southern coast at Cordova or Seward or their vicinity to the upper Yukon River, and would not be more than 722 miles long.

CANADA'S PROJECTS OF WATERWAY IMPROVEMENT.

The Hon. J. D. Hazen, Minister of Marine and Fisheries, addressed the tenth annual convention of the National Rivers and Harbor Congress, held recently at Washington, D.C., on the great projects of waterway improvement under contract or in contemplation in the Dominion of Canada.

It was pointed out by Mr. Hazen that Montreal, the chief port of Canada, affords the best example of modern harbor works and equipment and has special advantages over any port on the North American continent from its inland situation in regard to discharging of cargo and affording communication by water via the Great Lakes to a point 1900 miles farther inland at the head of Lake Superior. Mr. Hazen referred briefly to the great growth in trade at Montreal which has made necessary the deepening of the channel in the St. Lawrence River at a cost up to the present of $16,000,000; and which will be greatly augmented by the work now in progress.

Mr. Hazen pointed out also improvements under way or to be undertaken at other ports: at Quebec harbor, the lock and dam on the St. Charles River to cost $3,000,000; at St. John, improvements to cost millions, one contract alone amounting to $7,500,000; at Halifax, the reconstruction of deep-water terminals to cost over $8,200,000; the new breakwater 5,500 feet in length under construction at the twin ports of Fort William and Port Arthur; the many new drydocks, etc., at numerous smaller intervening ports, and at Vancouver and Victoria the government wharf and breakwater respectively, totalling a general cost of $5,500,000.

In connection with Canada's canal question, Mr. Hazen said: "Canada and the United States jointly operate one of the largest systems of Inland waterways in the world, a most valuable heritage for purposes of transportation. This whole system of canals on both sides of the line is free of tolls, and open to the vessels of both countries. The Canadian canal system represents a capital cost of $104,000,000. If to this, however, is added the capital cost of harbors, the dredging of channels, lighthouses, buoys, etc., it will be found that Canada has contributed upwards of $365,000,000 all told for the establishment of means of transportation by water."

He mentioned that the whole scheme for the Trent Canal is now being carried out; that the new Welland Canal is already under construction, and is to aggregate a cost in the neighborhood of fifty million dollars; and that the construction of the Georgian Bay Canal is one of the schemes contemplated for the near future.

Mr. Hazen closed his address by remarking that the Canadian Government has entered actively upon "the project of affording facilities at all our great national ports which will enable them to compete on at least even terms with any other ports on this continent."

German capitalists headed by Capt. Von Der Osten, of Berlin, have secured from the provincial government a concession of forty square miles near Sussex, N.B., and will prospect for salt, gypsum ore, potassium and petroleum. The project is capitalized at three million dollars, and in particular the promoters expect to develop a big industry in potassium, which is known to exist in large quantities, and for which the United States offers an almost unlimited market.

THE CORROSION OF WATER MAINS.*

By William Ransom, A.M.I.C.E.

THE subject of the corrosion of iron mains is one of great importance to waterworks engineers, who naturally desire to obtain as long a life as possible for their water mains, and also are anxious to use such materials as will not impart any impurity or deleterious property to the water in the course of its distribution. The need for investigation and conference on the subject can be realized and its practical importance better understood when the recent case of a town in South Africa is mentioned, where a new steel water main has become so pitted with rust that it has become necessary to partly replace it with a cast-iron main. It was found that the damage was due to the sulphuric acid in the soil resulting from the oxidation of pyrites in the soil. Other portions of the main have been protected by covering with two thicknesses of bituminized Hessian cloth, and afterwards coated with a bituminous composition.

The writer had his special attention drawn to this subject in connection with some investigations he made with regard to a town water supply which not only corroded the mains but deposited a brown percipitant upon exposure, and caused an objectionable discoloration to domestic utensils, etc., while at times an unpleasant smell was noticed when the water was drawn from the mains.

We are all familiar with the ordinary formation of rust, but there are many factors at work to complicate the corrosion of water mains, and in this short paper the writer can only hope to refer to one or two phases of the subject in which he has been especially interested.

Dry oxygen has no effect upon iron at normal temperature, but if the iron be heated oxidation takes place and a black scale or oxide forms on the surface, which, when the metal is heated to white heat, is represented by the formula Fe_3O_4. This is the scale which, being non-adherent, is brushed off the hot plates after they have passed through the rolling mills.

It is when moisture is present together with carbonic dioxide that oxygen is able to act most readily upon iron at the ordinary temperature and a brown hydrate of ferric oxide if formed. Water, which contains free CO_2, and is therefore a weak acid solution, will very quickly corrode the iron mains through which it is being distributed. The rust that is formed is not a protective coat, for it is hygroscopic, and fresh water is brought into contact with the iron to continue the process of oxidation. The chemical action produces a certain amount of heat, which also helps in the work of oxidation. The various impurities in the water and the different qualities of iron modify or complicate the corrosive effect on the mains and the discoloration caused to the water. The ordinary action of corrosion is prevented by giving the iron a protective coat of some bitumastic material, but there is great difficulty in ensuring perfect protection, for pinholes, etc., may soon form centres for the formation of rust.

There have been many investigators who have made a special study of the formation of rust. Wehner, of Munich, in 1907 summarized the various forms of rust under three headings: Firstly, coarse blotches or blisters of rust which are formed on the interior of water mains and on the exterior of pipes laid in damp or salt soil. Pro-

*A paper read at the meeting of the Institution of Civil Engineers, held at Birmingham on Nov. 20, 1913.

fessor James Campbell Brown likens this rust to the limpets which are found on a rocky sea coast, and found that they grow by addition of concentric layers. This incrustation will keep on extending, and in large mains may form a layer 1 in. to 1½ in. in thickness. If this be removed or the surface disturbed the incrustation will go on reforming. Secondly, a fine and more or less brightly tinted mud of a yellowish tinge, which is found deposited in the interior of pipes. Thirdly, graphitic destruction of iron, which is effected by weak acids, and causes the iron to assume a spongy nature. There is no outward indication of rust, and Wehner has found that this form of rust can take place, leaving a protective coating apparently undamaged. This fact emphasizes the necessity of care in selecting suitable materials for the manufacture of water mains.

The production of rust, especially in water service pipes, is often much accelerated by electric action. If there be two metals an electric disturbance is produced, and if the metals be conductors one will become electro-positive and the other electro-negative. If the water be slightly acid current is able to circulate, and the chemical action previously referred to at once comes into operation, and the electro-positive metal is attacked. Galvanized pipes are preserved from ordinary corrosion, but if the protective coating of zinc be cracked or has been imperfectly applied, electro-action will be set up, destroying the zinc, and exposing the iron to the ordinary action of the water. Hydrogen will at the same time be liberated, and impart an unpleasant smell to the water.

Waters which become discolored during the process of distribution and choke the mains with a brown deposit are chiefly those in which the presence of free CO_2 is able to intensify the ordinary action of rusting.

The chemical action can be briefly explained as follows: The water containig the free CO_2 forms a weak acid solution, and, attacking the iron pipes, produces ferrous carbonate or bi-carbonate, liberating hydrogen in the process, thus:

$$H_2O + CO_2 + Fe = FeCO_2 + 2H.$$

If the ferrous carbonate absorbs oxygen from the water or the air it oxidizes, and a brown hydrate is produced, while CO_2 is liberated which is ready to attack fresh iron. It will, therefore, be seen what an important bearing even a very small proportion of free CO_2 present in the water has upon the life of the main and the color of the water.

Ferrous carbonate is insoluble in water, and would quickly completely choke the mains but for the fact that it is dissolved in water which contains CO_2, while by the absorption of more CO_2 it becomes a bi-carbonate which is soluble in water, and is passed on to the consumer to be drawn off at the tap. If this bi-carbonate has not been able to absorb oxygen whilst in the mains the water when drawn from the tap will be clear and free from turbidity until, by combining with oxygen from the air after the water has been standing sufficiently long, the water will gradually become turbid, and then precipitate the brown hydrate. If the bi-carbonate has been able to absorb oxygen in the mains the water is drawn off in a turbid condition, and will gradually become clear, leaving the brown hydrate precipitate. If the water has been pumped and air sucked in, the above action is very much intensified, and if the water be allowed to remain stagnant in the mains serious deposit will occur. The mains would quickly become choked unless they are frequently flushed, while the water will be very much discolored.

We have seen how that hydrogen is liberated in the process of chemical action, and imparts an unpleasant smell to the water. This is naturally increased if the water remains stagnant in the mains to allow time for the hydrogen to accumulate, and the remedy is to liberate the hydrogen by frequent flushing of the mains and the avoidance of dead ends.

Where a public water supply is of such a nature as to produce the results above described, the problem is how to prevent the action of the free carbonic acid upon the mains, so as to fit the water for domestic and laundry use. We see in nature where water containing CO_2 has dissolved iron from the minerals with which it has come in contact during its passage through the soil, how upon exposure the ferrous bi-carbonate is deposited in the brown form so familiar to us in the watercourses and streams of iron districts. Household utensils and domestic sanitary appliances are soon stained by the use of such waters, while it is quite impossible to use the same for laundry purposes. Cisterns and pipes will become choked with the brown deposit, and from the consumer's point of view the question becomes of very great importance, especially as it is found to be more difficult to deal with waters which have such action than with those which bring iron with them in solution from their source.

The removal of the free CO_2 appears to be the only certain way of preventing the action of such waters upon the iron mains, and the passing on of ferrous bi-carbonate to the consumer, which, by absorption of oxygen, causes turbidity and the brown deposit.

Oeston, of Munich, mentions a peculiar case, where, in 1908, at Berlin, a water had been treated for the removal of iron. The carbonic acid gas, however, had not been eliminated, and upon examination of the water drawn from the cast-iron mains of the Berlin Zoological Gardens it was found, owing to the corrosion of the mains by the Co_2, that the percentage of iron had again risen, and the work of removing the iron from the water at its source was wasted. He also found that the greater the pressure in the mains the greater was the action of the carbonic acid gas upon iron.

In connection with the ground water supply of Frankfurt-am-Main, where the free Co_2 existed to the extent of 3 parts per 10,000, Scheelhaase describes an apparatus for the removal of the Co_2. The water passes through a special marble aerator, and is allowed to fall in the form of spray over the marble, which absorbs a large proportion of the CO_2, but the hardness of the water is increased by the formation of a bi-carbonate. The destructive action of the water upon the mains has ceased, and the cost of the process is given at about one-tenth of a penny per 1,000 gallons treated.

The writer does not propose to deal in this paper with the deposits of calcium carbonate caused by hard water, and the well-known processes of softening such waters; but it is well to bear in mind that such hard waters give a protective coat to the mains against the ordinary action of corrosion.

Dr. Hartwig Klut, of Munich, made a special study in 1907 of carbonic acid gas in relation to water supplies, and he found that when oxygen is present with CO_2 the latter acts upon the lead service pipes, and there is the danger of lead poisoning.

The Massachusetts Board of Health have made experiments with similar results. The removal of free CO_2 is therefore necessary in some cases to prevent the danger

of lead poisoning where the water passes through lead service pipes.

At Dessau, in Anhalt, where the water is very soft and contains so much CO_2 that lead was dissolved from the service pipes, the excess CO_2 has been removed by the addition of powdered carbonate of lime.

Many waters are contaminated with iron at the source of supply, and this iron not only imparts an unpleasant taste, but is a cause of deposit in the mains rather than a cause of corrosion. Such waters, if rendered slightly acid by vegetable matters, such as peat, deposit a ferruginous slime in the mains, caused by the growth of an organism known as Crenothrix, which is able to thrive under such favoring conditions. The dead organisms impart a bad taste to the water. The remedy is to remove the organic feeding matter by filtration and the iron by aeration. If the acid be neutralized, the iron organisms are not able to develop.

In North Germany, at Konigsberg, 90 per cent. of the iron in solution is removed by aeration. The water is delivered in a fine spray over coke filters, and ferric oxide is deposited in the coke.

The organism causing the black slime has been specially examined by Migula, of Carlsruhe, and has been given the name of Chlamydothrix. He says that the germs come with the water, and attach themselves to the inner surface of the mains. From minute specks of jelly the organisms develop into threads, while iron oxide is deposited by the organisms in the process of growth.

Professor James Campbell Brown says that waters which deposit black slime invariably contain an appreciable quantity of iron in solution in combination with organic matter of an acid character. He thinks that the slime organisms live on the carbon compounds which are found in a soluble organic compound of iron, and iron oxide is deposited throughout their growth.

The flocculent matter which is thus deposited by such iron organisms must not be confused with the corrosion of the mains caused by chemical action and subsequent deposit of the iron dissolved from the mains.

COST OF CONCRETE ROAD.

IN the following itemized table the compiler, Mr. B. P. Lampert, county engineer, Emery, Ia., gives the cost of building a concrete road at Fort Dodge, Ia. Points to be taken into consideration when studying the data are: (1) Average haul, 2½ miles; (2) sand not screened and not charged; (3) engineer's time included, also 1/5 cost of plant used.

Total amount laid, 9,472 square yards. Approximately 3,100 cubic yards of grading (cut and fill).

Labor on Concrete.

Based on average organization and average rate of 500 square yards daily.

No. of men.	Job.	Cost per day.	Cost per sq. yd.
2	Finishing and removing forms	$ 8.00	$0.0160
2	Striking off concrete	5.50	0.0110
1	Fireman on mixer	3.50	0.0070
1	Engineer on mixer	4.00	0.0080
2	Side forms and joints	6.00	0.0120
1	Cement	3.00	0.0060
2	Wheeling and shoveling sand	5.50	0.0110
3	Wheeling stone	8.25	0.0165
6	Shoveling stone	10.50	0.0330
1	Extra, fixing subgrade	2.75	0.0055
1	Water boy	1.00	0.0020
1	Hose boy	1.00	0.0020
23		$65.00	$0.1300

*Not included in calculating cost.

Material and Handling Same.

Job.		Total cost.	Cost per cu. yd.	Cost per sq. yd.
Grading: wheel scraper and wagon work	$ 497.25			
Loading wagons	60.00			
		$ 557.25	....	$0.0588
Surfacing	.....	307.50	....	0.0325
Baker joints and felt	.....	536.40	....	0.0566
Sand, 874 cu. yds. taken from pit:				
Stripping pit	60.00*	.....	....	.....
Loading	129.50	.....	....	.....
Hauling	243.00			
		372.50	$0.426	.0393
Crushed stone, 560.74 cu. yds.	560.74	.....	....	.....
Freight	285.09	.....	....	.....
Loading	141.45	.....	....	.....
Hauling	341.00			
		1,328.28	2.37	.1405
Gravel, 885 cu. yds.	595.04	.....	....	.....
Freight	403.02	.....	....	.....
Loading	123.50	.....	....	.....
Hauling	493.00			
		1,614.56	1.89	.1705
Cement, 2,413 bbls. at $1.56 on cars	3,764.28	.....	....	.....
Hauling	217.17	3,981.45	....	.4203
Total	.....	$8,697.94	....	$0.9183

General Charges.

Freight on mixer, both ways	$184.94		
Engineer	49.70		
		$ 234.64	$ .0247
Miscellaneous teaming		71.43	.0075
Oil, coal, gas, repairs		60.55	.0064
Misc. labor, unloading mixer, laying pipe, building culvert, lost time, etc.		176.69	.0187
Engineering and foreman		125.00	.0132
One-fifth of cost of plant		105.00	.0111
		773.31	.0816
Totals, all expenses		$10,750.72	$1.13

A steel dipper dredge of 5 yards' capacity is being completed by the M. Beatty and Sons, Limited, Welland, for the C. S. Boone Dredging and Construction Company, of Toronto, for use in harbor improvement work. The dredge has a hull of 100 feet in length with 40-foot beam, and 10 feet in depth. It is similar to those now being used by the Canadian Dredging Company, Midland; the Dominion Dredging Company, Quebec, and others. It has been used on a wide variety of work, and has established good records for capacity, and low cost of maintenance.

SEMI-STEEL CASTINGS.

In a paper read recently, by Mr. R. H. Probert, to the Ohio Society of Engineers it was stated that one of the principal points in making semi-steel is to have the metal hot. To get the best results and to insure a thorough mixing of the iron and steel when tapping, the metal is run into the tapping ladle, which is tilted enough to run the metal into a shank or bull ladle. The latter also is tilted to allow pouring the metal into the hand or crane ladles. When melting for castings weighing from 2,000 to 8,000 lbs. each, the crane ladle is of sufficient capacity to hold the entire amount of metal required, and into this ladle is placed 5 lbs. of 80 per cent. ferro-manganese to each ton of iron. This method of tapping permits the steel and iron to mix thoroughly in the ladles before pouring the metal into the molds.

In mixing metal for high-grade castings that are required to stand up under high pressure and high speeds, the pig iron is charged on the bed and the steel scrap on top of this charge of pig iron. Charges amounting to 2,500 lbs. each in a 40-in. cupola are as follows:

Coke	1,000 lbs.
Pig iron	1,000 "
Gray iron scrap	500 "
Steel scrap	500 "
Pig iron	500 "
Coke	250 "

The coke bed must be large enough so that the first iron will come hot. Having tapped the metal white hot, it must be poured into the molds as nearly as possible at that heat. The hotter the iron the greater should be the care taken in venting the molds, as the more resistance and refractory the mold, the more care and skill is required in feeding the hot metal into the mold.

The steel used is boiler-plate scrap from ¼ to 7/16 in. thick, either square or rectangular pieces, from 6 to 18 in. long. The steel scrap is not charged directly on top of the coke bed, but, as previously stated, about 150 lbs. of coke are charged on top of steel scrap before charging the next layer of pig iron.

Careful attention is given to the charging of the cupola throughout the various heats including the firing of the coke bed before the first charge of pig iron is placed in the cupola. By doing so, dull metal is avoided during the whole of the heats for the day's melt.

The range of analysis of the boiler-plate scrap, which consists of shell, firebox and flange steel, is as follows:

	Per cent.	
Sulphur	0.022	0.038
Phosphorus	0.015	0.020
Carbon	0.12	0.18
Manganese	0.34	0.45

In 25 minutes after the blast is turned on the metal is ready to be tapped and drawn off.

Recently several semi-steel flywheels about 9 ft. 6 in. in diameter, each weighing 7,500 lbs., were successfully cast without difficulty or loss. They were for special service, to run at a peripheral speed of 12,000 ft. per min. The castings proved to be clean, solid, without flaws, the metal was tough, but not hard, and the turnings curled from the tool like pine shavings. The steel scrap amounted to 25 per cent. of the charge. The transverse tests on a ¾-in. square bar with 12-in. supports averaged 1,625 lbs.

The analysis averaged:

	Per cent.
Silicon	1.41
Manganese	0.36
Phosphorus	0.462
Sulphur	0.122
Combined carbon	0.95
Graphitic carbon	2.46

The analysis of the pig iron charged with the gray iron and steel scrap averaged:

	Per cent.
Silicon	1.65 to 2.75
Sulphur	0.035 to 0.054
Phosphorus	0.322 to 0.754
Manganese	0.55 to 0.85

Small and medium-sized castings that are cored and of peculiar shape, weighing from 400 to 500 lbs. each, that are required to stand up under constant high duty, are made as previously stated, showing the same analysis in the pig iron and in the finished castings.

Gas-engine cylinders each weighing about 1,650 lbs. for 50-h.p. engines, were successfully made from semi-steel. The metals charged were No. 2 foundry pig iron, gray iron scrap and the steel scrap amounted to 30 per cent. of the charge. The transverse tests on ¾-in. square bars, with points of support 12 in. apart, averaged 1,755 lbs. The deflection amounted to 0.22 in. The cylinders were solid, clean and tough. They were easily machined and the bore showed excellent, smooth finish. The fractures on the test bars were fine and close grained and took a very fine finish when machined, draw-filed and polished.

The cylinders were poured on end, the molds were skin-dried and were provided with ample pouring basins, down gates or leaders and large risers. The shrinkage was about 3/32 in. to the foot, but on castings poured in a horizontal position the shrinkage is about 7/64 in. per foot.

In making the molds the best results are obtained by working the sand as dry as possible, not sponging the patterns around their ends and sides, as the water will dampen the edges of the molds and will result in making the castings hard on their outside edges—too hard to machine profitably.

Provide the molds with a pouring basin and well, and do not depend on one large down gate or leader. When making medium and small work, use a strainer gate, which is a pouring basin on the top surface of the cope, with sufficient down runners of small diameter to a gate below in the surface of the drag. These runners will prevent the lighter metal and other impurities from running down into the body of the mold, resulting in clean, solid castings. Large molds should be skin-dried, and all molds for semi-steel castings provided with ample pouring basins, down runners, gates, risers, etc.

The flasks should be strongly made, as the mold strain is entirely within itself and on heavy castings the flasks must be well braced and banded around cope and drag to counteract the great strains on the mold.

Semi-steel can be used in such castings as cylinders, pistons and plungers for steam, gas, ammonia and hydraulic work, engine and machine beds, flange couplings, bearing boxes, large flanges, brackets, pedestals, pinions and gear segments, forming dies for sheet metal, electric motor castings, etc.

It takes no more coke or labor to melt semi-steel than it does to melt gray iron—1 lb. coke to 7 and 7½ lbs. of iron.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MINING, MUNICIPAL, HYDRAULIC, HIGHWAY AND CONSULTING ENGINEERS, SURVEYORS, WATERWORKS SUPERINTENDENTS AND ENGINEERING-CONTRACTORS.

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CONTENTS OF THIS ISSUE.

Editorial:	PAGE
Pollution of International Waterways	903
Corrosion of Water Pipes	904
Leading Articles:	
Bridge Construction at Newcastle, N.B.	887
Effect of Heat Treatment on the Strength of Steels	890
Elevators: Their Uses and Abuses	890
Saskatoon's Water and Distribution System	895
Protracting Railway Traverses by the Method of Co-ordinates	896
Canada's Projects for Waterway Improvement	899
The Corrosion of Water Mains	899
Cost of Concrete Road	901
Semi-steel Castings	902
Letters to the Editor	904
Convention of the American Road Builders' Association	907
Concrete Road Construction	908
Engineers' Library	911
Coast to Coast	916
Personals	917
Coming Meetings	917
Railway Orders	918
Construction News	76
Technical and Municipal Societies	94

THE POLLUTION OF INTERNATIONAL WATERWAYS.

When the International Joint Commission meets next month it is quite likely that it will draft recommendations to the Canadian and United States Governments that will accentuate considerably the attitude of both countries with respect to the water pollution along about 2,000 miles of boundary line. Both countries have numerous cities that are deeply concerned in the investigation, and whether or not this winter will see legislation enacted to curtail the use of lakes and especially of rivers as general receptacles for all manner of refuse and waste, the report, in itself, will fill a most important mission, by revealing the present dangers that beset these riparian communities. The report will cover five waterways, viz., Niagara River; Detroit River and connecting waterways from Lake Huron to Lake Erie; St. Mary's River; St. Lawrence River from Lake Ontario to a point where it departs from the boundary; and a portion of the St. John River.

The Niagara River situation is the most acute. All the sewage from Buffalo, Tonawanda, North Tonawanda and Niagara Falls, N.Y., is discharged in raw state directly into the river, and the sewage of Lackawanna is discharged untreated into Smoke's Creek, whose outlet is 1½ miles above the head of the river. The population of the territory thus draining directly into the Niagara River from the New York State side, and above the Falls, is estimated at 615,000. All of these cities, together with numerous villages near the river bank, and the city of Lockport, with a population of about 20,000, take their water supplies directly from the river.

The Detroit River, and its connecting waterways, furnish a problem possibly greater than the Niagara conditions. The other points of investigation are likewise important to the people of both countries.

The International Joint Commission was assigned its task on August 1st, 1912, by the two Governments. The questions referred to it are as follows:—

1. To what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to the public health and unfit for domestic or other uses?

2. In what way or manner, whether by the construction and operation of suitable drainage canals or plants at convenient points or otherwise, is it possible and advisable to remedy or prevent the pollution of these waters, and by what means or arrangement can the proper construction or operation of remedial or preventive works, or a system or method of rendering these waters sanitary and suitable for domestic and other uses, be best secured and maintained in order to insure the adequate protection and development of all interests involved on both sides of the boundary, and to fulfil the obligations undertaken in Article IV. of the waterways treaty of January 11, 1909, between the United States and Great Britain, in which it is agreed that the waters therein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other?

The questions were considered at the October 1912, meeting of the Commission at Ottawa, and upon later advice as to the scope of the investigation, various meetings were held during the winter for the working out of all details. It was decided that the investigation should include a bacteriological examination of samples

of water taken, including the bacteria count and the qualitative and quantitative estimation of B. Coli, according to standard methods, and such chemical examination as might be deemed necessary. Dr. Allan J. McLaughlin, of the U.S. Public Health Service; Dr. J. W. S. McCullough, chief health officer of Ontario, and Dr. John Amyot, professor of hygiene, University of Toronto, have been actively engaged in these bacteriological examinations during the past summer and have very recently submitted their report.

Mr. Frank S. Streeter, representing the United States, and Mr. Henry A. Powell, representing Canada, constituted a committee which, pending the above report, looked after the gathering of such testimony from parties interested as might seem desirable in forwarding the investigation.

The Commission's findings will, as stated, be published shortly. It is generally understood that while they are not alarming they will disclose conditions that will necessarily be remedied to conform to the health conditions stipulated in Article IV., above referred to, of the waterways treaty.

THE CORROSION OF WATER MAINS.

The subject of pipe corrosion is one which necessarily interests engineers and manufacturers in their efforts to obtain durability and long life in water mains. The paper by Mr. Hale, read before the American Public Health Association, and published in December 4th issue of *The Canadian Engineer*, and the article by Mr. William Ransom appearing in this issue, contain a great deal of valuable information concerning corrosion from various causes.

There is no difficulty in realizing the need for sound investigation and conference on the subject, as every waterworks engineer is naturally desirous to use materials that will be durable, and that will not impart any impurity to the water, nor furnish it with any deleterious property in its course of distribution.

Mr. Ransom refers to a particular instance where a new water main had been laid down and which, after a brief duration of service, became so pitted with rust that it was found necessary to remove a portion of the distributing system and replace it, the damage being caused by the presence of free sulphuric acid in the soil, due to the oxidation of iron pyrites. He also calls attention to the fact that corrosion by electrolytic action is often much more serious than is commonly thought to be the case.

Mr. Hale refers to numerous sources of corrosion to be found in both raw and treated waters, the action being more pronounced when the metal is clean and free from incrustation, which forms a protective coating, depending upon the nature of the water, delaying the corrosion and reducing the resulting percentage of iron in the distribution service.

A third writer on the subject, Mr. E. K. Rideal, in a paper to the Society of Engineers (England) strongly supports the electrolytic theory of corrosion. He expresses his belief that the theory is perfectly tenable when due attention is paid to considerations such as alterations in the solution pressures on crystal surfaces, and the phenomenon of passivity shown by iron.

According to Mr. Rideal, corrosion is due either to internally generated electric currents or to those from external sources. The theory is applicable to the problems of rusting in reinforced concrete, water-pipes and structural iron-work, as well as to the action of stray currents from street railway circuits, damp electric-light leads and telephone cables. In the light of that theory both the plating of iron with metals, or covering the surfaces with paints and varnishes, are to be regarded as means to an end, namely, to prevent the formation of local "corrosion cells." The effect of pitting in steel pipes is to be attributed to inclusions of slag and oxides of iron. Metallic coatings must be perfectly uniform in character, otherwise rusting may be augmented instead of retarded by such processes, while paints should be applied to clean surfaces and should possess certain definite characteristics, such as high specific electrical resistance, a pigmentary vehicle that does not readily liberate water during the process of aerial autoxidation and is not permeable to water vapor when thus oxidized, and pigmentary particles not widely separated from iron in their electrochemical potential.

LETTERS TO THE EDITOR.

Re "Stresses in Circular Pipes."

Sir,—With reference to Mr. Hogg's article on "Stresses in Circular Pipes," which appeared in your issue of November 13th, while I cannot offer any detailed discussion upon it, one or two points may be noted. Mr. Hogg has applied the ordinary formulæ for the arch rib to determine the bending moments in a thin circular pipe due to the hydrostatic pressures exerted by the water, which it contains when just full, and supported on a horizontal knife edge below the pipe. The effect of putting the water under pressure, as in the case of a conduit conveying water to a turbine seems to have been considered only as producing a circumferential tension in the ring. The influence of this tension in determining the changes in the vertical and horizontal diameters of the ring does not appear to be touched upon, and while Mr. Hogg may have satisfied himself that an effect of this nature is insignificant as compared with the deformations which he has calculated, it does not appear in the analysis. If the pressure is very great in the pipe, then the deformations due to the weight of water in the pipe are, as Mr. Hogg says, insignificant; while if the pipe merely contains water which is not under pressure, those deformations are the only ones to be considered. Not having investigated such effects numerically, as Mr. Hogg has probably done, I cannot venture a suggestion as to their relative importance in determining Δx and Δy, and it would be interesting to have the deformations worked out for a pipe, say 6 or 8 ft. in diameter, under different heads of up to, say, 200 feet. If Mr. Hogg has such data perhaps he will publish it.

There are some misprints to be noted. On page 696 in the first equation for MD the integral should not contain the term (1–Cos ϕ). The subsequent expression found by substitution for Sin $\phi\ dp$ is, however, correct. On page 689, the expression for dp in the right hand column evaluates to $\frac{-r\,(\frac{1}{2}+k)}{H+(1+k)\frac{r}{r}}$, and not as stated. On page 697 in Fig. 3 there are too many x's and the text is not readily connected with the figure. I have not checked the analysis in detail, but as it follows along conventional lines

there is little likelihood of error arising. The chief interest of the investigation, to my opinion, would be in the presentation of comparative figures along the lines which I have suggested, but I do not think there is a great field for discussion.

Engineers are well aware of the existence of pressures due to earth loads, of the differences between a supporting saddle and a theoretical knife edge below the pipe, and of the necessity of modifying theoretical deductions based on assumptions which are necessarily so much at variance with the actual conditions. But such modifications are matters of judgment or even arbitrary opinion, rather than the result of any clear line of reasoning. For such reasons I regard the earlier part of Mr. Hogg's article as possessing interest which would be increased considerably if some actual examples were given to illustrate the points which I have noted.

E. BROWN,
Professor of Applied Mechanics and Hydraulics.
McGill University, Montreal, December 1st, 1913.

Sir,—While the discussion of "Stresses in Circular Pipes" by Mr. T. H. Hogg, in your issue of November 13th, forms a valuable contribution to the literature of the subject, there are still many important problems connected with this and allied fields to which the attention of skilled investigators might be directed with profit.

In the case of the particular type of structure considered by Mr. Hogg, namely, the large conduit subjected to low internal water pressure, it would be of interest to know at what head the consideration of bending moment in the shell becomes necessary for pipes of various diameters. Some valuable work might also be done in investigating the effect of the relatively shallow earth fill existing along such pipe lines on the total stresses in the pipe. The large variation between the lateral pressure at the crown of the pipe and at its base and the uplifting effect of the earth pressure on the the lower half of the pipe place the problem outside the case considered by Professor Talbot and quoted by Mr. Hogg—that of a uniformly distributed lateral pressure acting on the vertical diameter of the pipe. In this connection it is interesting to note that since each half of the pipe lying on one side of the vertical diameter is in effect an arch, the imposition of a load of the character of the earth pressure would require, for coincidence of the curve of the shell with the line of pressures, a pipe cross-section of flattened oblate form similar to that found desirable for the resistance of low internal water pressure. Another consideration of importance to the constructor of such pipes is the proper width of the saddle or bed of concrete upon which the conduit is to rest. In the recent discussion of the "Theory of Loads on Pipes in Ditches," by A Marston and A. O. Anderson, (Bulletin No. 31, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa), it has been shown that a pipe resting upon a shaped earth bed derives practically its entire support from the lowest 90 degrees of the surface. Whether a concrete bed of the same relative width would be suited to large pipes subjected to internal pressure might well be given some thought, and having arrived at the most desirable width of bed, equations for maximum moments corresponding to this condition would be found of especial value to the designer.

A promising field of enquiry related very closely to the one in which Mr. Hogg has done useful work, is that of the design of pipe culverts subjected to the pressure of earth embankments. Research pertaining to this problem does not concern the calculation of the stresses in the shell so much as the fixing of the loads applied to it. At the present time great divergence of opinion exists as to the amount of earth filling which a culvert should be figured to carry. Some engineers assume that the entire weight of earth above the structure is supported by it while others consider less than half that amount as sufficient. The effect upon the culvert of live-loads moving along the embankment is a source of probably greater disagreement. Assuredly valuable work might be done in reducing these uncertainties of loading, for, by so doing it would be possible to design culverts by a little more rational process than mere guesswork.

It is to be hoped that Mr. Hogg and other investigators of the problems relating to stresses in pipes, sewers, tubes, culverts and tunnel linings will carry their researches still further. Certainly there is no more promising field for practical mathematical research.

C. R. YOUNG.
University of Toronto, December 18th, 1913.

Sir,—Professor Brown, in his discussion of the article on "Stresses in Circular Pipes," states that the effect of putting the water under pressure seems to have been considered in the analysis, only as producing a circumferential tension in the ring, and that the influence of this tension in determining the changes in the vertical and horizontal diameters of the ring does not appear to be dealt with. The writer must apologize for having given in the discussion only the analysis of the particular case when the conduit is filled with water to the crown. The general case for water to any head above the top of the pipe has been analyzed, but the integrations are much more laborious and long drawn out. The results are exactly the same, however, as the results obtained for the particular case and given in the paper, with the exception of the amount of the tension, which of course varies with the head; the additional amount being represented by Hyr, I infer from Professor Brown's letter that he believes the deformations may be affected by the water pressures when the head is above the crown of the pipe. This is not the case, as noted on page 698 of the article, and as proved by the analysis of the general case.

It is true that, as the head increases the tension in the shell will increase, and this in turn will cause an increase in the length of the circumference. Within the elastic limit, however, this movement will be comparatively small. In any case, the values given in the article for the deformations are for the deformations due to the eccentric loading. If a person were interested in obtaining the exact amount of the shortening and lengthening of the diameter, the increase due to the stretching of the shell would have to be added or subtracted from these deformations. These figures, however, are of no practical use, since within the limits of allowable stress of the material, the stretching of the shell is exceedingly small. They might perhaps be of service in the use of concrete or concrete lined steel pipes in determining whether a coating of plaster would crack.

The writer desires to point out that the conditions of loading in a horizontal circular pipe under water pressure is very similar to the case of an eccentrically loaded column. In the case of a column, it is the eccentric load

which causes deformation in the sense of a departure from the vertical axis. The axial load on a column has no effect on the deformation in this sense, but simply shortens the column by compressing the material.

The writer regrets that the analysis of the general case of water pressure above the top of the pipe cannot be given here; space will not permit.

The misprints noted by Professor Brown are errors which have slipped in, in the hurry of preparation. Also Fig. 3 was traced by an assistant and the x's have been misplaced. A little thought, however, will clear this up when following the analysis.

The writer would like to draw attention to a fact which has been overlooked in a number of the other discussions presented, the formulæ derived, allow of the ready fixing of the stresses in such conduits, even although it may not seem desirable for construction reasons to use the hydrostatic chord in preference to the circular shape. As noted in the article, these stresses have previously been overlooked.

In answer to Mr. Young, in the writer's opinion the correct formulæ as obtained in the discussion should always be used in computing the stresses of this particular type of structure. There is little difficulty in the use of the equations for practical design and it will always be safer to compute the bending moment due to the water pressure, and include sufficient material to care for these additional stresses. As regards the point at which it becomes desirable to use the hydrostatic chord in place of the circular shape the cost of materials and local conditions will have a large bearing. It is unlikely, however, that there would be any economy in the use of the hydrostatic chord, for pipes less than 8 feet in diameter under a head of more than 50 feet. Under such conditions it would be more economical to use the circular shape, as the saving in material in the use of the chord would be more than counterbalanced by the constructional difficulties introduced by the irregularity of the shape.

It is quite true, as pointed out by Mr. Young, that the oblate form is desirable from the point of view of earth pressure. This is easily seen if we assume fluid pressure outside; in which case we get the hydrostatic arch as the most desirable form to resist the pressure.

T. H. HOGG.

Toronto, Dec. 20th, 1913.

Re "Flat Slabs."

Sir,—Mr. Elmont states that the matter regarding moments is a question of test loading. The writer will submit that Dr. Eddy pointed out that his (Mr. Elmont's) mathematics did not apply to the flat slab as built by Turner, because his theory assumed a uniform distribution of reinforcement; and, accordingly, the mathematics which he has merely copied from Grashof, does not apply to this particular construction. It is difficult, indeed, to discuss the subject of mechanics with one who, while familiar with Clapeyron's theorem, assumes that it is inapplicable to the flat plate.

Mr. Elmont's attention has been called to the fact that, under bending, energy is stored radially and circumferentially. Ordinary familiarity with the construction would impress anyone with the fact that circumferential deformation does not affect the vertical geometry of the slab; whereas, the radial deformations alone determine deflection. Hence, there is less deflection with the storage of energy partly in a circumferential direction, than where it is stored in a radial direction; and this effect on the total work of deformation is most marked, and effects the magnitude of the moments to be resisted.

This subject will be discussed very fully and completely in a long paper, about completed, for discussion in one of the large engineering societies; and it will be sufficient for the present, to state that this theory of work, properly developed, is the simplest solution of all the problems the writer has met in reinforced concrete construction; and it shows the absurd degree of error which those engineers have fallen into, who assume that the old reliable law of conservation of energy does not apply, and that corollaries derived therefrom do not apply to such a device as a reinforced concrete floor slab.

C. A. P. TURNER.

Minneapolis, Minn., December 2nd, 1913.

Sir,—The writer desires to reply that he neither stated that "the matter regarding moments is a question of test loading" nor that Clapeyron's theorem could not be applied to flat slabs.

As regards Grashof's theory on flat plates and slabs, which Mr. Turner now deems inapplicable to the Eddy-Turner flat slab design, the writer would say that he fails to see that their design is so defective that it is not even governed by that theory, which is simply built up from the fundamental equations of external stress and strain, as Dr. Eddy also has expressed it in his and Mr. Turner's joint opus entitled "Flat Plate Theory." It is strange that Mr. Turner has only recently discovered the usefulness of the theory of work, while other structural engineers have employed it for years as the general basis for calculation of statically indeterminate structures. By further study Mr. Turner will find that also Grashof's formulæ can be derived from it.

The conclusion the writer drew from the results arrived at in his paper on "Bending Moments in Flat Slabs" was merely that a certain type of flat slab, which includes Messrs. Eddy-Turner's, could be improved by arranging reinforcement as described in the paper.

V. J. ELMONT.

Montreal, December 9th, 1913.

At the annual meeting of the directors of the American Highway Association, the announcement was made that Atlanta had been selected by the executive committee and that the convention would be held there from October 19th, to October 26th, 1914. The selection of Atlanta was due to the fact that the committee considered the south entitled to the annual congress in 1914 as the east was recognized at the 1912 meeting, the north-west at the 1913 meeting and the far west will receive the 1915 meeting. The unique experiment by Georgia in working the entire state convict force on the roads will afford an interesting study to the delegates, while the stimulation afforded by the great good roads assemblage will probably hasten the establishment of state highway departments throughout the southern states.

The Dominion Iron and Steel Company, of Sydney, N.S., are preparing to install a new furnace in their rolling mill department with a view of developing an output of soft steel in addition to the other products at present manufactured. It was at first intended to establish a number of extra soaking-pits in the blooming mill division, but it was finally decided to adopt the furnace for the soft steel production. New tables are also shortly to be put in the rolling mill to replace those which have been in use for a long period.

CONVENTION OF THE AMERICAN ROAD BUILDERS' ASSOCIATION.

THE tenth annual meeting of the American Road Builders' Association was held in Philadelphia, December 9th to 12th inclusive. It is stated that the attendance exceeded in good measure any of the previous sessions. The registration of members and delegates approximated 1,100.

The convention was officially opened on Tuesday afternoon, December 9th, by Governor Tener, of Pennsylvania, who delivered an address on the good roads movement, in which he passed very commendatory remarks respecting the efforts of the various organizations and the receptive mood of the popular mind in the interests of road improvement.

Col. E. A. Stevens, Commissioner of the Department of Public Roads of New Jersey, read a paper on "Highway Officials, Their Duties and Powers," which dealt with the subject in considerable detail. It was followed by a discussion opened by Mr. A. N. Johnson, State Highway Engineer, Illinois, who explained fully the methods of road administration adopted by his and other States, emphasizing the dependency of success upon the "pay-as-you-go" system. Mr. A. R. Hirst, who occupies a similar position in Wisconsin, described the new road laws and the fundamentals of road making and maintenence with which he had to do. He enumerated the ways in which Wisconsin roads were financed to be as follows:

(1) A municipality, the county and the State may bear equal shares of the expense.

(2) The county may assume two-thirds.

(3) A private citizen may guarantee one-sixth of the total expenditure.

"Division of Expanse, Responsibility and Authority Between Nation, State, County and Town" constituted a paper read by Mr. S. P. Hooker, Superintendent of Highways of New Hampshire, in which were explained the various methods that have been proposed for federal aid toward road construction. In this connection, he emphasized the fact that the question of federal aid should be given very careful consideration, and that any accepted arrangement for the extension of same, should be most wisely handled.

Mr. Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment of New York City, opened the discussion and emphasized Mr. Hooker's cautionary remarks concerning the neglect of careful consideration and planning as evidenced by previous cases where federal aid has been extended. Mr. Harold Parker, ex-chairman Massachusetts Highway Commission, also spoke, urging the appointment of a committee with international scope to investigate the matter, this committee to have three members, an engineer, a lawyer and a business man.

Mr. J. de Pulligny, director of the French Mission of Engineers to the United States, gave a brief description of the methods under which the important public roads of France were constructed, and paralleled with it the lack of organization which is in evidence in America. He remarked that the admixture of engineering ability and financial backing required organization to ensure success in road building. He stated that the French unit of assessment is the square mile, that towns do their own maintenance, and that 90% of the present French system are township roads, upon which is spent 80% of the road funds. The old national roads we hear so much about constitute less than 6% of the present system.

The session on Wednesday morning opened with a paper by E. L. Cranford, road contractor, Brooklyn, N.Y., who dwelt upon the relation of the contractor, the engineer and the inspector to each other. In his address, he showed the frequent lack of harmony, and explained numerous methods of redress, expressing a clear conception of the functions of each official. Prof. A. H. Blanchard, of Columbia University, opened the discussion in a very appreciable manner, corroborating the general opinions expressed by Mr. Cranfield toward methods of making the relation and conditions more harmonious. Mr. H. W. Durham, Chief Engineer of the Bureau of Highways, Borough of Manhattan, N.Y.; Mr. F. E. Ellis, Manager of the Essex Trap Rock and Construction Co., Peabody, Mass.; Mr. Geo. S. Webster, Chief of the Bureau of Surveys, Philadelphia, and others continued the discussion, bringing out numerous suggestions worthy of due consideration for the improvement of conditions by intelligent co-operation.

A paper entitled "The Determination of the Amount of Re-alignment, grading and Drainage to be Done in Connection With Road Work" was read by Mr. S. D. Foster, Chief Engineer of State Highways, Pennsylvania. Among those who presented discussions were J. A. Johnson, Massachusetts Highway Commission; Mr. R. A. Meeker, Department of Public Roads, New Jersey, and Mr. J. H. MacDonald, Highway Commissioner, Connecticut. Another important paper was that by Mr. L. R. Grabill, Suburban Road Superintendent, Washington, D.C., who dwelt upon the factors covering the proper selection of road and street pavements.

Col. W. D. Sohier, Chairman, Massachusetts Highway Commission, in discussing Mr. Grabill's paper, emphasized the need of accurate traffic investigation and careful forecasting in future road improvement. He urged the adoption of an expense unit with traffic as a basis, suggesting the cost of maintenance per ton per mile over a unit width. He stated that the traffic in Massachusetts had doubled in two years' time, and that computation should be made with respect to the maximum traffic which will be encountered during the lifetime of the road.

Mr. W. A. MacLean, of the Ontario Public Roads and Highway Commission, gave a short address, outlining the work which the commission purposes doing in Ontario, and commenting upon the observations which have already been made through investigations. He suggested the method followed in England to secure stability of road foundation should be closely studied, and that roads in this country, after grading, be allowed a period of about three years of traffic in order to obtain natural settlement before road metal and surfacing be applied.

Papers giving details of construction of various types of roads and pavements were read at Thursday's session. Mr. Lynn White, Chief Engineer of the South Park Commissioners, Chicago, read a paper entitled "Bituminous Macadam and Bituminous Concrete." Other papers were "Earth Roads," by E. A. Kingsley, State Highway Engineer of Arkansas; "Sand-Clay Roads," by E. J. Watson, Commissioner, Department of Agriculture, Commerce and Industries, South Carolina; "Gravel Roads," by G. W. Cooley, State Engineer of Minnesota; "Concrete Roads," by E. F. Rogers, State Highway Commissioner of Michigan; "Birch Roads," by J. M. McCleary, Engineer, Cleveland, O.; "Wood and Asphalt Block," by H. H. Schmidt, Chief Engineer of the Bureau of Highways of Brooklyn, N.Y.; "Waterbound Macadam," by J. W. Hunter, Deputy State Highway Commissioner of

Pennsylvania; "Sheet Asphalt," by George H. Norton, Deputy Engineer Commissioner, Buffalo, N.Y.; "Granite Rock," by R. H. Gillespie, Chief Engineer of Highways, Borough of The Bronx, New York City.

Another paper which brought forth much open discussion was read by Mr. H. C. Hill, Meriden, Conn., who spoke concerning unit price and lump sum contracts and percentage work.

Thursday afternoon was taken up by an automobile trip over the different types of recently constructed roads and pavements including the inspection of the Philadelphia Service Test Roadway, which is built of twenty-six separate sections, with each section constructed of a different road material.

Prevost Hubbard, Institute of Industrial Research, Washington, D.C., read a paper on Friday morning entitled "The Testing of Materials for Road and Street Construction." Another important paper was "Sub-Organization for Securing Efficient Maintenance," by Mr. J. M. Carlisle, State Highway Commissioner, New York. These two papers, together with their discussion, constituted the entire session. In the afternoon Mr. A. W. Dean, Chief Engineer, Massachusetts Highway Commission, who spoke on "General Methods of Repairs and Renewals," and Mr. W. H. Connell, Bureau of Highways and Street Cleaning, Philadelphia, on "Bituminous Surface Treatment and Dust Prevention," presented very instructive papers, which called forth a good deal of discussion. These were followed by reports of committees, etc.

A synopsis of each of the papers read will appear in *The Canadian Engineer* at an early date.

CONCRETE ROAD CONSTRUCTION.*

By A. N. Johnson,
State Highway Engineer, Illinois; Springfield, Ill.

OWING to the nature of a concrete pavement there are involved in its construction certain principles quite different from those entering into the design of most other pavements. The fact that a concrete pavement consists of large slabs of rigid material, having a coefficient of expansion due to temperature changes very nearly that of steel, demands provisions for such changes.

As a concrete pavement possesses far less resiliency than most other street pavements, the stresses from traffic loads are greatly increased. This is particularly true of the blows delivered to the surface of the pavement by heavy horse-drawn traffic. Moreover, as all the surface is liable to receive such stresses, it is necessary that every portion of it shall be equally well constructed. It is, therefore, of first importance in the construction of a concrete road to have the greatest possible uniformity in the composition of the concrete. It is not only necessary that each batch of concrete shall have the requisite amount of cement and properly proportioned aggregate, but that every portion of each batch shall be so deposited in the road as to be as nearly uniform as possible.

Again, owing to the brittle character of the concrete, it is evident that depressions in the foundation causing a settlement of the pavement will be manifested by cracks, while such depressions occurring in a pavement of more resilient character, as for instance in most all forms of macadam construction, may not cause any serious break in the surface. Therefore, the utmost care should be taken to provide proper drainage for the foundation soil, perhaps even more care than in many other forms of construction.

Joints.—A concrete pavement is to be regarded as constantly moving. As the temperature increases, the pavement lengthens and with a fall in temperature it shortens. It is evident that provision for these variations must be made in the design of the pavement. Likewise it has also been shown by recent investigation that the absorption of moisture induces an increase in the bulk of the concrete, while the loss of moisture produces a shrinkage from which it will be readily appreciated that climatic changes introduce very complex conditions.

To prevent formation of cracks in a concrete road, in a haphazard way, joints must be arbitrarily placed in the pavement at the time of construction. As every joint in the pavement is a source of weakness, which the traffic will detect and which will afford an opportunity for moisture to penetrate the foundation, it is highly desirable to make as few joints as possible.

If the coefficient of friction of the concrete with the soil is assumed as unity, a slab of concrete 25 ft. long may be pulled over the foundation without exceeding 20 or 25 lb. tensile stress. Therefore, if expansion joints were placed every 50 ft., the centre of the slab, as the slab contracts, would develop a stress in the concrete within allowable limits.

If a crack, due to shrinkage that occurred in the pavement, remained compressive, that is, if it did not subsequently become filled with grit that would prevent the crack from closing as the pavement tended to swell, either from a higher temperature or absorption of moisture, there would be no great necessity for providing beforehand for expansion joints. This is based on the fact that concrete as it sets is observed to shrink an amount about equal to its expansion due to a change in temperature of 70° Fahrenheit, and the small shrinkage cracks which occur offer sufficient room for subsequent expansion of the pavement due to any expected rise of temperature.

But the joints will not remain free of grit, with the result that compressive stresses of over 1,000 lb. per sq. in. may be developed which are sufficient to buckle the comparatively thin slab of a concrete road. It is therefore important that expansion joints be provided and, moreover, that they be constantly maintained so as to be always compressible, which requires that they shall be filled with a plastic material, either a suitable coal tar or asphaltic pitch.

Various devices for the construction of expansion joints have been tried. In some cases ordinary wood paving blocks have been laid, on the theory that the shrinkage of the wood blocks in dry hot weather would provide sufficient room for the expansion of the concrete and that in cold weather, usually wet weather, as the concrete contracts the wood blocks will swell and the joint will remain filled. Steel plates, cut to the shape of the crown of the road, have been manufactured, with which each edge of the joint is lined, the space between the plates being filled with pitch.

It should be observed that there is very likely to be some unevenness at the joints, due either to faulty construction or subsequent wear, so that it is desirable, if traffic is to be inconvenienced the least possible, to place

*Paper presented before the Permanent International Association of Road Congresses, London, 1913.

the joints at other than 90° with the centre line of the pavement. An angle of 60° with the centre line of the road has been successfully used and found to add much to the comfort of traffic.

Materials.—Attention has been called to the fact that every portion of a concrete road should be of a high-grade concrete and also uniform. Many failures of concrete roads, due to raveling under traffic, may be explained by a lean mixture or a lack of uniformity. If a successful concrete pavement is to be laid, a concrete rich in cement must be used. It is evident that the strength of the pavement to resist the action of traffic depends upon the strength of the matrix or mortar in the concrete, assuming a proper aggregate has been employed. Also, if each particle of the aggregate is to be held in place, it is necessary that there shall be a sufficient amount of matrix entirely to surround each piece. To accomplish this purpose, it is first necessary that the mortar be rich in cement and second that the concrete be rich in mortar. probably quite as many failures have been due to a lack of mortar in the concrete as to a lack of cement in the mortar. If every particle of aggregate is to be surrounded by mortar, there must be mortar in excess of the voids in the coarser aggregate. Therefore, if failures have occurred with mixtures providing but 50% of mortar, as would be the case, for example, in a 1:2½:5 or 1:2:4 mixture, no great advantage would be gained by merely increasing the amount of cement and leaving a deficiency of mortar, for example, substituting for the above mixtures a 1:1½:3. A mixture that increases this proportion of mortar should generally be used; a 1:2:3½ mixture may be recommended.

Each batch of concrete must be thoroughly mixed and, as it is deposited in the road, great care should be exercised that the mortar does not flow to the edge of the pile and leave a core of aggregate with insufficient mortar. This is quite likely to happen and must be remedied by workmen who should be provided with rakes or shovels to distribute any such nests of aggregate. A little care and watchfulness will entirely obviate any difficulty from this source.

The nature of the aggregate will determine the wearing qualities of a concrete road. It is therefore important that only hard, sound materials be used for this purpose. In general, limestones and similar soft rocks are not to be recommended, while quartzitic or flint gravels afford widely dispersed sources of excellent materials.

Drainage.—It has been observed on some concrete roads that longitudinal cracks had occurred which are thought to have been due to the seepage of water under the outer edges of the concrete slab, thereby softening the foundation and causing a movement of the concrete slab by frost action. To prevent this, it is recommended that a shallow trench about the width of a shovel be constructed under each edge of the pavement, this trench forming a blind drain to be filled even with the subgrade with some coarse material and that lateral blind drains be placed from 40 to 50 ft. apart across the shoulders of the road, these cross drains extending from the longitudinal drains to the gutters or side ditches thereby preventing any seepage of surface water under the edge of the pavement in the foundation.

Two-Course Construction.—Many concrete pavements have been constructed in two courses, using a leaner mixture for the lower course and a richer mixture for the wearing surface. Evidently, this is an economical arrangement and would be recommended were it not for the unsatisfactory results obtained due to the fact that at the junction of the two classes of concrete there is developed a horizontal plane of weakness which would be caused by even a comparatively short delay in applying the top course. Under exposure to the hot sun, whereby the surface of the pavement becomes of a higher temperature than the lower portion, there is a tendency for the pavement to become slightly convex on the upper or wearing surface. If there is a horizontal plane of weakness near the convex surface, the upper layer of the pavement may become separated from the lower layer. And this has actually occurred. Soon after this takes place, the surface cracks under traffic and rapidly deteriorates. Therefore, unless some method can be found by which the top layer of rich mixture can be deposited simultaneously with the leaner mixture of the lower course, it is recommended that the whole pavement be made of uniform quality throughout equal to that desired for the wearing surface.

Curing the Concrete.—A most important part of the construction of concrete roads, and one that has been very often neglected, is a proper protection for the concrete while setting so that there will be no lack of moisture at this time. As soon as the concrete is a few hours old it should be covered with canvas which is kept moist. This canvas is to be replaced by a layer of earth which should be kept well wet for a period of ten days to two weeks.

Crown.—A concrete road requires perhaps less crown than any other form of paving surface, scarcely more than the eye would demand for appearance sake. One-eighth to one-quarter inch per foot will be found sufficient.

For convenience in construction, the roadbed may be made practically level and, it is evident, should be constructed with considerable care so that it does not become necessary to fill depressions in the roadbed with expensive concrete. The crown may be given by making the roadway slightly thicker at the middle than at the sides.

Thickness.—A thickness of 6 to 8 in. for the concrete seems sufficient for all ordinary conditions. On roads 20 to 24 ft. in width, and average of 7 in. may be used with 8 in. at the centre and 6 in. at the sides.

A form of construction that may prove desirable, where the greatest economy must be exercised, would be to provide a comparatively narrow strip of concrete at the centre with a good macadam construction for the shoulders. This would answer for those roads where the traffic at a given time of day is nearly all in one direction. Under these conditions a strip of concrete 10 to 12 ft. wide at the centre would take practically all the wear while the narrow strip of macadam at either side, 3 or 4 ft. in width, would suffice for the occasional passing of vehicles.

This character of construction is particularly applicable to a vast mileage of highways in America where such an enormous percentage is merely earth roads and where at present the maximum length of roads at the lowest cost possible is of the utmost importance.

Finish.—A concrete road should be left slightly rough as would be effected by a wood float. The templet which is used to give the shape to the surface of the road can be so devised and handled as practically to give the desired finish to the surface with the possible exception of here and there a slight imperfection which should be remedied by men with hand floats working from a lightly constructed bridge thrown across the road. It is highly desirable, however, that as little as possible be left to the

hand finishers as there is inevitably a tendency on their part to work slight depressions in the surface of the concrete which can scarcely be detected until the concrete has set and it is too late to afford a remedy.

Conduct of Construction.—The actual work of construction consists mainly of two parts: First, the preparation of the roadbed and hauling of materials thereon in such quantities as may be needed ready for the mixed. Second, placing the concrete and trimming the road sides.

The mixer used should be of a type especially adapted for this work, one which will move under its own power along the road as the work progresses and provide convenient means for handling the material onto the road.

Attention is called to the fact that the success of the road primarily falls upon the second portion of the work, which, however, involves but 9% of the total cost. It is suggested, therefore, that the public department having in charge a considerable mileage of this construction could well carry it on under two divisions, allowing the first part of the work to be done by contract while the actual placing of the concrete should be done by day labor under the immediate supervision of the officials of the department, in this way securing with the least trouble and expense assurance of proper construction in every particular. The organization for placing the concrete is compact, easily controlled by one man and, moreover, this portion of the work moves along rapidly and uniformly, so that its cost from time to time should vary but little and can be estimated with precision.

Costs.—The difficulty of presenting cost data that would be of any very general application is fully appreciated. The following table is offered together with such general information as to conditions as may prove of some interest if not of actual value.

Estimate of Cost of 1 Square Yard of Concrete Road. 7 Inches Thick.

No profits or overhead charges included.

Labor ..... 25c. per hour
Team and driver ..... 45c. per hour

	—Length of haul—			
	½ mi.	1 mi.	2 mi.	3 mi.
Superintendent, watchman and miscellaneous labor	0.055	0.055	0.055	0.055
Shaping roadbed and trimming shoulders	0.083	0.083	0.083	0.083
Loading and hauling materials.	0.116	0.153	0.218	0.296
Mixing and placing	0.109	0.109	0.109	0.109
Cost of sand and gravel at $1.50 per cu. yd., f.o.b. destination	0.379	0.379	0.379	0.379
Cost of cement at $1.20 bbl....	0.364	0.364	0.364	0.364
Expansion joints spaced 50 ft...	0.025	0.025	0.025	0.025
Coal, oil and miscellaneous supplies for mixer	0.007	0.007	0.007	0.007
Forms and other lumber	0.005	0.005	0.005	0.005
Total	1.143	1.180	1.245	1.323

For a thickness of 6 in. a similar analysis gives total costs per sq. yd. for the various hauls as follows: ½mi., $1.003; 1 mi., $1.035; 2 mi., $1.091; 3 mi., $1.158.

In adopting concrete for a road surface, it should be borne in mind that if a hard rigid form of pavement is undesirable for the traffic to be accommodated, it will not prove satisfactory. For example, with a large amount of light, horse-drawn traffic some more resilient form of pavement would be found better adapted, but where a large amount of motor and heavy horse-drawn traffic is to be provided for, concrete pavements are proving satisfactory. There are experimental data at hand which seem to indicate a concrete pavement to be one of the most durable forms of construction that have been employed, and, under many conditions, the most economical.

The wide distribution of materials suitable for concrete makes this form of construction of the widest application and, in fact, in many areas where there is nothing but gravel deposits, poor for ordinary road purposes, a concrete road becomes the most economical and durable pavement possible. Moreover, it does not require exceptional skill on the part of the workmen, but may be successfully laid, under careful supervision, with any reasonably good labor.

CANADIAN CANAL TRAFFIC IN 1913.

In a report recently issued by the Department of Railways and Canals, Ottawa, it is shown that the total tonnage to pass through Canadian canals for the past navigation season was 51,319,426. Last year with the ending of the navigation season the figures showed that 46,952,605 tons went through Canadian canals, the figures for the 1913 season, therefore, making an increase over last year's figures of 4,366,821 tons.

It will be noticed that there has been a falling off in the tonnage handled by the Ottawa Canal. The decrease for this year over last is 26,912. However, the principal freight to pass through that waterway is sand and building material and therefore the decrease is attributed to the lesser demand by contractors. This is also the case where other waterways show a decrease as their traffic depends upon the demand made for sand and similar material.

The figures also show that the Rideau Canal has accommodated more traffic during the past season than the previous or any other year in its history, the increase this year amounting to 11,090 tons.

The figures for the season ending November 30th, 1913, with the increase or decrease over last year's are as follows:—

Canal.	Traffic, in tons.	Increase or decrease.
Sault Ste. Marie	42,022,609	2,920,815
Welland	3,545,984	726,973
St. Lawrence	4,275,863	823,400
Chambly	555,602	62,813*
Ottawa	365,438	26,912*
Rideau	171,223	11,090
St. Peter's	65,108	1,699*
Murray	180,576	11,605
Trent	55,728	21,384*
St. Andrew's	81,295	14,254*
Total	51,319,426	4,366,821

*Decrease.

"Vol III. of the Annual Tables of Constants and Numerical Data, Chemical, Physical and Technological," published by the International Commission of the Seventh and Eighth International Congresses of Applied Chemistry, is now in press and will be issued early in 1914. A descriptive circular with references to reviews of previous volumes may be secured on application to the University of Chicago Press, the American distributers.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

CONTENTS.

Book Reviews:

Design of Plate Girders 911
Conservation of Water 911
The Railways of Great Britain 911
A Pocketbook of Useful Formulæ 913
The Railway Goods Station 913
Highway Engineering 913

Publications Received 913
Catalogues Received 914

BOOK REVIEWS.

Design of Plate Girders.—By Lewis E. Moore, B.S., C.E. A. M. Am. Soc. C.E., Mem. Western Soc. of Engineers; Associate Professor of Structural Engineering, Massachusetts, Institute of Technology. Published by McGraw-Hill Book Company, Inc., New York. 283 pages; 85 illustrations; 3 folding charts; 42 tables; cloth; size, 6 x 9 inches. Price, $3.00.

This book is the outcome of six years' experience in teaching the subject of Bridge Design and of practical railroad work and designing in a bridge company. The author has also had experience on the Massachusetts Railroad Commission.

His practical experience has led him to thoroughly appreciate the difficulties encountered by young designers, with the result that the work is exceptionally complete and will be found very useful to structural engineers.

The arrangement of the subject matter is logical, and the space devoted to the various parts of the subject bears a better proportion to their relative importance than is to be found in most books of this nature. The explanations of the formulæ used are very full and clear, and numerous examples of the results of faulty design give the reader an appreciation of girder design from a practical viewpoint such as is seldom obtained from a text-book.

A contribution on deflection by Prof. W. H. Lawrence, of the Massachusetts Institute of Technology, will be found at the end of the chapter on the Theory of Plate Girders. There is also incorporated in the book a very useful chapter by John C. Moses, of the Boston Bridge Works, on Shop Practice. In this chapter the reader is introduced to considerations which are of the utmost importance, and which are, in a great many cases, either unknown to the designer or lost sight of in the mass of purely theoretical knowledge which he uses in his design. A design of this kind produces either of two results. Firstly, if the engineering department of the bridge company awarded the contract is abnormally busy or undermanned, the design will be executed, as nearly as possible, in accordance with the plans supplied, and the cost of fabrication will be excessive. Secondly, the bridge company may, as is usually the case, redesign the structure (without weakening it) to conform to economical shop practice. In this event the new design must be checked by the original designer, and the cost of the design is more than it would otherwise have been.

In the last chapter is embodied a set of the general specifications of the New York, New Haven and Hartford Railroad, dated 1912. Most bridge designs in Canada are, however, governed by the specifications of the different railway boards.

The book also contains a useful set of tables.

Conservation of Water.—By Walter McCulloh, C.E. Published by Yale University Press, 135 Elm Street, New Haven, Conn.; 225 Fifth Avenue, New York City. 106 pages; 40 plates; cloth, 7 x 10 inches. Price, $2.00 net, postage 15 cents extra.

This volume constitutes the first of the series of memorial lectures delivered under the Chester S. Lyman Lectureship Fund, before the Senior Class of the Sheffield Scientific School, of Yale University, and is made up of five chapters with the following captions: Introductory, Basic Data Essential to a Comprehensive Study of Water Storage, Water Power, Water Storage for Water Supplies, Sanitation and Irrigation, and the Water Resources of New York State. The lectures cover the field of the use and storage of water in a broad and general manner. The book is not a text-book in any sense of the word, but affords a readable commentary on the salient features of water conservation. It is unfortunate that as no doubt the size of the book has been curtailed by the necessity of covering the work in five lectures, space should be given to descriptions of the power plants at Niagara, since these developments have all been described many times, both in the engineering periodicals and in recent text-books. The volume is very handsomely printed, the numerous illustrations give it a most pleasing appearance; and, altogether, it will form a desirable addition to the library of the hydraulic engineer or the student interested in conservation.

The Railways of Great Britain.—By Lord Monkswell, D.L. Published by Smith, Elder & Company, 15 Waterloo Place, London, S.W. 296 pages; 25 illustrations; cloth. Price, $1.50.

The table of contents, which extends through five chapters, covers almost every item of railway equipment, expenditure, working, financing, traffic, hotels, water communication, labor union problems, and, indeed, all the varied activities and details of management involved in the maintenance and working of a large, modern railway. The main headings include the East Coast, the Railways of Central England, the West Coast and the railways of the South and East. The author, Lord Monkswell, is the third Baron with that title, but the family name is Collier. He is a barrister by profession, who has made railroad operation a study, and has written very fully on "French Railways." His book on British practice, while not being technical in the narrow sense, yet contains a great deal of technical information. It is a general and comprehensive survey of the whole railway situation as it exists in the British Isles at the present time.

The author deals very frankly with the matter of railway competition. In many cases, he shows that where there is an assurance of very considerable traffic between two points, served by two or more lines, it is almost impossible to bring about any competition in the ordinary sense of the term The tendeny is to enter into an agreement whereby each line binds itself not to give more than such and such facilities to the public. In cases of this kind, the only remedy for the public lies in the Government imposing definite conditions in the interest of the people. Even then, tacit understandings are reached between the companies, and these understandings not only tend to suppress competition still further, but actually hinder the introduction of improvements. Notwithstanding all this, it is true that the railways of Great Britain are ahead of their continental rivals in the matter of public conveniences.

Pursuing this matter, under a different heading, Lord Monkswell says that if there are two things, above all others, which the public would thoroughly appreciate, they are decreased third class fares and increased speed. In 1888, when the race from London to Edinburgh took place, and in 1895, when the race to Aberdeen was on, some very remarkable locomotive performances were shown. The Caledonian Railway, working the passenger traffic from Carlisle to Edinburgh, were able to haul a train, on time all the way, with perfect ease. This was done with a "single" driver engine weighing 42 tons, of which 17 tons were on the driving wheels, and these had a diameter of 84 inches. The grate area was only 17 square feet, or about the size of an ordinary dining-room table. The engine, No. 123, was timed to run 100¾ miles in 112 minutes and surmount the "Beattock bank," a grade of 1 in 80 for ten miles and 1 in 75 for six miles. The daily performance of this engine, well within the booked time, produced a profound impression at that period, and all the more so, when it was apparent that her uphill work was better than her downhill performance. The designs of engines used on the Caledonian proved what can be done in the way of speed, but the timing of trains at the present day has not been kept up to the high level of promise inaugurated in the West Coast race to Scotland. At that time, however, the entire railways of Great Britain felt the impetus, and the speed of trains was accelerated all over the Kingdom, until, as our author shows, the paralyzing effect of "agreements" deadened and restricted the otherwise natural growth of improvement.

It has been held that high speed on long non-stop runs is expensive, and with this subject Lord Monkswell deals very fully. The average British railway manager believes that high speed is a good thing, but believes also that it is costly, and does not pay. How far the danger of misplaced switches or misread signals, enters into this view, Lord Monkswell does not say. The author, however, believes that accelerated service can be made to pay. High speeds cost more than slow speeds, but the corresponding advantages gained by selling the better article, i.e., rapid transportation, might easily put the balance on the right side of the ledger. As a concrete example he takes the 6.05 a.m. ex-Euston for Manchester, and shows in detail what effect altering its time of arrival from 9.35 to 9.05 a.m. would mean and what the cost of gaining this 30 minutes would be. Step by step he proceeds, and takes the difference in cost, if more powerful engines replaced those now in use, with increased outlay for up-keep, more fuel, more supplies, and even higher wages for driver and fireman. All the many etceteras are taken note of, and set down as money items required in gaining the half hour, daily on this train. On the assumption that the engines ran 40,000 miles between "shoppings," the increased cost would be 2½d. a mile. Adding to this, the extra expense in road maintenance, and that due to increased wear and tear of train, he says that even taking the most unfavorable view possible, that 5½d. a mile would be the limit of extra expense, and that the average, when other trains are considered, would probably be considerably less. In face of this, if the increased speed attracted six more third class passengers to travel, the railway would actually be making a profit.

Lord Monkswell does not leave the matter here, but offers several very pertinent suggestions as to how time could be saved on the run from London to Edinburgh. He does not merely say it can be done, but shows how. He cites instances of locomotive performance on the Nord, in France. He gives his own country credit for pre-eminence in long non-stop runs, and shows the saving that has been effected by the use of the Ramsbottom "pick-up" water-troughs. He advocates a serious trial of increased speed as a revenue producer.

In the matter of railway carriage design, the old stage-coach, modified to suit railway service, was long the model. The advent of Pullman cars showed what could be done when that model had been entirely abandoned. The Pullman car is not popular in Great Britain, as English travellers prefer the compartment system, and their desires must be met; but certain it is that, unpopular as the Pullman car itself is, yet its advent produced a very marked change in the whole spirit of British railway carriage design. The increased dead weight per passenger, which gradually came as a result of increased comfort for patrons is at the bottom of the heavier engine design, which naturally went hand-in-hand with the desire for comfort and speed.

Railway signals are dealt with when the London and South-Western is under review. The author believes that the British system of signals is the simplest and most complete now employed. He says: "Ordinary visual signals leave little to be desired in broad daylight; they are slightly less perfect at night, when color and not shape has to be depended on." This is, perhaps, a fairly accurate statement of the average man's opinion. We can only say that experts are here and there beginning to modify their views, and feel that "position" for day and "color" at night is not an ideal arrangement. The author may have this in mind, for in a footnote he remarks: "Possibly something may be done by means of flashlight signals to differentiate signals at night." The Great Western, he tells us, has experimented with cab signals, both audible and visual, which give a driver the correct indication of the position of any signal he is approaching. The L. and S.W. are successfully experimenting with a system of wireless train control which involves the automatic stop.

The whole of the goods traffic on all the railways is gone over in detail, and to those who know only our long, unbroken trains of bulk freight, such as ore and coal, the demands of British traffic will be a revelation. The whole of the goods traffic seems to us more like a magnified express business than legitimate freight handling. The small car has its uses over there, and its economies, and the heavy, high capacity box cars used in Canada would well-nigh be useless in Great Britain.

As science advances and inventions multiply the possible rivals of the locomotive are mentioned in this book. Electricity has now an established place of its own, and the tram-car has secured a field for its own activities which is no longer debatable. The possibilities of the turban principle are still remote as applied to the locomotive, while the Diesel engine, using crude oil fuel, may some day be applied to railway work.

The book as a whole contains a mass of most useful information, and, though we have touched on the locomotive side of it for the benefit of interested readers, yet we have

only given a sample of its interest and its scope. The book can be read with profit and pleasure by the financier, the lawyer, the business man and the technical student, and, indeed, by any intelligent man to whom the many phases of the railroad problem appeals. The facts presented are not complicated by tables and masses of statistics, but the whole story is written in easy, flowing, connected style, which gives to the many and diverse topics treated an interest and a value which is unique in semi-technical literature.

A Pocket-Book of Useful Formulæ.—By Sir Guildford L. Molesworth, K.C.I.E., Past-President of the Institution of Civil Engineers, M. I. Mech. E., Fellow of the University of Calcutta; and Henry Bridges Molesworth, M. Inst. C.E. With an Electrical Supplement by Walter H. Molesworth, M. I. E. E., M. I. Mech. E. Published by E. & F. N. Spon, Limited, 57 Haymarket, London, and Spon & Chamberlain, New York. Twenty-seventh edition, revised and enlarged; 800 illustrations; viii. + 938 pages; oblong 32mo.; leather; gilt edges. Price, $2.00.

Molesworth's Pocket-Book of Engineering Formulæ needs no more than a mention to engineers. Fifty years have elapsed since the first edition was published containing 220 pages. In this, the twenty-seventh edition, there are 944. The pocket-book has been thoroughly revised, and contains a valuable addition in an Aviation Section. The Electrical Section has been carefully revised, and its symbols brought in accord with the International Standard Notation. This little volume well deserves its name of "A Pocket-Book of Useful Formulæ and Memoranda for Civil, Mechanical and Electrical Engineers."

The Railway Goods Station.—By Fred. W. West. Published by E. & F. N. Spon, London, and by Spon & Chamberlain, New York. 192 pages; fully illustrated; cloth; 4½ x 7½ inches. Price, $1.50.

This volume, written as a guide to the control and operation of the railway goods station, supplies a good deal of much-needed information, and a number of suggestions on the main principles upon which the regulation and organization of a goods station are based. The author does not attempt to publish an exhaustive treatise on the subject, but the general information concerning the station itself, staff organization, office routine, and discipline, the checking of goods, etc., should be found instructive. Of course, there is the fact that the book deals specifically with English practice, and a good deal of it, therefore, would be found somewhat impracticable by Canadian station men.

Highway Engineering.—By Arthur H. Blanchard, C.E., A.M., Professor of Highway Engineering, Columbia University, New York, and Henry B. Drowne, C.E., Instructor in Highway Engineering, Columbia University, New York. Publishers, John Wiley & Sons, New York. 762 pages; 240 illustrations; 40 tables; 5 plates; cloth; 6 x 9 inches. Price, $4.50.

The subject-matter of this volume, according to the author's preface, is based largely on the courses of instruction given by them at Columbia University and upon their practice as highway engineers. It is designed not only as a text for students, but also as a reference for engineers.

The order of arrangement is good, the treatment of the various phases of the subject is clear and concise, the text is well supplied with tables, diagrams and half-tones, and the volume is a model of the printers' art. Of many of the illustrations it must be said that the authors have given considerable advertising to a number of those who furnished cuts of machinery, a thing which, in a treatise of this nature at least, is open to criticism.

Chapters X. to XV. inclusive are devoted to bituminous materials. The authors deal at some length with the nomenclature, sources of supply, properties, physical and chemical tests, and also, in the light of more recent investigations and practice, with the employment of the material in the various types of construction and maintenance. To this extent a contribution has been made to the literature in highway engineering.

Of the remaining chapters it must be said that the subject-matter has, in most cases, been fully covered by former writers, and that this part of the book is largely a work of compilation. The volume will, however, find a place both with the student and with the engineer.

PUBLICATIONS RECEIVED.

Canadian Society of Civil Engineers.—Bulletin No. 9, dealing with elections, Society affairs, accessions to the Library, etc.

Ohio State Board of Health.—Monthly bulletin for November, containing articles on subjects of interest in the field of public health.

Department of Customs, Canada.—Report for year ending March 31st, 1913, comprising tables of imports, exports and navigation, compiled from official returns, 656 pages.

The Red Iron Ores of East Tennessee.—Bulletin No. 10, of the State Geological Survey. Compiled by E. F. Burchard, geologist. A book of 170 pages, well illustrated by figures and maps and carefully indexed.

Production of Copper, Gold, Lead, Nickel, Silver, Zinc and other Metals in Canada during 1912.—A report of 86 pages by C. T. Cartwright, B.S., Assistant Mining Engineer, Mines Branch, Department of Mines.

Central Railway and Engineering Club of Canada.—Official report of the October, 1913, meeting. The 48-page pamphlet contains an historical paper on Compressed Air by P. McCabe, Toronto Railway Company.

Coal-Mine Accidents.—Bulletin 69 of the United States Bureau of Mines, compiled by Fred. W. Horton, dealing with accidents in the United States and in foreign countries; and making comparisons. A booklet of 100 pages, well tabled and illustrated.

Board of Highway Commissioners, Saskatchewan.—Annual report for year ending with Feb., 1913, containing reports of Bridge, Highways, and Accountants' branches; regulations of municipal highways, and Public Highways Act; 56 pages, well illustrated.

American Society of Testing Materials.—Proceedings of the 16th annual meeting, held at Atlantic City, N.J., June, 1913, containing committee reports, papers and discussions of the Convention. A volume of 1,140 pages, illustrated and supplemented by numerous plates.

Industrial Research in America, dealing with the orderly and sustained progress that has been made in scientific achievement. A 24-page booklet, comprising the presidential address of Arthur D. Little before the American Chemical Society at Rochester, N.Y., Sept. 9th, 1913.

Phase Compensation, with Special Reference to Single-Phase Motors.—By V. A. Fynn, Consulting Engineer, Wagner Electric Manufacturing Company, St. Louis, Mo., being an amplification of articles published severally in the "Electrical World" during July, 1913; 51 pages, 43 figures.

Canadian Railway Club.—Official proceedings of November, 1913, meeting. It includes a paper and discussion

on "The Conservation of Natural Resources through the Electrification of Railways," by G. P. Cole, M.Sc., Mem. A.I.E.E., Canadian General Electric Company, Toronto.

Safety in Tunneling.—An 18-page pamphlet, written by D. W. Brunton and J. A. Davis for the United States Bureau of Mines, comprising instructions to the superintendent, the foreman, and the miner, and containing a list of publications by the Bureau on mine accidents and methods of mining.

Possible Causes of the Decline of Oil Wells, containing suggested methods of prolonging yield. Issued by the United States Bureau of Mines, Department of the Interior, as Technical Paper No. 51. Prepared by L. G. Huntley. Comprises 32 pages, and contains a list of publications on petroleum technology.

Laws Relating to Liability of Employers.—Second interim and final reports by the Hon. Sir William Meredith, C.J.O., Commissioner. A 58-page publication, including the draft of an act to provide for compensation to workmen for injuries sustained and industrial diseases contracted in the course of their employment.

Portions of the Atlin Mining District, B.C.—Memoir No. 37, Geological Survey Branch, Department of Mines, Canada. Compiled by D. D. Cairnes. This book deals with the general character and geology of the district, and directs special reference to lode mining. It has 128 pages, with numerous photographic reproductions and maps.

Production of Iron and Steel in Canada during 1912.—Compiled by John McLeish, B.A., Chief of the Division of Mineral Resources and Statistics, Mines Branch, Department of Mines, Canada. This 40-page bulletin deals with iron ore, pig iron, ferro-products, steel, bounties, exports and imports of iron and steel goods for the year.

Geology of the North American Cordillera.—Report of the Chief Astronomer, Department of the Interior. A detailed report on the geology of the mountains crossed by the international boundary at the 49th parallel. This publication constitutes Volume III., and comprises 10 chapters in 300 pages, fully illustrated with plates and figures.

Relation of Manufacturer to the Patent System.—An extensive article by W. M. Grosvenor, dealing with the close inter-relation between patents and the development of modern industry, and maintaining that the subject does not receive sufficient consideration on the part of economists in the United States, advising, in conclusion, the appointment of a Patent Commission.

Psychological Aspects of the Problem of Atmospheric Smoke Pollution.—By J. E. Wallace Wallin, Ph.D., of the Mellon Institute of Industrial Research and School of Specific Industries, University of Pittsburg. A 46-page pamphlet, dealing with the pathology and the aesthetic aspects of smoke pollution. The third bulletin of the Institute on Smoke Investigation.

Provincial Board of Health of Ontario.—Thirty-first annual report, containing a résumé of the work of 1912, including reports of Provincial Medical Inspector; reports of Laboratories of the Board and official regulations. A 496-page book, illustrated, and including Bulletin No. 1, being a treatise on the design, regulation and action of slow sand filters, by F. A. Dallyn, B.A.Sc., C.E., Provincial Sanitary Engineer.

Pollution of Boundary Waters.—A preliminary report of the special committee of the International Joint Committee having supervision of the investigation relating to boundary waters' pollution. It contains a compilation of documents relating to petitions of the Erie and Ontario Sanitary Canal Company for permission to divert 6,000 second-feet from Lake Erie for the purpose of remedying the existing pollution of Niagara River.

Mines Branch, Department of Mines.—A summary report dealing with the work of the Branch during 1912, containing general report of Dr. Eugene Haanel, director, a report on the field work, chemical laboratories, statistical division, assay office, fuel-testing station, ore-dressing and metallurgical laboratories, etc. It contains 174 pages, supplemented by maps of the Yukon Mining Districts.

Tungsten Ores of Canada.—A report by T. L. Walker, M.A., Ph.D., Mines Branch, Department of Mines, Ottawa. A treatise on the metal and its uses, general geological occurrence of tungsten ores, their concentration. The bulletin includes data concerning the world's production, and enumerates in detail the location of the various ore bodies throughout the Provinces of Canada. An appendix deals with a comprehensive bibliography of Canadian tungsten literature.

Chrome Iron Ore Deposits, in the Eastern Townships of Quebec.—A Report by Fritz Cirkel, M.E., Mines Branch, Department of Mines, Canada. A 140-page book containing full information respecting chrome iron ore mines throughout Canada generally, and including several chapters upon the uses and technology of chromium and its compounds. An appendix contains notes by Mr. W. Borchers on the metallurgy of chromium. The report is supplemented by numerous plates, photographs and drawings.

Hydro-Electric Power Developments.—Bulletin No. 4966A of the General Electric Company, describing numerous Hydro-Electric installations, such as those of the Great Western Power Company, Stanilaus, Great Falls, Mississippi, Pennsylvania, Connecticut River, Utah, and other similar developments. The publication is well illustrated with transmission line equipment, lightning arresters, transformers, generators, alternators, and plans, etc., of power sites. The Canadian General Electric, Limited, Toronto, are the distributors.

Canadian Trade Index.—A directory of the manufacturers of Canada, classified according to the articles made. The 1913-15 edition, compiled and published by the Canadian Manufacturers' Association, Inc., Toronto. The index includes within its scope all reputable manufacturing plants doing more than a local business. It includes a good deal of general information in concise form concerning the kindred character that all business houses may be presumed to require. This is a noteworthy addition to previous volumes of the work. 6½ x 10 inches; 288 + 170 pages, advertising; cloth. Price, $3.00.

Diagram Giving Stresses in Beams.—By H. R. Thayer, assistant professor of structural design, Carnegie Institute of Technology, Pittsburg. Published by D. Van Nostrand Company, New York City. Size, 7½ x 11½ inches. Price, $0.20 net. This is a compact diagram whereby sizes of I-beams, steel channels, wooden beams, composite girders, etc., can be obtained with ease and comparative accuracy. From it may be speedily deduced stresses in a beam caused by a given load or moment, stress modulus required for given loadings and stresses, design of beam for given stresses and loads or moments. It will be found a valuable time-saver in designing offices and remarkably comprehensive in its service.

CATALOGUES RECEIVED.

Apollo-Keystone Copper-Bearing Steel Sheets.—Published by the United States Steel Products Company, descriptive of this product, designed to resist rust. Full information respecting types, widths, etc.

The Concrete Roads of Wayne County.—A reprint of a paper presented by Ed. M. Hines, County Road Commis-

sioner, Detroit, to the National Association of Cement Users, distributed by the R. D. Baker Company, Detroit, Mich.

Pacific Type Locomotives.—Bulletin No. 1016, American Locomotive Company, New York City, containing tabular comparison of this type as built by that company for various roads. The bulletin is well illustrated, and contains general information that will be found of interest.

General Catalogue.—Robert Hudson, Leeds, England, manufacturer of portable railway plants, steel tipping wagons, locomotives, turntables, switches, crossings, rails, etc. Illustrating also a complete supply of contractor's plant, mining accessories. 70 pages, illustrated, and equipped with price lists.

The Milburn Light.—A handsomely printed 48-page catalogue published by the Alexander Milburn Company, Baltimore, descriptive of their portable acetylene lights for powerful out-door illumination. It contains a few pages on oxy-acetylene welding and cutting apparatus, as manufactured by the company.

Gears and Rolling Mill Pinions.—An 8-page pamphlet published by the Mesta Machine Company, Pittsburg, containing interesting data respecting gears in heavy mill machinery, and charts for determination of the dimensions of moulded gears for cast-steel. A section of the catalogue is also devoted to cut gears.

Steam Water and Air-Flow Meters.—Bulletin No. A4157. Canadian General Electric Company, Limited, Toronto, showing illustrations descriptive of accessories, parts, and installations of these products. Contains tables of pipe fittings, plugs, reducers, etc., and diagrams of dimensions of orifice tubes for measuring steam, air or water flow.

Baker Armored Concrete Pavement.—40-page illustrated catalogue, published by R. D. Baker Company, Detroit, Mich., descriptive of their armored plate to take care of expansion in concrete pavements. The catalogue also describes their installation bar. It contains interesting data about pavement materials, and includes specifications for laying concrete pavements, using the above appliances.

Hoisting Accessories.—A well-illustrated, carefully compiled 28-page pamphlet, being Bulletin No. 1805, Mining Machinery Department, Canadian Allis-Chalmers, Limited, Toronto. It is descriptive of cages and skips, landing-dogs, wire rope, sheaves, differential drums, safety hooks, mine and scoop cars, ore bins, and bin gates, etc. Photographs, line diagrams, charts and tables of strengths, weights, dimensions, etc., make this catalogue one that will be well appreciated.

ENGLISH CHANNEL TUNNEL POSSIBLE.

At the first Franco-Prussian Travel Congress, held in London the latter part of November, 1913, Sir Francis Fox, the engineer, gave an address explaining how the channel tunnel may be, and probably will be constructed between England and France. Sir Francis Fox and his partners agree that the enterprise is one that can be carried out with certainty, and at a comparatively moderate cost, the geological and other conditions being of exceptionally favorable character for the construction of a submarine tunnel. The English company would construct the double-barrelled tunnel from Dover to a point in mid-channel, and the French company would construct the other half from Sangatte. Borings would be made through the lower, or gray chalk, which is practically free from and remarkably impervious to water. This chalk bed is eighty-seven feet thick at Dover and eighty feet thick at Sangatte. Its ingredients are very similar to the components of Portland cement. It is an excellent material to work in as it "puddles" itself and becomes impervious. Sir Francis pointed out that protective works might be constructed similar to those introduced by the French, Swiss, and Italian military authorities in connection with the Alpine tunnel from the "food-supply-in war-time" point of view. "Finally, we ought emphatically to dispel a fallacy which seems to have arisen in connection with the earlier proposals," he said, "namely: that in case of war it would be necessary to blow up or permanently destroy this great work of a channel tunnel. Both in the English and the French portions the level of rails has been so arranged that, by the simple process of opening some valves—which will be under the control of the military authorities, and within the lines of fortification at Dover—a sufficient volume of water could be admitted to fill the tunnel to its roof—for a few hundred yards. This would eventually block the tunnel without injuring it." He estimated that the "drainage heading"—a smaller boring in advance of the main boring—could be driven through the chalk at the rate of seventeen yards a day, or three miles a year each way, making a joint progress of six miles a year. It would thus take four years to complete the drainage bore, and the entire work might be completed in a little over six years. Each tunnel would, when completed, consist of a cast-iron tube, "grouted" on the outside with cement, and lined inside with concrete in cement, so as to make a smooth surface and prevent corrosion.

FILTER PATENT SUIT DECIDED.

A decision has just been rendered at Cincinnati sustaining the patent of J. C. W. Greth, for Water Purifying Apparatus described by claim 11, of that patent, as follows:—

"In continuous flow water purifying apparatus the combination with a single tank containing the chemical reacting compartment, and an upward flow settling compartment of a series of independent gravity filters carried on the top of the tank, fed by overflow from the settling compartment, and each having means for washing the filter and a valve to close communication with the settling compartment, whereby any one of said filters may be isolated and washed, while the flow continues through the others from said supporting tank."

The suit was originally filed at Louisville, Ky., in 1910, by Wm. B. Scaife and Sons Company, of Pittsburgh, Pa., against the Falls City Woolen Mills. The district court denied the injunction and appeal was taken with the above result.

Under the ruling of the Court in this case, it would seem that there would be no way to use plural, or continuously washable—without interrupting—filters in any continuous system in the United States. Greth having been the first to devise such structure, or, as the Court says, near the end of its decision:—

"The idea of a group of filters, each of which could be cut out independently, without affecting the work of the others was broadly old, but had been applied nowhere except in city water supply systems or for analogous uses where the lake, river or pond was the settlement basin and the water was brought therefrom in conduits to the filters. It had never been applied as a part of a unitary structure in the treatment of water to produce a comparatively small continuous flow for industrial purposes. When so united with such a structure, in a compact unitary well designed and effective form, it makes a new combination, and it produces a result different from what had before been accomplished."

COAST TO COAST.

Chatham, Ont.—It is announced that the Chatham water commission has a surplus of $5,834 for the past year.

Calgary, Alta.—The gross earnings of the Calgary municipal street car lines were $60,670, and the expenses about $1,000 less than this figure.

Vancouver, B.C.—Station work is now proceeding on 28 miles of the 38-mile section of the Hope Mountain railway which is being constructed through the Coquahalla by the Kettle Valley Railway, for the joint use of the V.V and E. and the K.V.

Winnipeg, Man.—Winnipeg's hydro-electric system continues to show steady progress and the record was obtained during November, when apparent net earnings amounted to $79,677.35 after making all allowances for discounts, possible bad debts and so on. This is an increase of $7,645.27 over the preceding month.

Ottawa. Ont.—The latest available information gives the total appropriation for improvements to the harbors of Canada as $28,214,000. The work, which involves harbor dredging and river work, has occupied the main attention of the public works department during the past season. Of the amount appropriated, $17,000,000 will represent practically the amount spent by the end of the present fiscal year.

New Westminster, B.C.—The department of public works does not contemplate letting any more contracts during this year. This is because the work provided for in the 1913 estimates is now either completed or under way and any new works will have to come under next year's estimates. Since the federal house does not meet until January it will be at least March or April before the department of public works' estimates have been considered.

Stratford, Ont.—At Stratford the Grand Trunk Railway Company has constructed and officially opened a $50,000 new station. The new station is said to be one of the finest on the road, and will also house the divisional headquarters. It is built of brick, with Roman stone facings, and has a frontage of over 150 feet. New additions were also made to the yards, and new freight sheds were erected.

Peterborough, Ont.—One hundred arc lamps have recently been installed at Kingston by the Hydro-Electric Commission at a cost of $120,000. The new light and power system has been switched on, and has so far proven satisfactory. The wires for the street lighting have been placed underground; and in the down town district, the few poles necessary will be placed in the rear of the buildings.

Port Arthur, Ont.—For the year 1913, the electric department in Port Arthur showed a net profit of $62,000, or a gross profit of $165,700. At present the city is using 2,100 horsepower from the Hydro-Electric Commission, and 700 horsepower from the Current River station. The present storage capacity of the various dams in the system is 1,843,100,000 cubic feet, and water this fall was running over all which was an unprecedented condition for this time of the year.

Ottawa, Ont.—By the middle of January, the report being made by officials of the Canadian and United States Governments on the serious pollution of international waters extending from the Lake of the Woods to the St. John River, will be before the International Joint Commission. The examination made so far is complete except with regard to the St. John River, where some further work has to be done. The report of the engineers who have been taking the levels of the Lake of the Woods will also come before the commission at the same time.

Fredericton, N.B.—Development in railway facilities in New Brunswick, and particularly in Fredericton and its neighborhood, has been decidedly marked during the past few years. When the several lines of railway now under construction are finished and in operation, and some other lines now in contemplation have also been built and are in operation, no country will possess more or better transportation facilities than New Brunswick. Within a very short time, a railway will be in operation in practically every settled portion of the province; and the days when the farmer is compelled to drive many miles by team in order to reach a market town, will soon be a thing of the past.

Montreal, Que.—According to the statements of J. G. Sullivan, chief engineer of the western lines of the C.P.R., that company has had under construction this year a grand total of 1,700 miles of railway west of Fort William. The amount of work which has been handled by the construction department of the company this year represents more material than was moved during any period in the construction of the Panama Canal and represents no less than 30,000,000 cubic yards. In regard to the grading of new lines this season, the total work accomplished amounts to 557 miles of new line, exclusive of sidings and terminal work and 262 miles of double-tracking on the main line.

Ottawa, Ont.—Doubts which have been entertained concerning the harbor possibilities of James Bay, have been dispelled by the summer investigation of the hydraulic surveys, conducted under the auspices of the Naval Service Department. These have led to the conclusion that first-class harbor facilities are to be found in James Bay in the vicinity of the mouth of the Nottaway River. Good shelter, ample room, and a sufficient depth of water have been found, and very little silt is in evidence to necessitate dredging. Soundings indicate plenty of water right out into the bay. Examination of conditions at the mouth of the Moore and Rupert Rivers shows that they are out of the question as harbor possibilities. Ice conditions will, of course, have to be contended with in James Bay, but the difficulties in this connection are by no means insurmoutable for navigation.

Galt, Ont.—The report of the local Hydro-Electric Commission shows, during the past 11 months of the present year, 434 new subscribers, which will doubtless be increased in December to 475. During 1912, there were but 347 new applications for service. The capital investment of the commission is now $177,936.76 and the total increase of this account for the present year is $47,946.90, of which $25,028.74 is for ornamental lighting. The work on installing ornamental lighting this year has been very extensive, 23 miles, 184 feet of cable being laid and 252 lighting standards placed. Galt to-day has more ornamental lighting than any place its size in Canada and still has a number of streets to be supplied for which petitions are now in hand. The total cost of operation including sinking fund and interest for the 11 months of the present year is $30,463.30, while the revenue for the same period amounts to $40,509.32, leaving a gross profit of $10,046.02. The increase of business of the department is better illustrated by the increase in the connected power load of 750 horsepower one year ago to 1,103 horsepower at the present time. Galt is now paying $21.50 per horsepower.

Barriefield, Ont.—It is expected that by Christmas the new Barriefield station of the Marconi Wireless Telegraph Company of Canada will be almost complete. The two masts at Barriefield are 450 feet apart, and 185 feet high. The cross-arms are 20 feet wide and are used to space the aerial wires. The aerial, in this case, will take the form of the letter "T" so as to radiate and receive equally in all di-

rections. There will be two gasolene engines, of eight horsepower each, and two special high frequency generators. These travel at a speed of 200 revolutions a minute. Mr. Edwin E. Robinson of the technical engineering staff of the company reports the situation at Barriefield as ideal, and expects to send one of the first messages to Midland, about 100 miles north of Toronto. The Barriefield station will give out a musical note when messages are being transmitted, probably about middle "C" on the piano. This is accomplished by a disc which has a number of points passing very close to two fixed points at a very high rate of speed. There will be in the neighborhood of 100,000 volts on the aerial. Around the outside of the operating house is buried a quantity of copper netting and zinc plates. This is to act as a return circuit to another station, the air being used in place of wire.

Toronto, Ont.—This year Toronto has acquired four continuous stretches of good roadway, which the city has not known before. Since Yonge Street has been repaired, there is a splendid straight road from Toronto Bay to York Mills, a distance of seven miles at least. Since University Avenue has been newly paved, a splendid connection of about six miles of roadway has been afforded along that avenue to College Street, west on College to St. George Street, north throughout the length of St. George to Dupont Street, west on Dupont to Spadina Road, north on Spadina to Davenport Road, west on Davenport to Walmer Road, north on Walmer to Theodore Road, west on Theodore to Bathurst Street, north on Bathurst to St. Clair Avenue, and thence along St. Clair to Prospect Cemetery and West Toronto. The third roadway connection, which is about seven or eight miles long, follows University Avenue to Anderson Street, west along St. Patrick Street to Bathurst Street, and thence west on Arthur and Dundas Streets through West Toronto to Lambton. The fourth follows east along Wilton Avenue, crossing the Wilton Avenue bridge, and along the Wilton Avenue extension beyond Broadview Avenue to Bolton, north on Bolton to Gerrard Street, along Gerrard to Logan Avenue, north on Logan to Danforth Road, and finally along Danforth to East Toronto and the Kingston Road.

PERSONAL.

CLARENCE W. NOBLE, contracting structural engineer, Toronto, who has been on a trip throughout the Canadian West during the past five weeks, is expected to return next week.

J. E. GRIFFITH of the British Columbia Civil Service, and previously associated with the construction department of the Canadian Pacific Railway west of Winnipeg, will, it is announced, succeed W. W. Foster, resigned, as Deputy Minister of Public Works for British Columbia.

R. H. CUNNINGHAM, B.A.Sc., has been appointed manager of Canadian Hoskins, Limited, Walkerville, Ont. For several years Mr. Cunningham was connected with the Hoskins Manufacturing Company of Detroit, and received the above appointment upon the opening of the Canadian branch factory.

J. W. STEWART, of Foley, Welch and Stewart, railway contractors, has assumed the managing directorship of the construction of the Pacific Great Eastern Railway, now under construction from Vancouver to Fort George. This change was necessitated by the illness of Mr. Welch. The firm is striving to have about 1,100 miles of the road completed by next August, giving direct connection between Vancouver and Lillooet.

COPIES WANTED.

About six copies each of *The Canadian Engineer*, issues of July 31st and September 4th, 1913, are desired. We would be glad to advance by one month the date of expiration of subscription of any subscriber who may care to forward a copy of either of these dates from his own file.

VICTORIA BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Victoria branch, Can. Soc. C.E., was held on Thursday, December 11th, at the branch club rooms, 534 Broughton Street, when the following officers were elected for 1914—viz.:—

Executive—F. C. Gamble, chairman; D. O. Lewis, vice-chairman; A. E. Foreman, treasurer; R. W. Macintyre, secretary; E. H. Harrison and Lewis W. Toms. The auditors are H. A. Icke and F. A. Richardson.

The chairman gave a brief review of the work accomplished by the branch during the past year, and whilst advocating a change of officers from year to year, at the same time expressed his appreciation of being elected by acclamation to a third term in the chair.

Mr. J. B. Holdcroft, A.M., read an interesting paper, illustrated with diagrams, on the "Cellular design of vibrated concrete construction, with especial reference to its use in sub-aqueous work," which evoked an animated discussion between the members present.

STEAM TURBINES.

At the first regular meeting for the season, on December 19th 1913, Mr. J. A. MacMurchy of the Westinghouse Machine Company, Pittsburg, Pa., addressed the Toronto section of the American Institute of Electrical Engineers, on "Steam Turbines." The address was illustrated, and created much interest.

THE CENTRAL RAILWAY AND ENGINEERING CLUB.

The regular monthly meeting of the Central Railway and Engineering Club of Canada was held in the Temple Building, Toronto, on Tuesday, December 23rd. A very interesting paper was read on "Scientific Illumination," illustrated by lantern views, by Mr. J. W. Helps, late Industrial Engineer, Toronto Hydro-Electric System. Mr. C. L. Worth, Toronto, is Secretary.

COMING MEETINGS.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.—Seventh Annual Convention will be held at Great Northern Hotel, Chicago, December 29th to 31st. Secretary, I. W. Dickerson, Urbana, Ill.

MINING AND METALLURGICAL SOCIETY OF AMERICA.—Annual Meeting will be held in New York City, January 13th, 1914. Secretary, W. R. Ingalls, 505 Pearl Street, New York.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

ORDERS OF THE RAILWAY COMMISSIONERS
OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20999—December 11—Authorizing C.P.R. to construct spur for Merchants' Trust and Trading Co., Limited, town of Nanaimo, Vancouver Island, B.C.

21000—December 11—Extending, until March 1st, 1914, time within which C.P.R. reconstruct culvert on Chalk River, Sub. Div., Eastern Div., bridge No. 53.2, near Arnprior, Ontario.

21001—December 9—Directing that, within 15 days after Applicant, G. A. Farrill, of Kenilworth, Ont., notifies C.P.R. that he has dug ditch "H. G." to right-of-way of fence at point "G," said Ry. Co. extend ditch on north side of crossing to right-of-way of fence, at point "G," and place at least six inches of gravel on farm crossing approaches.

21002—December 12—Authorizing C.P.R. to construct road diversion in Sec. 9-34-18, W. 3 M., Sask.; and construct, at grade, its Wilkie-Auglia Branch across said diversion at mileage 40.2.

21003—December 13—Authorizing C.P.R., to construct, at grade, its Snowflake Westerly Branch across road allowance between Secs. 14 and 15-1-11, W. P. M., Manitoba, at mileage 9.11 on said Branch.

21004—December 11—Amending Order No. 20878, dated Nov. 1st, 1913, by adding words, "except Sunday," after word "daily" and before word "passenger," in second line of operative part of Order.

21005—December 9—Amending Order No. 17522, dated 18th, 1913, by adding words, "in so far as it relates to Chemainus Road only," after "plan 'A,'" in second last line of operative part of said Order .

21006—December 15—Authorizing C.P.R. to construct siding for Canadian Bag Co., Limited, Montreal, Que., subject to certain conditions, and approving and authorizing clearances as shown on plan, subject to condition that men be kept off tops and sides of cars while operating said siding.

21007—December 10—Authorizing London and Lake Erie Ry. and Trans. Co. to connect with the M.C.R.R., for interchange of traffic between said Railways, just northeast of station in St. Thomas, Ont.; M.C.R.R. put in switch, at its own expense, and do work on its right-of-way, furnishing, free of cost, land therefor, as shown on plan; cost of remainder of work paid by London and Lake Erie Ry. and Transportation Co.

21008—December 11—Authorizing C.P.R. to construct sidings for city of Montreal, Que., at Mile End.

21009—December 11—Authorizing, temporarily, and until interlocking plant is installed, C.L.O. & W. Ry. (C.P.R.) to operate its trains across C.N.O.R. in Lot 27, Con. 2, Tp. Pickering: interlocking plant to be installed by June 15th, 1914; pending installation crossing be protected by flagmen, appointed by C.N.O.R. at expense of C.L.O. & W. Ry.

21010—December 9—Rescinding Order No. 17667, dated Oct. 4th, 1912, in so far as it relieves C.P.R. from fencing that portion of its right-of-way from mileage 29.5 to 32, east side, and mileage 29.5 and 31.5 on west side. 2. Directing C.P.R. fence said portion of right-of-way from mileage 29.5 to 32, on east side, and from mileage 29.5 to 31.5 on west side, on or before May 31st, 1914.

21011—December 15—Declaring that charge of thirty-four ($34) dollars for demurrage on shipments of coal, consigned to Canadian Coal and Commission Co., Bienfait, Sask., and shipped on 9th and 11th days of December, 1912, was illegal.

21012—December 11—Authorizing C.N.R. and C.P.R., pending installation of interlocking plant, to operate over crossing in N.W. ¼ of Sec. 16-52-24, W. 4 M., Alta., until June 15th, 1914, subject to condition that crossing be protected by flagmen, appointed by C.P.R., at expense of C.N.R.

21013—December 10—Authorizing G.T.P. Branch Lines Co., and C.P.R., to operate over crossing at Regina, Sask., without their first being brought to a stop.

21014—December 11—Approving plans, on file with Board under file with the Board under file No. 22913, showing G.T.R. Ry. Co.'s 88' 6" and 75' turntables.

21015—December 11—Authorizing G.T.R. to reconstruct abutments of bridge No. 63, mileage 152.51, carrying 20th Dist. of its railway over public road at Holmesville, Tp. of Goderich, Co. Huron, Ontario.

21016—December 13—Authorizing, temporarily, pending installation of interlocking plant at crossing, C.P.R. and G.T.R. to operate their trains over crossing in West Half of Lot 14, Con. 2, Twp. of Trafalgar, Co. Halton, Ont., at mileage 32.56 from Toronto, subject to condition that trains of both companies be brought to a full stop before crossing diamond.

21017—December 12—Authorizing G.T.P. Ry. to divert Government Road at mileage 212 west of Yellowhead Pass, Cariboo District, B.C.

21018—December 13—Approving revised location of G.T.P. Ry. main line through Chig-ni-Kath Indian Reserve, from mileage 125.55 to mileage 127.08, Range 5, Coast Dist., B.C.

21019—December 13—Authorizing G.T.P. Ry. to construct highway in N.E. ¼ Sec. 8-45-1, W. 6 M., Dist. North Alberta, Alta., at mileage 1028 West of Winnipeg, under its main line of railway.

21020—December 13—Authorizing G.T.R. to construct siding into the premises of the Lyster Wood Box Turning and Enamelling Co, on Cadastral Lot 16-A, original Lot 16, Rge. 5, Tp. Nelson, Co. Megantic, Que.

21021—December 15—Authorizing C.P.R. to operate its trains over bridge No. 0.85, on Temiskaming Branch, Lake Superior Div., Ont.

21022—December 16—Approving proposed location of C.P.R. shelter station on E. ½ of Lot 18, Con. 4, Tp. Asphodel, Ontario.

21023—December 10—Approving location C.P.R. station at Reeder, in S.E. ¼ of Sec. 19-13-27, W. P. M., at mileage 21.4 on Co.'s Virden-McAuley Branch.

21024—December 9—Approving further proposed alterations required to be made in C.L.O. & W. Ry. (C.P.R.) railway in order to accommodate extra tracks in Ry. Co.'s station grounds in town of Bowmanville, so as to include those portions of subdivisions Lots 3, 5 and 6, Block 2 of said town.

21025—December 12—Approving Supplement No. 1 to Express Classification for Canada No. 3, amending and superseding Section 2 of Article T of Tariff of Rates on Money, Securities, etc.

21026—December 15—Approving revised location C.N.R. spur for Thomson, MacDougall and Company, Woodlands, Man., through Sec. 18-14-2, and Secs. 13 and 11-14-3, W. P. M., Man., from mileage 3.38 to 4.92; and authorizing the construction of said revision over two (2) road allowances,—1, Secs. 13 and 12, and 14 and 11, Tp. 14, R. 3, W. 1 M., and 2, Secs. 13 and 14, and 12 and 11, Tp. 14, Rge. 3, W. 1 M.; and rescinding Order No. 19970, dated Aug. 6th, 1913.

21027—December 5—Authorizing C.N.R. to open for traffic its line of railway from mileage 83 to Moose Jaw, in Prov. Sask., on its Radville-Moose Jaw Line, a distance of three miles.

21028—December 20—Requiring C.P.R. to extend to Ontario and Manitoba Flour Mills, Limited, privilege of milling all-rail grain at Sudbury, Ont., in transit from Port Arthur, Fort William, and points west thereof, at through rate to all points east of Sudbury, and the Detroit and St. Clair Rivers reached by millers west of Fort William under milling in transit arrangements, subject to regulations and restrictions thereof; and subject, also, to same additional toll of 1c. per 100 lbs. for terminal service at Sudbury, said rate to come into force not later than January 12th, 1914.

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This specification is simply the standard formula for building a first-class roof of this character.

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Montreal, P. Q.

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General Contractor
C. E. Deakin
Roofers: Campbell & Gilday

Special Note We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding. If any abbreviated form is desired, however the following is suggested: ROOFING—Shall be a Barrett Specification Roof laid as directed in printed specification, revised August 15, 1911, using the materials specified, and subject to inspection requirement.

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are set in CAPITALS.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of *The Canadian Engineer* referred to.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Beloeil Village, P.Q., wharf	Jan. 5.	Dec. 11.	82
Calgary, Alta., machinery, etc.	Dec. 31	Nov. 13.	88
Megantic, Que., concrete dam.	Jan. 5.	Dec. 18.	82
North Toronto, Ont., waterproofing of subways	Dec. 27.	Dec. 11.	86
Ottawa, Ont., sketch designs for building	Jan. 2-14.	Aug. 28.	84
Ottawa, Ont., coaling plants, etc.	Jan. 7.	Nov. 13.	86
Ottawa, Ont., ice-breaker	Jan. 8.	Nov. 27.	84
Ottawa, Ont., dam on French River	Dec. 29.	Dec. 11.	86
Ottawa, Ont., purchase of patrol boats	Jan. 7.	Dec. 18.	84
Ottawa, Ont., submarine cables for Halifax, N.S., and St. John, N.B.	Jan. 15.	Dec. 18.	88
Ottawa, Ont., steel pipes	Feb. 3.	Dec. 11.	88
Quebec, Que., heating, etc., in Post Office building	Jan. 8.	Dec. 11.	80
Toronto, Ont., mechanical filtration plant	Jan. 20.	Nov. 27.	88
Winnipeg, Man., water supply		Oct. 16.	86
Winnipeg, Man., railway ties, etc.	Dec. 29.	Dec. 18.	78
Winnipeg, Man., ice breaker, etc.	Dec. 26.	Dec. 18.	84

RAILWAYS—STEAM AND ELECTRIC.

+—College Bridge, N.B.—The Cabinet Council at Ottawa recently awarded to S. R. GOUDET and C. DUPUIS the contract for the erection of a station building and platform at College Bridge, N.B., at a cost of $4,300.

+—Kingston, Ont.—Orders have been recently received by the CANADIAN LOCOMOTIVE COMPANY for one saddle-tank locomotive for the British Columbia Equipment Company, Vancouver; two saddle-tank locomotives for the Confederation Construction Company, Welland Canal; one saddle-tank locomotive for the Union Carbide Company of Canada, Welland; six moguls for J. D. McArthur, Hudson Bay Construction Company. These contracts added to that of the extension of the government contract placed less than a month ago, will keep the company busy until next May.

Montreal, Que.—A new line under the title of the Hudson's Bay and High River Railway is under contemplation. British capital to the extent of two and a half million dollars has already been put into the projected line, through Southern Alberta, which will tap the coalfields west of High River and eventually connect with the western terminus of the Hudson Bay Company's line. At present preliminary survey lines are being run and parties are out in the field mapping out a route north and east from High Wood Hills at the foot of the Rockies, west of High River. Although no definite route has been decided upon, it is an assured thing that the road will be through the Okotoks and Black Diamond oil fields. The road will probably be opened as an independent line until the Hudson Bay line is extended westward through Saskatchewan and southern Alberta, when it will doubtless be taken over by the big company.

Montreal, Que.—With reference to a petition laid before the last meeting of the city council, asking to have the agreement with the Tramways Company carried out by laying the street car tracks along Van Horne Avenue to the western limits, the secretary informed the council that the company would commence to lay the tracks early next spring and the work would be pushed forward as quickly as possible.

Montreal, Que.—The Montreal Chambre de Commerce has been asked to interest its members in having a branch line of railway constructed from Montreal to Abitibi, to connect with the Grand Trunk Pacific railway.

Ottawa, Ont.—The Western Central Railway will apply to parliament at its next session for extension of time for the beginning of construction and for other railways to guarantee its bonds.

Ottawa, Ont.—The Norfolk and Elgin Railway will apply to parliament next session for incorporation. The proposed route is from Simcoe westerly through the townships of Woodhouse and Charlotte, southerly through North Walsingham, then southerly to the shore of Lake Erie, and from there to Port Burwell.

Ottawa, Ont.—The proposal now being negotiated with the Government, Sir Rodolphe Forget, Sir William Mackenzie, and others, is that the Quebec and Saguenay line be assisted financially in order to ensure completion, and that a joint arrangement be made whereby the Canadian Northern, the Grand Trunk Pacific and the C.P.R. would have running rights over it from Quebec to the terminal at St. Catharines Bay, the entrance to the Saguenay River, which is proposed as a St. Lawrence winter port.

Ottawa, Ont.—The agreement has been signed by the Hon. Frank Cochrane, which will enable the commencement of the immense terminal undertakings in Quebec. They involve the division between the Grand Trunk Pacific and Canadian Pacific for the construction of a union depot and also a freight depot, extensive car shops at St. Malo, and a large freight yard at St. Foye. A tunnel is to be built between the Union Station and the one on the harbor front. The negotiations of the government involve the purchase of three miles of waterfront at Quebec at a quarter of a million dollars.

Saskatoon, Sask.—As a result of the action of the city council recently, the Radial Line from Saskatoon will be taken over and operated as soon as orders-in-council can be secured authorizing this city to operate the line. The government will be requested to pass the necessary orders.

St. John, N.B.—Plans have been filed at the registry office for the construction of a spur line about two miles long from the I.C.R. branching from the main line beyond the One Mile House in the Marsh Road, and crossing through the Old Marsh Road to Kane's Corner, and from there diagonally across to Courtenay Bay at the foot of Edgeburt Street, and thence across on trestle to the foot of Union Street, where it joins the old Courtenay Bay spur.

Toronto, Ont.—Nothing further will be done this year in the proposed Municipal Hydro-Electric Railway, but a conference between the commission and representatives of the municipalities will be held early in January. All the surveys

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and collection of data have now been secured, and it is probable that a definite scheme will be outlined at the January meeting.

+—**Westville, N.S.**—The Ottawa Cabinet Council recently awarded to MESSRS. McLEOD AND SIMMS the contract for the construction of a freight shed at Westville, N.S., to cost $1,750.

GARBAGE, SEWAGE AND WATER.

London, Ont.—The London board of trade has appointed a sub-committee to consider the advantages and feasibility of separating the hydro and waterworks departments, which will report at the next general meeting of the board.

London, Ont.—The Trades and Labor Council has expressed itself as strongly opposed to the idea of the City Gas Company distributing natural gas in London, its chief reason being that the price that will be asked, if the by-law carries, is considered by many to be almost prohibitory.

London, Ont.—A meeting of the London Board of Health will consider the matter of the distribution of natural gas in London without its being purified before entering the city mains. Should the board insist upon the purification of the entire supply, the agreement may have to be declared cancelled as an economic impossibility; for it would then be impossible to use the gas for fuel purposes.

New Westminster, B.C.—Sufficient names have been secured to a petition, the result of which will be that the by-law for the gas plant purchase will be resubmitted to voters. The city council has handed over the petition to the assessment commissioner for inspection.

Ottawa, Ont.—The Economical Gas, Light and Power Company, of Montreal, which offered a short time ago to instal at Ottawa a gas plant which would supply gas at 75 cents a thousand for lighting and 60 cents a thousand for heating, has announced that it is prepared to send at once to Ottawa an engineer to explain before the City Council the whole proposition.

Ottawa, Ont.—A meeting of the International joint commission will be held in Washington, beginning on the morning of January 13. The commission will consider the application of the Michigan Northern Power Company for authority to build a dam for power purposes at Sault Ste. Marie; also the application of the Greater Winnipeg Water district to divert water from Shoal Lake, west of the Lake of the Woods, for the purposes of a water supply for the city of Winnipeg.

Quebec, Que.—The legislative assembly unanimously voted the third reading of the Ottawa water bill on December 19th, with two amendments, one to translate into French the title of the bill, the other to replace clause nine by the following:—"The lands acquired or possessed in consequence of the coming into force of this act, shall not be subject to municipal taxes except in the same proportion as those imposed on other lands in the same municipality. Provided, however, that as soon as water will be furnished to the city of Hull in the manner provided in section 5 of the present law, all lands acquired or possessed in the city of Hull in consequence of the coming into force of the present law will become exempt from municipal and other taxes for ever, but the buildings and pipes for the purposes of this act shall for ever be exempted from all municipal and other taxes."

Stamford, Ont.—The contracts have not been awarded for water pipes and pumps, these being held over by council for further consideration. The engineer was instructed to enquire into the stability of steel pipe, and it is probable that this contract will be left to the new council for award.

+—**Stamford, Ont.**—The Stamford council met recently and awarded the contract for 6, 8, and 10-inch valves to the CANADIAN FAIRBANKS MORSE COMPANY, of Toronto.

+—**Stamford, Ont.**—The municipal council has awarded to the DARLINGTON PUMP MANUFACTURING COMPANY of Williamsport, Pa., for hydrants at a tender of $33.80 per hydrant.

+—**Toronto, Ont.**—The board of control has awarded a contract for 12-inch pipe to the CANADIAN ALLIS-CHALMERS COMPANY, and for 6-inch pipe to the NATIONAL TUBE COMPANY of Pittsburg, Pa.; the contracts to involve an expenditure of about $90,000.

Toronto, Ont.—The board of control has accepted contracts for approximately $200,000 worth of sewer construction in various parts of the city, including Moore Park, Danforth Avenue (from Hillingdon Avenue to Woodbine Avenue), Annette Street, and Woodbine Avenue.

Victoria, B.C.—As a result of negotiations with the Esquimalt and Nanaimo Railway officials, a by-law for the gradual acquisition of the Leech River watershed at a reduced figure—e.g., $142,050 less than the original offer—is to be considered by council when further information has been obtained upon the subject from experts.

Victoria, B.C.—The South Vancouver Municipal Council has sent a deputation to meet the provincial executive in connection with its water records proposals covering Seymour Creek for the announced purpose of constructing a water system of its own, and claims that several private records on the creek should be cancelled by the government as they are not in use. The South Vancouver representatives claim that the records held by the city will not be in any way interfered with and that there will be sufficient water to cover for Vancouver and South Vancouver records.

Winnipeg, Man.—Tenders will be received up till January 9th for the supply of a quantity of cast-iron water pipe (class "C"), and specials for the domestic waterworks system. Plans and specifications may be obtained from the City Engineer, 223 James Avenue, Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control.

Winnipeg, Man.—Tenders will be received up till January 2nd for the supply of 300 6-inch valves for the domestic waterworks system. Plans and specifications may be obtained from the City Engineer, 223 James Ave., Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control.

LIGHT, HEAT AND POWER.

Ayr, Ont.—The farmers of the Roseville and New Dundee districts are asking for information and estimates from the Hydro-Electric Commission for the supply of power for farm labor purposes.

Calgary, Alta.—On the recommendation of the commissioners the council has approved the tender and let a contract to the KILMER, PULLEN & BURNHAM COMPANY for a motor generator set at $18,250.

Calgary, Alta.—The city council has agreed to a recommendation of the city commissioners making an agreement with the Bowness Estates Company to supply current to the Bowness line of street cars for a term of three years at 2 cents per kilowatt hour.

London, Ont.—The board of trade has appointed a subcommittee to investigate the natural gas situation. The committee is to secure first-hand information from Windsor, Chatham and other natural gas-using municipalities, and will report at the next meeting of the board.

Prince Rupert, B.C.—The city council decided at its last meeting to submit a by-law to municipal electors on the hydro-electric scheme.

Wilkie, Sask.—The town council has considered and will further consider the placing of a by-law before the people of Wilkie to raise $30,000 for the extension and development of the electric light service here. This will include the installation of an additional engine to produce a greater supply of electrical energy for consumption by the residents in a private capacity and later to supply motive power for various industries.

Winnipeg, Man.—Tenders will be received up till January 5th for the supply of pole type and subway transformers required during the year 1914. Plans and specifications may be obtained from the office of the City Light and Power Department, 54 King St., Winnipeg, Man. Signed, M. Peterson, Esq., Secretary, Board of Control.

Winnipeg, Man.—Tenders will be received up till January 29th for the manufacture and delivery of electrically operated switching apparatus and accessories for the King Street substation. Plans and specifications may be obtained from the

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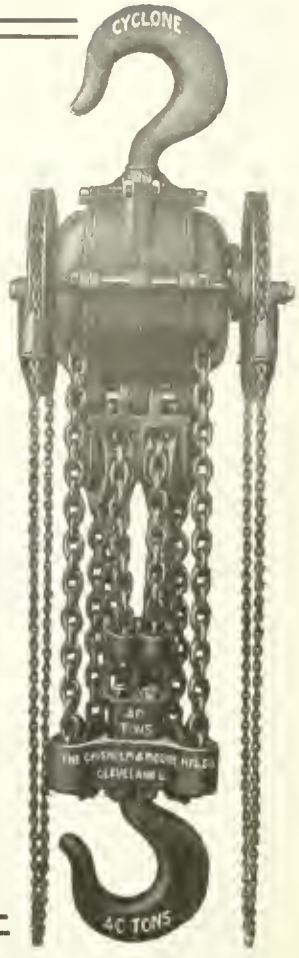

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BRIDGES, ROADS AND PAVEMENTS.

Assiniboia, Man.—At the final meeting of the Assiniboia council for 1913, notice was given of a motion to rescind the contract awarded to the Bitulithic Company for the construction of 7 miles of pavement from Kirkfield Park to the western boundaries of the municipality. This has the effect of holding up the signing of the contract by the present council, and leaves the matter to be dealt with by the new council, which takes office on January 7th, 1914.

Berlin, Ont.—At the recent special sitting of the Highways Commission in Berlin, representatives of Waterloo County give as their opinion that the extent of Government aid given towards the construction of good roads throughout the province should be two-thirds of the cost, as well as a share of the maintenance of improved highways. It was also urged by farmers that, not trunk roads, but good township roads to nearest markets and shipping points, was what was needed in the province.

Brantford, Ont.—The civic Board of Works has decided to make application to the Railway Board for two subways at the intersections of the Grand Trunk Railway with Market Street and St. Paul's Avenue respectively.

Medicine Hat, Alta.—A subway at River Street at a total cost of only $75,000, including both steel and concrete work, is the proposition which McCoy and Levine, in conjunction with the contracting firm of Grace, Higdon and Kerr, put before the city council recently. It was referred to the public works committee to be dealt with at a future adjourned meeting of the council.

Moose Jaw, Sask.—The question of securing financial aid from the provincial government, from the cities of Moose Jaw and Regina and from the intermediate municipalities towards the cost of a highway to be built between the two cities, is being taken up by the Regina Automobile Club. The club will doubtless receive the co-operation of the civic board of trade.

North Vancouver, B.C.—The district council has endorsed the proposal for a driveway up the North arm, connecting Keith Road with Indian River. The secretary of the Seymour and North Arm Ratepayers' Association wrote stating that the public works department wished to be advised of the estimated cost of same, so that the road superintendent of the association could make a report on it before the estimates for next year were made. Engineer Cosgrove was instructed to forward this estimate, which will show approximately $200,000. It is understood further that the government is considering a road from North Vancouver to the Squamish, the alternate route being up the Seymour River.

Prince Albert, Sask.—A definite announcement has been made by the Hon. J. H. Calder, Minister of Railways in the Saskatchewan Legislature, to the effect that actual work on the Grand Trunk Pacific bridge over the South Saskatchewan River will be commenced within thirty days. The government intends giving the company a further guarantee of $2,000 per mile for railroad construction, and in addition $1,300,000 to cover the cost of two railway bridges, one of which is on the line from Young to Prince Albert. It is expected that a time limit will be placed on the construction of the South Saskatchewan bridge in order that no delays may take place.

St. Johns, Que.—The Provincial Government has acceded to the demand of a delegation from the town council respecting the construction of a free bridge between St. Johns and Iberville, and a bill presented by Hon. Mr. Taschereau is now before the Legislature proposing that the Government undertake the construction and take over the amount voted by the municipalities of St. Johns and Iberville, and also the Dominion Government grant.

Toronto, Ont.—The Harbor Commissioners have approved plans for a lift bridge of the "scissors type" to be erected over the Don River at Cherry Street next spring, at a cost of $294,000, the lift span to be 86 feet.

Vancouver, B.C.—The Kilsilano-Burrard Street Bridge Association has formed again to endeavor to bring once again before the people of the city the scheme for the erection of a bridge between the end of Burrard Street and a point on the Kitsilano Reserve.

Windsor, Ont.—Essex County Council has definitely refused to vote on the proposed by-law to expend $1,000,000 on a chain of good roads throughout Essex County and the by-law will not be considered at the January elections.

INDUSTRIAL WORKS.

A—Nassau, Ont.—Tenders will be received up till December 31st for excavation and dredging in the tail race of the power plant of the Canadian General Electric Company, Limited, at Nassau, about 6 miles from Peterborough. Plans and specifications may be seen at the offices of the company at Toronto, or at Peterborough; or at the office of Henry Holgate, Consulting Engineer, Richelieu Building, Montreal, Que.

Ottawa, Ont.—Tenders will be received up till January 12th for the construction of the substructure and approaches of a highway bridge at North Timiskaming, County of Pontiac, Que. Plans and specifications may be obtained from the Department of Public Works, Ottawa, Ont. Signed, R. C. Desrochers, Secretary.

St. John, N.B.—As a result of the fact that No. 9 crib of the new Sand Point wharf broke off below low-water, it may be necessary to tear out the remaining section, and to construct an entirely new crib. The extent of damage to No. 10 crib, recently overturned partially by the tide, is not yet known; but it is generally believed that the complete construction of two new cribs will have to be undertaken.

+—Thornbury, Ont.—The contract has been awarded by the Dominion Government to N. B. HORTON and J. D. STODDART, of Owen Sound, for harbor improvements at Thornbury, Ont., to cost $15,844.55.

Vancouver, B.C.—The civic bridges and railways committee, at its last meeting, heard the report of Engineer A. P. Hueckel, who is in charge of the East End viaduct. He reported that the plans had not yet been received from the Great Northern Railway at St. Paul. He was instructed to write the head office making the request that they be forwarded as soon as possible. The city engineer was ordered to go ahead with the plans of the retaining wall in False Creek for submission to the Harbor Board.

MISCELLANEOUS.

+—Edmonton, Alta.—The contract has been awarded to the ROBERT & SCHAEFER CO., of Chicago, by the Brazeau Collieries, Limited, to install a plant of 2,000 tons daily capacity on its property at Nordegg, 120 miles west of Blackfalds, on the C.N.R. branch from Stettler, Alta. The plant is to be in operation by next September.

Montreal, Que.—The plants of the Canadian Car and Foundry Company, and plants of its subsidiary companies, were closed on December 20th, and will not be opened until after the first of the New Year, the object being to go over the entire equipment and to make all necessary repairs.

St. John, N.B.—Mayor Frink has devised a means for providing a site for additional piers in St. John harbor. A large area of water front on the eastern side of the entrance to the main harbor, adjoining the Ballast wharf property, is lying practically idle, and its usefulness is destroyed by an I.C.R. trestle which crosses the property. The Mayor suggests that the trestle be moved back and thus room would be provided for two large steamer berths, which could be erected with very little preliminary work.

Victoria, B.C.—Tenders have been called for December 27th in connection with the work on the Hudson Bay Company's new store at Victoria, and work is to commence by January 15th. Some of the works for which separate tenders are called, are reinforced concrete, plain concrete, sheet metal work, ornamental iron, architectural terra cotta, etc. The first four stories of the building will be erected at a cost of $450,000.

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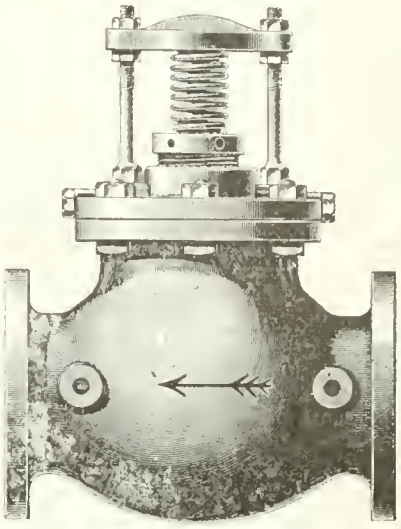

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MONTREAL TORONTO VANCOUVER

CURRENT NEWS.

Beaton, B.C.—Good progress is reported on the construction of the floating wharf at Beaton.

Brantford, Ont.—On January 15th at Brantford Hydro-Electric current will be turned on for ornamental street lighting purposes, and February 1st, for the use of domestic and commercial lighting purposes.

Brantford, Ont.—Dr. F. G. E. Pearson, M.H.O. for Brantford, gives it as his opinion that a big artificial gas plant will be located on Lake Erie, where coal haul is cheap, and will supply a chain of municipalities in the southern part of western Ontario through the pipes now laid and being laid for natural gas, which, he claims, will not last forever. The Dominion Gas Company, in furnishing the Kent product at Brantford, already has claimed danger of a shortage in the Haldimand field.

Brantford, Ont.—Brantford's lighting rates under the Hydro-Electric will be about half the present rate charged by the Western Counties Company. The present electric light rate is 8½ cents per kilowatt. The new Hydro rate will be 3½ cents per kilowatt and 4 cents per 100 square feet of floor space.

Delhi, Ont.—The prospects for securing sufficient contracts for the required waterworks revenue of $2,000 at Delhi, are very encouraging.

Fort William, Ont.—The work to be carried out next year in the Mission river, and for which tenders have been received at the Department of Public Works, Ottawa, covers the construction of quay walls of 2,646 feet total length, in two parts, of 1,225 feet and 1,421 feet respectively. The construction is to be of square timber crib work, close faced on the outer faces and open faced on the inner faces, the outer faces to have a batter of 1 in 24, and the other faces to be vertical. When fully ballasted the top of the crib work is to be six inches below low water level. The superstructure is to be of concrete, and when completed to be 5.5 feet above low water level. The site will be dredged to a depth of 26 feet at low water.

Fredericton, N.B.—Warden W. R. Fawcett, of Temperance Vale, has just completed the construction of three bridges in the province, the Jones Creek Bridge, Malone Bridge at Sussex, and the Smithtown Bridge. The largest of these is the Jones Creek Bridge, erected at a cost of $8,000. All the bridges are completed with the exception of the roofing in, which will be done in the spring.

Fort William, Ont.—It is expected that steel will be laid to connect up the new line of the C.N.R. between Port Arthur and Sudbury by the beginning of the year, according to the statement of A. J. Isbester, resident engineer. At present there are 18 miles on which the steel is to be placed, and all grading is completed.

Hamilton, Ont.—The city council has decided to let the matter of the C.N.R. level crossing on Waterdown Road stand over until all possible information has been presented to council.

Kimberley, B.C.—Work is progressing favorably on the new power plant that is being installed by the Consolidated Mining and Smelting Company at Sullivan Siding, and in the course of a few weeks the air compressor will be run by steam power furnished by two steam boilers instead of water power as at present.

London, Ont.—The increase in the consumption of power at London was responsible for the stringing of a third feeder recently. Also, work is progressing night and day for the supply of the London Street Railway with Niagara current.

Montreal, Que.—The Northern Railway has completed the preliminary survey of 170 miles between Calumet and Belle River on the G.T.P., and it is expected to start construction work in the spring.

Moose Jaw, Sask.—The new C.N.R. branch line from Avonlea to Gravelbourg has been handed over by the contractors to the company, and it is anticipated that this will be in operation within a short period.

New Hazelton, B.C.—The Stewart Brothers have completed their contract at Burns lake, and have shipped part of their plant to Fraser lake. Since April, they have moved over 800,000 yards of rock and earth, employing in the work a large force of men, several steam shovels, and several donkey engines.

North Vancouver, B.C.—In connection with the acquiring by the city of the Rice Lake lands for watershed purposes, the government sent a message to the city council to the effect that it would have to defer further its decision until a conference could be held with the district council and the British Columbia Electric Railway Company, the other two parties interested in the right to purchase.

Ottawa, Ont.—Work is advancing rapidly on the new Welland Canal and section 8 will be the next section for which tenders will be called. This is the section next to Port Colborne, and will be an expensive cut as it is through rock for the most part. Plans and specifications are now in preparation and tenders will be called for during the winter.

Ottawa, Ont.—Seven of the hydro-electric companies operating under Dominion charters, generated 191,986 horse-power during the last fiscal year, and of this amount 101,423 horse-power was exported to the United States, while 90,462 horse-power was used in Canada. The points of export are Fort Frances, Niagara Falls, Aroostock Falls, N.B., and Vancouver. The chief exporting companies are the Canadian Niagara Power Company, which sold 49,850 horse-power in the United States, in contrast to 1,682 horse-power used in Canada, and the Ontario Power Company, which exports 38,912 horse-power, in contrast to 43,503 horse-power used on this side of the line.

Ottawa, Ont.—There has been spent to date $153,000,000 on the National Transcontinental Railway and the Quebec Bridge. The steel-laying on the main line between Moncton and Winnipeg was finished just a month ago, but about $17,000,000 will be needed to complete the road for actual operation.

Ottawa, Ont.—G. A. Mountain, chief engineer of the railway commission, and Assistant Engineer Simmons have inspected the C.N.R. Ontario Railway from Ottawa to Napanee, which has recently been completed, and which is a continuation of the Toronto-Napanee line. The line is in good condition, and will be opened for freight and local passenger traffic on January 5th. Through service will begin in the spring. Splendid steel bridges have been constructed and preparations are being made for the manning of the stations along the line.

Ottawa, Ont.—The new government wireless stations at Toronto and Port Burwill are now practically completed, and will be ready for operation at the beginning of the new year. They will afford wireless communication for the railway ferries plying all winter on Lake Ontario and Lake Erie. Next spring the station at Kingston will be opened, giving connection right through to Montreal and completing the chain from the head of the lakes to Belle Isle.

Ottawa, Ont.—It has been learned with authority that the Canadian Northern Railway Company will be the owner of the Quebec and Saguenay Railway within a few days; and an official statement will be issued as to the outcome of negotiations in progress at Ottawa.

Peterborough, Ont.—A. B. Colville, Vice-President of the Peterborough Light and Power Company, has sent a letter to the City Clerk, stating that in the event of the city of Peterborough not having obtained possession under the Hydro expropriation by-law of the plant of the company by January 1st, 1914, the company would be pleased to continue lighting the streets of the city at the same rate as under the company's street lighting contract expiring December 31st, 1913, and to continue to do so till the city gets possession.

Peterborough, Ont.—The price at which the Otonabee Power Company will sell to the city has been fixed at $48,000. It is probable that an arrangement will also be made whereby the franchise of the company will be extended from month to month until the city will be in a position to supply power to the customers now served by the Otonabee Power Company.

Peterborough, Ont.—The contractors who are building the C.P.R. bridge across the Otonabee River expect to have the structural work complete by Christmas, but the middle span, which will be a swing section, will not be erected till the fall. This is due to the fact that a swing bridge was not demanded until the plans for a stationary bridge had been completed. Contractors will construct what is technically known as a bobtailed swing, which will provide a thirty-seven foot channel.

The Departmental House for Mechanical Goods HAS ARRIVED

What the department stor is to the general public our "Mechanical Goods Departmental House" is to the engineering and contracting field.

The public takes the efficient and time-saving merchandising methods of the department store as a matter of course. In the mechanical world we offer the same convenient service.

Why lose time "shopping" around town when you can buy anything you want and of a standard quality all under "one roof"?

Our business is divided into a number of departments in order that it may be handled most expeditiously and to the best interests of our customers.

In addition to the staple articles pertaining to each department we handle a great many specialties, some of which are listed below

SCALE DEPARTMENT
- Fairbanks World-famous Scales, of all types and sizes

VALVE and STEAM GOODS DEPARTMENT
- Fairbanks Brass and Iron Valves
- Pratt and Cady Valves
- Foster Reducing Valves
- American Steam Pressure Gauges
- Wainwright Joints
- Penberthy Oilers
- Strong Steam Traps
- Wainwright Heaters
- Burt Exhaust Heads
- American Safety Valves
- Trident Water Meters
- Palmetto Packing
- Durabla Packing
- Oster Stocks and Dies
- Tools and Fittings

ENGINE DEPARTMENT
- Fairbanks-Morse Oil Engines
- Fairbanks-Morse Marine Engines
- Fairbanks-Morse Tractors
- Farm Machinery
- Motor Boat Supplies
- Automobile Supplies

PUMP DEPARTMENT
- Fairbanks-Morse Steam Pumps
- Power Pumps
- Goulds Power Pumps
- Hand Pumps
- Combined Engines and Pumps
- Spraying Outfits
- Air Compressors
- Suburban Water Systems

ELECTRICAL DEPARTMENT
- Fairbanks-Morse Generators and Motors
- Edison Storage Batteries
- Suburban Lighting Outfits

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- Pratt and Whitney Tools
- Brown and Sharpe Tools
- McDougall Lathes
- Bertram Tools
- Machine shop tools of all kinds
- Wood Working Machinery

TRANSMISSION DEPARTM'T
- Fairbanks Wood Split Pulleys
- Universal Giant Shaft Hangers
- Skefko Ball Bearings
- Nicholson Couplings

RAILWAY and SUPPLY DEPARTMENT
- Fairbanks-Morse Motor Cars
- Elwell-Parker Trucks
- Barrett Jacks
- Arthur Koppel Industrial Ry. Equipment
- Fairbanks-Morse Air Compressors
- Fairbanks-Morse Hoisting Engines
- Fairbanks Trucks
- Milburn Lights
- Smith Concrete Mixers

SMALL TOOL and SUPPLY DEPARTMENT
- Pratt and Whitney Tools
- Brown and Sharpe Tools
- Yale and Towne Hoists
- Alundum Grinding Wheels
- Crystolon Grinding Wheels
- India Oil Stone
- Parker Vices
- Union Chucks

SAFE and TYPEWRITER DEPARTMENT
- Dominion Safes and Vaults
- Noiseless Typewriters

TRUCK DEPARTMENT
- Mack Trucks (gasoline)

Send now for catalogue of goods that interest you

The Canadian Fairbanks-Morse Co. Limited

"The Departmental House for Mechanical Goods."

MONTREAL ST. JOHN QUEBEC OTTAWA TORONTO
WINNIPEG CALGARY SASKATOON VANCOUVER

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned, and endorsed "Tender for Submarine Cables," will be received at this office until 4 p.m., on Thursday, the 15th January, 1914, for 10 knots of gutta-percha cable with 4 conductors and 14 knots of gutta-percha cable with 2 conductors to be delivered at Halifax., N.S., or St. John, N.B., by the 1st of May.

Specification and forms of tender can be obtained on application to the office of the General Superintendent of the Government Telegraph Service at the Department of Public Works, Ottawa.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 per cent.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 9, 1913.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—51974.

TENDERS FOR DREDGING.

The undersigned will receive tenders up to December 31st, 1913, for excavation and dredging in the tail-race of their Power Plant at Nassau, about six miles from Peterborough. The estimated amount of material to be removed is 24,000 cubic yards. Plans and specifications may be seen at the offices of the Company, either at Toronto or Peterborough, or at the office of Henry Holgate, Consulting Engineer, Richelieu Building, Montreal. Lowest or any tender not necessarily accepted.

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED.

CITY OF OTTAWA, DOMINION OF CANADA.

TENDERS FOR STEEL PIPES.

Sealed tenders in duplicate addressed one copy to the City Clerk, City of Ottawa, Canada, and the other to Sir Alex. Binnie, Son and Deacon, St. Stephens House, Westminster, London, England, and endorsed, "Tenders for steel pipes," will be received until 4 p.m. on Tuesday, the 3rd day of February, 1914, for about forty-two miles of steel pipe, fifty-four inches internal diameter, about thirty-two miles of steel pipe, fifty-eight inches internal diameter, and about eleven miles of steel pipe, fifty-one inches internal diameter.

Forms of tender and specification may be obtained from Sir Alex. Binnie, Son and Deacon, St. Stephens House, Victoria Embankment, London, S.W., or from the City Engineer of Ottawa, Canada, on and after the fifteenth, on receipt by them of a cheque to the value of five hundred dollars, made out to the City Treasurer of the City of Ottawa, Canada, which sum will be returned on receipt of a bona fide tender.

The lowest or any tender is not necessarily accepted.

No tenders will be considered except from actual manufacturers capable of supplying the whole of the pipes within a period of two and a half years from the date of acceptance of the tender.

SIR ALEX. BINNIE, SON & DEACON,
Engineers in Chief,
St. Stephens House,
Westminster, London.

Dated December 4th, 1914.

NEW INCORPORATIONS.

Cowganda, Ont.—Marten Lake Mining Company, Limited, $2,000,000. W. T. Grose, J. J. Trickey, T. Scott.

Ottawa, Ont.—Oil Processes, Limited, $7,000,000. E. Seybold, W. G. Bronson, M. Orme.

Sherbrooke, Que.—Sherbrooke Tile and Brick Company, $75,000. N. N. Walley, C. Beauchesne, N. E. Walley.

St. John, N.B.—The Canada Nail and Wire Company, Limited, $200,000. W. A. Johnston, R. L. Johnston, G. McRae.

L'Epiphanie, Que.—La Compagnie Electrique de L'Epiphanie, Limited, $49,000. J. A. Bourheau, J. B. T. Richard, M. Forest.

Montreal, Que.—The Rigaud Granite Company, Limited, $250,000. E. Fabre, C. G. Ogden, P. S. Conroy. Richmond Construction Company, Limited, $100,000. P. Bercovitch, W. P. Kearney, E. Lafontaine.

Toronto, Ont.—Automatic Advertising Co., of Canada, Limited, $40,000. J. E. Wood, W. H. Denny, J. W. Bundy. Pneuma Tubes, Limited, $1,000,000. G. H. Gray, W. R. Willard, J. J. Gray. The Credit Valley Stone Company, Limited, $250,000. R. A. Reid, A. B. Reston, D. J. Coffey. Construction Supply Company, Limited, $60,000. W. Bain, J. Ellis, J. J. Dashwood. Vaughan Sand and Gravel Company, Limited, $100,000. T. W. Murray, R. Richards, W. Fairburn. Sulphur Products, Limited, $150,000. V. C. Gordon, T. E. McCracken, J. R. Roaf. Non-Nitric Explosives Company, Limited, $180,000. J. J. Flint, G. D. Waters, H. A. Hall.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria St., London, S.W.:—

A Canadian firm makes inquiry for names of United Kingdom manufacturers of sheet zinc, 36-in. x 8-in., No. 9 gauge; 48-in. x 8-in., No. 9 gauge; and 60-in. x 8-in., No. 9 gauge.

From the branch for city trade inquiries, 73 Basinghall St., London, E.C.:—

A London dealer in electrical supplies, who claims a large connection with consumers of amber mica, would be glad to act for Canadian producers upon a commission basis. A London firm with several continental branches, who specialize in insulating materials, are open to consider offers of high-class Canadian amber mica, and invite quotations from Canadian shippers.

MEXICAN EAGLE ASPHALT

TRADE MARK

Adelaide Street West, Toronto, paved with Mexican Eagle Asphalt.

"Its own best advertisement"

REFINED TO DEFINITE SPECIFIED STANDARDS — EVERY BARREL GUARANTEED UNIFORM

For prices, analyses, samples, etc., please address

THE ASPHALT AND SUPPLY CO. LIMITED

SOLE CANADIAN AGENTS FOR THE MEXICAN EAGLE OIL Co LIMITED

TRANSPORTATION BUILDING — MONTREAL

MONTREAL MARKET LETTER.

There is absolutely no interest whatever in the iron and steel situation here from the standpoint of trading. The holiday spirit prevails, and no one is talking about anything save Christmas. There is no buying whatever of iron and steel, and merchants are not making any attempt to do business, knowing that such would be futile. These remarks apply not only to the present week, but will apply to the following week and possibly to several weeks thereafter. In fact, the general view expressed by merchants here is that no one need look forward to any new business of consequence until well into January, and possibly until after the first of February.

Industrial undertakings which call for large expenditures on iron and steel are for the most part dependent upon the financial situation; and the financial situation is in turn dependent upon conditions outside of Canada, so that it becomes necessary at the present time to wait upon financial developments on the other side of the Atlantic. Reference is now more especially made to Paris, upon which centre the eyes of financiers are at the moment turned. It is expected that some large flotations are to be made in Paris very shortly and the manner in which these are taken will give a fair indication of the general situation. An enormous amount of financing is pending throughout Europe, and much is also pending in the United States. Meantime, expenses in Canada are being cut every day, so that, unless it turns out that there is more money abroad than is thought to be at the moment, it seems likely that demands for iron and steel will not reach very large volumes for some time to come. This, naturally, has an effect also upon prices. These are holding extremely steady, being at a low level. No changes of prices are taking place, largely for the reason that few are making any effort to buy and very few offers are being received.

A number of the larger works are either closing down or operating on short time, and it is likely that others will adopt a similar policy before long.—Montreal, December 23rd.

The best equipment in Canada

E. G. LAW

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Pneumatic Foundations, Piers, Concrete Work, Pile Driving, Subaqueous Work

Glenwood Avenue **TORONTO** 'Phone N. 3053

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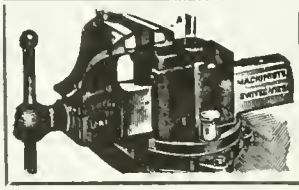
We use hot process, can galvanize malleable material successfully and give good service.

QUEEN CITY GALVANIZING WORKS

5 WABASH AVENUE, TORONTO



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GUARANTEED BREWERIES SAW MILLS MINES LAUNDRIES

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THE BEST FOR DYE HOUSES BLEACHERIES and ALL EXPOSED SITUATIONS

D. K. McLAREN, LIMITED,

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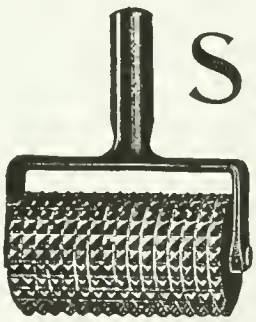
QUEBEC 21 St. Peter St.
ST. JOHN, N B. 64 Prince William St.



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Repair work and re-cutting rollers a specialty

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A box of **GROUND MICA** in your **MACHINE SHOP**

will pay for itself in two weeks if used in tempering steel tools.

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NORTHERN CRANES

All types, sizes, capacities

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Use BUFFALO PITTS CO.

Traction Trains & Haulage Outfits

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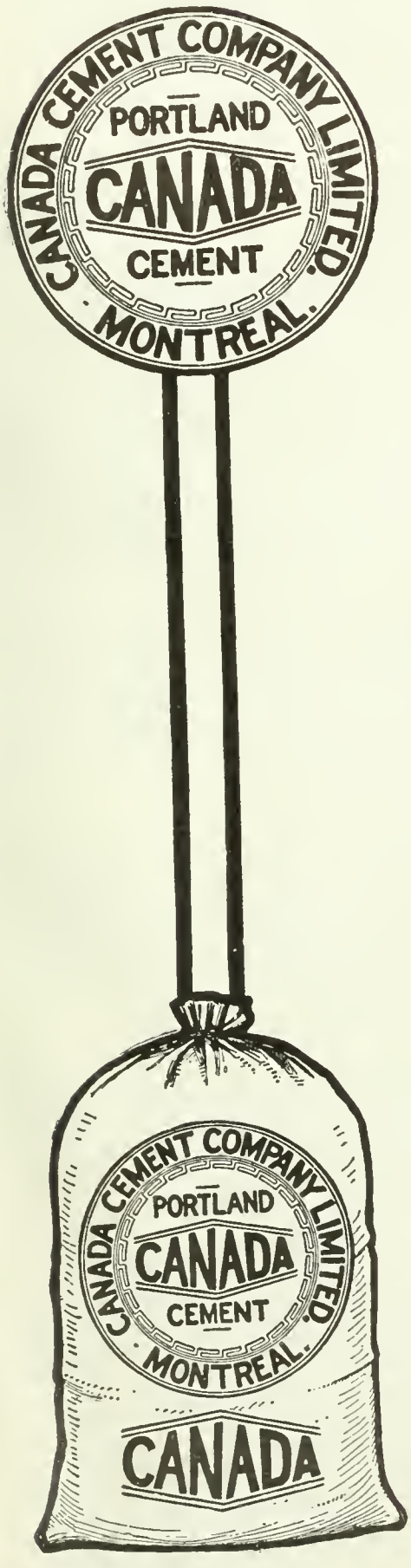

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The next step towards ideal construction, is to realize that for satisfactory concrete work, it is necessary to use a cement that is uniformly high-grade

CANADA Portland CEMENT

is the selection of the leading engineers, architects and contractors. Their experience has proved that in this brand they can obtain a certainty of success.

With concrete coming into more and more general use for the construction of buildings, bridges, viaducts and highways, it is vitally important that those in authority on such matters should select the best materials obtainable.

Use the cement that our best architects and engineers have selected for their most important undertakings. Select Canada Cement — it costs no more than any others.

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Second-Hand Machinery

Advertisements under this heading three cents per word per insertion, if not "displayed." Minimum 50 cents per insertion.

New and Second-hand

Contractors' Machinery For Sale

IMMEDIATE DELIVERY.

1—8"x12", double cylinder, double drum hoist with boiler (new).
1—7"x10", double cylinder, double drum hoist with boiler (used).
1—6"x12", double cylinder, double drum hoist with boiler (new).
1—6½"x8", double cylinder, double drum hoist with boiler (new).
1—6½"x8", double cylinder, single drum hoist with boiler (used).
1—6½"x8", double cylinder, double drum hoist without boiler (new).
1—5"x7", double cylinder, single drum hoist without boiler (new).
1—5"x6", double cylinder, single drum hoist with boiler (used).
1—No. 3, Ransome Concrete Mixer on skids (used).
1—No. 2, Ransome Concrete Mixer on wheels (used).
1—9"x10", Belt Driven Air Compressor (used).
1—8"x10"x8", Steam Driven Air Compressor (used).
4", 5" and 6", Centrifugal Pumps, d.-c. to Vertical Engines (new).
5" and 6", Belt Driven Centrifugal Pumps (used).

H. W. PETRIE, Limited

Front Street West TORONTO, ONT.

Positions Wanted

Advertisements under this heading one cent per word per insertion. Minimum charge fifty cents per insertion.

MECHANICAL CONSTRUCTION engineer and draftsman, experienced designer and erector of mining plants, Marcus screens, coal-washing plants, and buildings, cost estimator and supervision, all kinds of steam engines, boilers, air machinery, etc., seeks position. References. Box 188, *The Canadian Engineer*, Montreal.

CIVIL ENGINEER of four year's standing; familiar with transit and level work; design of switchboards and power plants, is open for position. Speaks English and French. Has also experience in underground conduit work. First-class draughtsman. A practical man. Box 208, *The Canadian Engineer*, Toronto.

Condensed Advts.

Advertisements under this heading three cents per word per insertion. Minimum charge fifty cents per insertion.

NOTICE.—In conformance with the Patent Act, and particularly Section 38 with reference to Canadian Patent No. 137,470, granted to Alexis LeBlanc, for improvements in Electro-Magnetic Motor, the public are hereby notified that the article protected under the said patent has been manufactured by Messrs. Thos. Lawson and Sons, Limited, of Ottawa, Canada, and that inquiries with regard to the same, for licenses to manufacture or other negotiations with reference to the Patent Rights may be made to the undersigned, Lloyd Blackmore and Company, Limited, Patent Solicitors and Experts, Hope Building, Ottawa, Canada.

FOR SALE—One "Cooke" 6-inch transit and 15-inch "Cooke" Y level, very little used. The property of the late James Melville Robertson. Complete outfit for $200; terms cash. Address J. Grant MacGregor, Red Deer, Alta.

Positions Vacant

Advertisements under this heading two cents per word per insertion. Minimum charge fifty cents per insertion.

WANTED.

Ontario Land Surveyor to act as Corporation Surveyor for the City of Port Arthur.

Applications will be received by the undersigned up to January 20th, 1914.

Applicants should state experience and salary expected.

L. M. JONES,
City Engineer.

ONTARIO LAND SURVEYOR required for general work in Toronto and suburbs, one having had experience in estate subdivision work. Permanency for good man. Apply stating age, and salary expected, to Box 198, *The Canadian Engineer*, Toronto.

MECHANICAL DRAFTSMAN.—Location, Toronto, with first-class experience in design of special equipment, conveying machinery, ore and coal chutes and gates, and capable of successfully designing mechanical operations from suggestions of the Engineer. Preference given to man who has a knowledge of large steam piping. Applicants to state age, name, references, and give a full outline of experience, names of firms where this experience has been gained, which will be treated confidential. Address Box 200, *The Canadian Engineer*, Toronto.

STRUCTURAL STEEL DRAFTSMAN.—Location, Toronto, capable of accurately designing and detailing industrial plant buildings, and special structures in connection with conveying machinery. Preference given to man familiar with special steel plate structures. Reply stating age, describe fully experience and mention references to Box 202, *The Canadian Engineer*, Toronto.

ARCHITECTURAL DRAFTSMAN.—Location, Toronto, experience in design and detail of industrial plant buildings essential. Reply stating age, experience, and describing some of the work carried to completion, and name references. Address Box 204, *The Canadian Engineer*, Toronto.

A1 TRACER.—Location, Toronto. Must be first-class letterer, rapid and accurate. Applicants to state age, describe fully experience and submit samples of lettering. Address Box 206, *The Canadian Engineer*, Toronto.

Despatches from London say that parliament will be asked to sanction a huge project next year for supplying electricity in bulk to London by a private enterprise. The company will undertake the electric lighting and the power supply of London now carried on by the Electric Lighting company and will provide a great central station, which will be equal, if necessary, to providing electric power for railways. Several railways, notably the Midland, the London and Northwestern, and the Great Northern, at the present time have important electrification projects in hand, and Mr. Guy Garnet, general manager of the Midland railway, is in America studying the electrification question.

Manufacturing 48" Pipe at Berlin, Ontario, Canada.

MERIWETHER SYSTEM

CONTINUOUS RE-INFORCED CONCRETE PIPE

PATENTED

LOCK JOINT PIPE COVERS NORTH AMERICA

Sewage flowing through Lock Joint Pipe reaches the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Hudson's Bay and the Great Lakes.

Lock Joint Pipe is in use for sewers and water conduits in the following States: Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, Washington.

The following Provinces of Canada: Quebec, Ontario, Saskatchewan, Alberta and British Columbia.

And in the Island of Cuba.

The Lock Joint Pipe Company is the largest manufacturer of reinforced concrete pipe in the world.

LOCK JOINT PIPE CO.

165 BROADWAY - NEW YORK CITY

Write for new Illustrated Catalog

QUEBEC and ONTARIO—Francis Hankin & Co., 202 Coristine Bldg., Montreal; 117 Mail Bldg., Toronto.
MANITOBA, SASKATCHEWAN and ALBERTA—Canadian Lock Joint Pipe Co., Ltd., Regina, Sask.
BRITISH COLUMBIA—Pacific Lock Joint Pipe Co., 1005 A St., Tacoma, Wash.; Globe Bldg., Seattle, Wash.

MARKET CONDITIONS

Montreal, December 22nd, 1913.

Bar Iron and Steel—Trade is reported active. Bar iron, $2.05 per 100 pounds; best refined horseshoe, $2.30; forged iron $2.20; mild steel, $2.15; sleigh shoe steel, $2.15 for 1 x ⅜ base; tire steel, $2.25 for 1 x ⅜ base; toe caulk steel $3; machine steel, iron finish, $2.25.

Cement—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb. bbl., in cotton bags, adding 10c. for each bag. Good bags re purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain—The market is quoted per 100 lbs. as follows:—¼-in., $5.65; 5/16-in. $4.70; ⅜ in., $4.00; 7/16-in., $3.65; ½-in., $3.45; 9/16-in., $3.45; ⅝-in., $3.35; ¾-in., $3.25; ⅞-in., $3.15; 1-in., $3.05.

Explosives and Accessories—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots Montreal; 50 per cent., 16½c., and 60 per cent., 18c. Blasting powder, 25 lb. kegs, A, $1.85, and B, $2.35 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; double strength, $1, and broken lots higher; electric blasting apparatus:—Batteries, 1 to 10 holes, $13.50; 1 to 10 holes, $20.50; 1 to 50 holes, $41. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength per 100 fuses:—4 ft. wires, $3; double strength, $3.50; 6 ft. wires, $3.54, and double, $4.04; 8-ft. wires, $4.08, and double, $4.58; 10-ft. wires, $5, and double, $5.12.

Galvanized Iron—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Colborne Crown, $4.20; Apollo, 10¾ oz., $4.30. Add 25c. per 100 lbs. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe—(See Pipe, Wrought and Galvanized)

Iron.—Following prices are on dock. No. 1 Summerlee, $21.75 per ton; selected Summerlee, $21.25; soft Summerlee, $20.75 per ton. No. 3 Middlesboro irons are about $19 per ton. Carron iron number for number and grade for grade is quoted about the same price as Summerlee. Canadian iron sells here at about $19 to $19.50 per ton, on track.

Lath—See Lumber, etc.

Lumber, etc.—Prices on lumber are for car lots, to contractors, at mill points. Red pine mill culls out, $20 to $22 per 1,000 feet; white pine, mill culls, $20. Spruce, 1-in. by 4-in. to 6-in., $21; 1 x 7 to 9, $24 per 1,000 ft.; mill culls, $18. Hemlock log run, culls out, $19. Railway Ties, Standard Railway Ties, hemlock or cedar, 50 to 55c. each. Telegraph poles: seven-inch top, cedar poles, 25-ft. poles, $2, each; 30 ft., $3.75; 35-ft., $4.50 each; 40-ft., $6; 45 to 50, 16c. per foot. Laths: Quotations per 1,000 laths at manufacturers' points. Spruce 4-ft. x 1½ in., mill run, $3 to $3.25; pine 4-ft. x 1⅜-in., mill run, $3.25 to $3.75. Shingles: Cedar shingles, same conditions as laths, X, $2.10; XX, $2.40; XXX, $2.80.

Pipe—Cast Iron—The market is dull and rather easy:—$34 for 6 and 8-inch pipe and larger; $35 for 40-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought and Galvanized—Demand is fair and the market steady: —¼-inch $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch $27. On the following the discount is 72½ per cent. for black and 62½ per cent. for galvanized:—2-inch, $36; 2½-inch, $57.50, and 3-inch $75.50; 72½ per cent. off for black, and 62½ per cent. off for galvanized: 3½-inch $95 4-inch, $1.08.

Toronto, December 24th, 1913.

The following are the wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:

Axes.—Standard makes, double bitted, $6 to $10; single bitted, per dozen, $7.50 to $9.

Bar Iron—$2.25 base, per 100 lbs., from stock to wholesale dealer. In enormous demand.

Bar Mild Steel—Per 100 lbs., $2.25. Sleigh shoe and other take same relative advance.

Boiler Plates—½-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes—Orders continue active. Lap-welded, steel, 1¼-inch, 10c. 1½-inch, 9c. per 10-ft.; 2-inch $8.50 to $9; 2½-inch, $10; 2½-inch, $10.50; 3-inch, $12.10; 3½-inch, $15; 4-inch, $19.

Bricks—In active movement. The price is $11.50 for grey stock, $12 for red stock. Don Valley pressed brick are in request. No. 1 dry pressed and buff bricks are worth $18 delivered and $17 at works per 1,000. Port Credit Brick Company's prices are as follows, f.o.b., Port Credit: Wire cut bricks, $10 per M.; pressed bricks, $14 to $15 per M., three grades.

Broken Stone—Lime stone, good hard, for roadways or concrete, f.o.b., quarries 70 to 75c. per ton of 2,000 lbs., either 1-inch, 10c., 2-inch or larger, price all the same. Rubble stone, 55c. per ton. Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa, or Quebec Province. At Washago, $2.50 per ton for small, and $1.15 for large, freight to Toronto 60 cents.

Cement—Demand very brisk, and prices maintained. In large quantities the price is $1.50, sacks, 40c. extra; car lots $1.55, sacks extra; city dealers ask $1.85, sacks extra. Prices remain firm.

Copper Ingot—The market is lower at 15½ to 16c., sheet copper case (16 oz. soft), 22½c. to 24½c. per lb.

Detonator Caps—75c. and $1 per 100; case lots, 5,000, 20 per cent. off.

Dynamite—The prices for this explosive vary according to the percentage of nitro-glycerine compounded in the mixture and are as follows, f.o.b., Toronto:—40 per cent., 16¼ cents per pound, 1 to 9-case lots, 50 lbs. to case. For each additional 10 per cent. nitro-glycerine add 1½c. per hundred. For 10 case lots and over deduct ½ cent. For 20-case lots and over deduct 1 cent. For 40-case lots and over deduct 1½ cents.

Fuses—Electric Blasting—Double strength, $3.50 per hundred, advance 5c. per hundred for each 2 in. wire additional. Single strength, $3 per hundred, advance 5c. per hundred for each 2-in. wire additional.

Iron Chain—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; 5-8-inch, $3.55; ¾-inch, $3.45; ⅞ inch, $3.40; 1-inch, $3.40 per 100 lbs.

Iron Pipe—Quotations are changed as follows:—Black pipe, ¼-inch, $2.04; ⅜-inch, $2.04; ½-inch, $2.72; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch $6.19; 1½-inch, $7.43; 2 inch, $9.90; 2½-inch, $15.80; 3-inch, $20.75; 3½-inch, $26.13; 4-inch, $29.70; 5-inch, $40.60; 6-inch, $52.64. Galvanized Pipe, ¼-inch, $2.86; ⅜-inch, $2.86; ½-inch, $3.57; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50; 2½-inch, $21.56; 3-inch, $28.31.

Lead—Firmer, $5.25 to $5.50.

Pig Iron—We quote Clarence at $24 for No. 3; Cleveland, $24; Summerlee, $27; Hamilton quotes $22; Midland, No. 1, $22; No. 2, $21.50. There is considerable enquiry for 1914.

Pitch and Tar—Pitch, unchanged at 75c. per 100 lbs. Coal tar, $3.75 per barrel.

Roofing Slate—Most of the slate used in Canada comes from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But Jackson Bangor, 10 x 16 may be quoted at $6.75 per square of 100 square feet f.o.b. cars, Toronto; seconds, 50c. less. Mottled, $8; green $8, with a prospect of advance. Dealers are fairly busy.

Sand—Sharp, for cement or brick work, $1.15 per net yard f.o.b., cars, Toronto siding.

Sewer Pipe—

	4-in.	6-in.	9-in.	12-in.	24-in.
Straight pipe; per foot	$0 25	$0.40	$0.65	$1.00	$ 3.25
Single junction, 1 or 2 ft. long	1.00	1 60	2.60	4.00	13.00
Double junctions	1.25	2.00	3.25	5.00	16.25
Increasers and reducers	....	1.60	2.60	4.00	13.00
P. & H. H. traps	2.00	3.20	6.50	15.00	....
Bends	0.75	1.20	1.95	3.00	9.75

Above is the October list as changed. The retail price is less 65 per cent. off these figures on all sizes 9 inches and under, or less 60 per cent. off these figures on anything over 19 inches. For car-loads a greater discount.

Steel Beams and Channels—Active—We quote:—$2.65 to $3 cut to length per 100 lbs., according to size and quantity; angles, 1½ by 3-16 and larger, $2.50 to $2.75; tees, $2.75 to $3 per 100 lbs. Extra for smaller sizes of angles and tees.

Sheet Copper—22c. per lb.

Sheet Steel—American Bessemer, 10-gauge, $2.75; 12-gauge, $2.80; 14-gauge, $2.50; 17, 18, and 20-gauge, $2.75; 22 and 24-gauge, $2.80; 26-gauge, $2.85; 28-gauge, $3. A very active movement is reported at unchanged prices.

Sheets, Galvanized—Apollo Brand—Sheets, 6 or 8 feet long, 30 or 36 inches wide: 10-gauge, $3; 12-14-gauge, $3; 16, 18, 20, $3.30; 22-24, $3.40; 26, $3.50; 28, $3.90; 29, $4.10; 10¾, $4.10 per 100 lbs. Fleur de Lis—28-gauge, $4.25; 26, $4.05 per 100 lbs. Active and firm at these prices.

Tin—The combination seems to hold, and the price 45 to 50c. lower.

Tool Steel—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tank Plates—3-16 inch, $2.40 per 100 lbs.

Zinc—Spelter—Good demand, and the feeling strong. Light stock; excelle demand. We quote very firm at $6 to $6.50 per cwt

Winnipeg, December 23rd, 1913.

Anvils—Per pound, 11½ to 12½c.; Buckworth anvils, 80 lbs. and up, 10¼ to 10¾c., anvil and vise combined, each $5.50.

Bar Iron—$2.50 base.

Bars—Crow $4.50 per 100 pounds.

Beams and Channels—$3 to $3.10 per 100 up to 15-inch, 4, 30, 41, 50, 118, 119, 172, 132, 145, 176.

Brick—Kiln run per M, $13; sewer pipe per M, $14; chimney per M, $14; veneer per M, $15; pressed per M, $25 to $50; enameled per M, $100; sand lime per M, $13.

Cement, Portland—$2.40 to $2.50 per barrel.

Chain—Coil, 3 16-in., $10; ¼, $7.25; 5-16, $5.65; ⅜ $5; 7-16, $4.75; ½, $4.50, 9-16, $4.50; ⅝, $4.40; ¾, $4.25. Logging, 5-16, 6½c.; ⅜, 5¾c. Tie out, 70 and 10 per cent.

Copper—Tinned, boiler, 26½c., planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

Dynamite—$11 to $13 per case.

Galvanized Iron—Apollo, 10¾, $4.80; 28, $4.60; 26, $4.20; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90. Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30 22, $4.30; 20, $4.10 per cw

Iron—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75 24-gauge, $3.90; 26-gauge, $4; 28 gauge, $4.10. Galvanized—American 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26 gauge, $4.65; 28-gauge, $4.80; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English or 30-gauge American, $4.90; 30-gauge American $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5; bar, $2.50 base.

Pipe—Iron, black, per 100 feet, ¼-inch $2.40; ⅜-inch, $2.55; ½-inch, $2.85; ¾-inch $4; 1-inch $5.75; 1¼-inch, $7.80; 1½-inch, $9.35, 2-inch, $12.50; galvanized—½-inch $4.35; ¾-inch, $5.20; 1-inch, $7.55; 1¼-inch, $10.25; 1½-inch, $12.25; 2-inch, $16.40. Lead, 7.60 per cent., full coil.

Pitch—Pine, $6.50 per barrel, in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Steel Plates, Rolled—3-16-in. $3.35 base; machinery, $3 base; share; $4.50 base; share crucible, $5.50; cast share steel, $7.50; ice caulk, $4.50 base; tire steel, $3 base; cast tool steel, 11c., 9 to 12½c.

Tool Steel—8½ to 15c. per pound.

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